Orestimba Creek

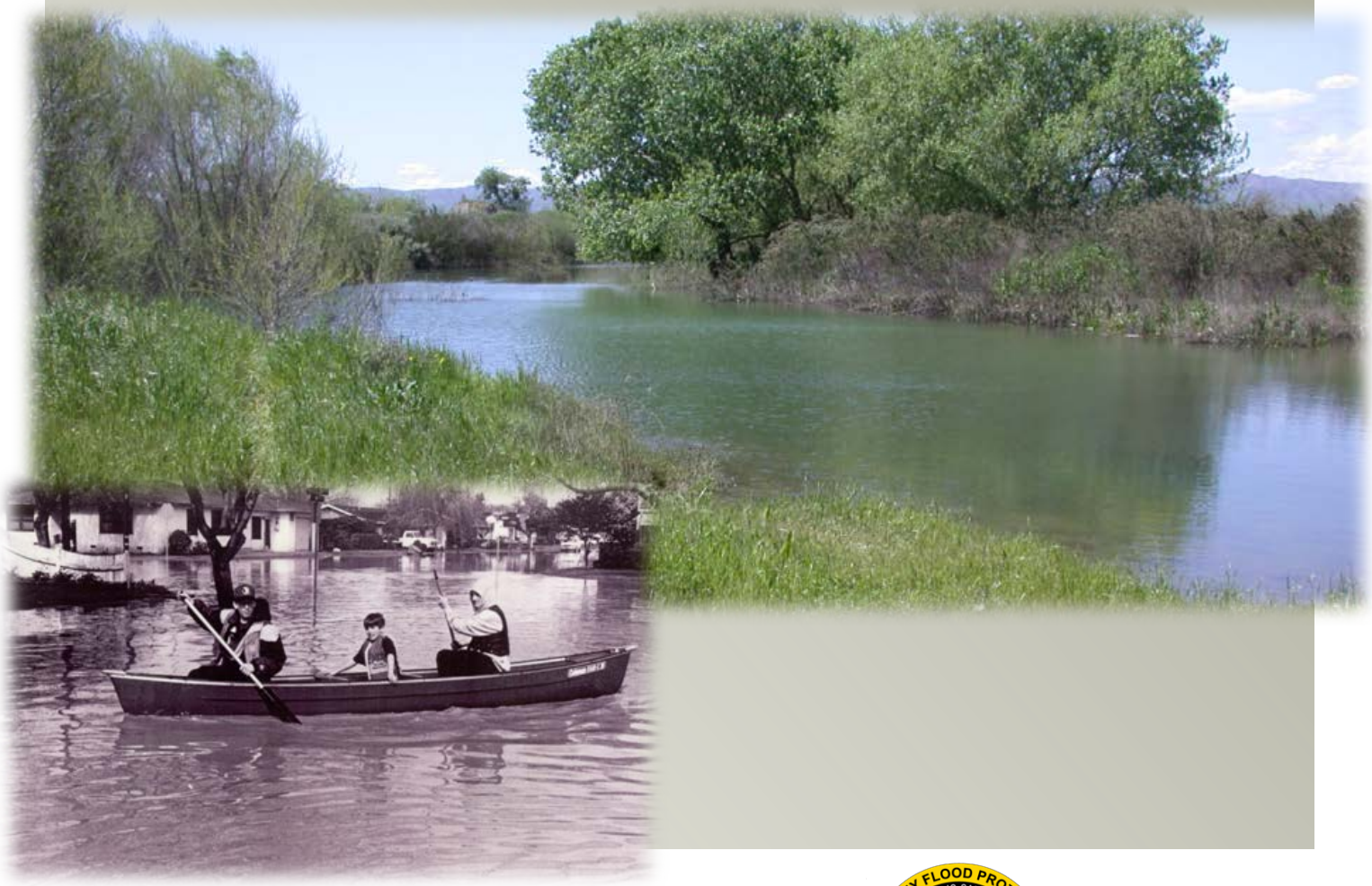
West Stanislaus County, California

Draft Report for Public Review

Draft Interim Feasibility Study

Draft EA/IS

December 2012



US Army Corps of Engineers ®
Sacramento District

Central Valley Flood Protection Board
Public Safety and Flood Management
State of California

Stanislaus County

SUMMARY

This report: (1) assesses the risk of flooding to the City of Newman and surrounding agricultural areas; (2) describes a range of alternatives to reduce flood risk to the City of Newman and surrounding agricultural areas; and (3) identifies a tentatively recommended plan (TRP) recommended plan for implementation. This report constitutes both a Feasibility Report, that describes the planning process followed to identify the Federal interest in a TRP, and an Environmental Assessment/Initial Study (EA/IS). This integrated Feasibility Report/EA/IS with a Finding of No Significant Effect and Mitigated Negative Declaration, when final, will be submitted to HQUSACE, the Assistant Secretary of the Army for Civil Works and the Office of Management and Budget (OMB) for review and approval, and then transmitted to Congress for potential project authorization and funding of the Federal share of the project.

BACKGROUND

The U.S. Army Corps of Engineers (USACE) initiated the Feasibility Study at the request of Stanislaus County, the non-Federal sponsor for the study. The California Department of Water Resources (DWR) has contributed funding in support of the non-Federal share of the study costs. USACE and Stanislaus County are the lead agencies in the Feasibility Study, with USACE taking the lead under NEPA and Stanislaus County taking the lead under CEQA.

The local coordination partners in the Feasibility Study are the City of Newman and the Orestimba Creek Flood Control District. Numerous other agencies, organizations, and individuals participated in the study including local landowners and residents, the Central California Irrigation District (CCID), the California Department of Water Resources (DWR), the California Department of Fish and Game (CDFG), the U.S. Fish and Wildlife Service (USFWS), and The Nature Conservancy (TNC). Congressmen Dennis Cardoza and Jeff Denham, along with Assembly Member Anthony Canella and their staff members have been actively involved with the study.

As a result of flooding along Orestimba Creek in February, 1980, the Reclamation Board of the State of California (now known as the Central Valley Flood Protection Board [CVFPB]) requested that USACE investigate potential solutions to the flooding problems. A reconnaissance investigation by USACE was completed in July 1980 which resulted in a finding that a viable solution may exist to the flooding along Orestimba Creek. This study was not pursued due to lack of landowner support for the project. An earlier USACE effort in January 1964 was cited in this Reconnaissance Report but no report was produced. In March, 1995, Orestimba Creek experienced the largest storm over 78 years of record (1932 to 2010). At that time, 12,000 cubic feet per second (cfs) was recorded at the USGS gauge on Orestimba Creek near the California Aqueduct. The floodwater overwhelmed the channel and flowed overland across agricultural fields, backing up against a railroad embankment and inundating the City of Newman. Estimated damages from this flood event were $5.6 million. Stanislaus County

subsequently prepared a Hazard Mitigation Grant Application dated January 1996. At the request of Stanislaus County, USACE initiated a Section 905(b) Analysis in April 1997, which is a reconnaissance level investigation based on existing information. This investigation determined a likely Federal interest in flood damage reduction for Orestimba Creek. The Feasibility Phase was initiated in September 1998. A map of the study area is shown in Figure S-1.

CONSIDERATION OF ALTERNATIVE PLANS

During the feasibility study, the Federal planning process for development of water resource projects was followed to identify a recommended plan for implementation. Following definition of flood-related problems and opportunities, specific planning objectives and planning constraints were identified. Then various management measures were identified to achieve the planning objectives and avoid the planning constraints. Management measures were screened based on how well they met the study objectives and cost effectiveness, and some measures were dropped from further consideration at that point. The retained management measures were combined to form the building blocks of alternative plans.

A preliminary array of alternatives was developed that encapsulated the identified measures to address flooding problems in the study area. These preliminary alternatives included setback levees, bypasses, dry dams, channel improvements, a chevron levee (a partial ring levee) and various non-structural measures. The preliminary alternatives were developed to a level of detail to allow a basic comparison of the costs and benefits of each proposed plan. Many of these preliminary alternatives were eliminated based on estimated costs and potential mitigation requirements.

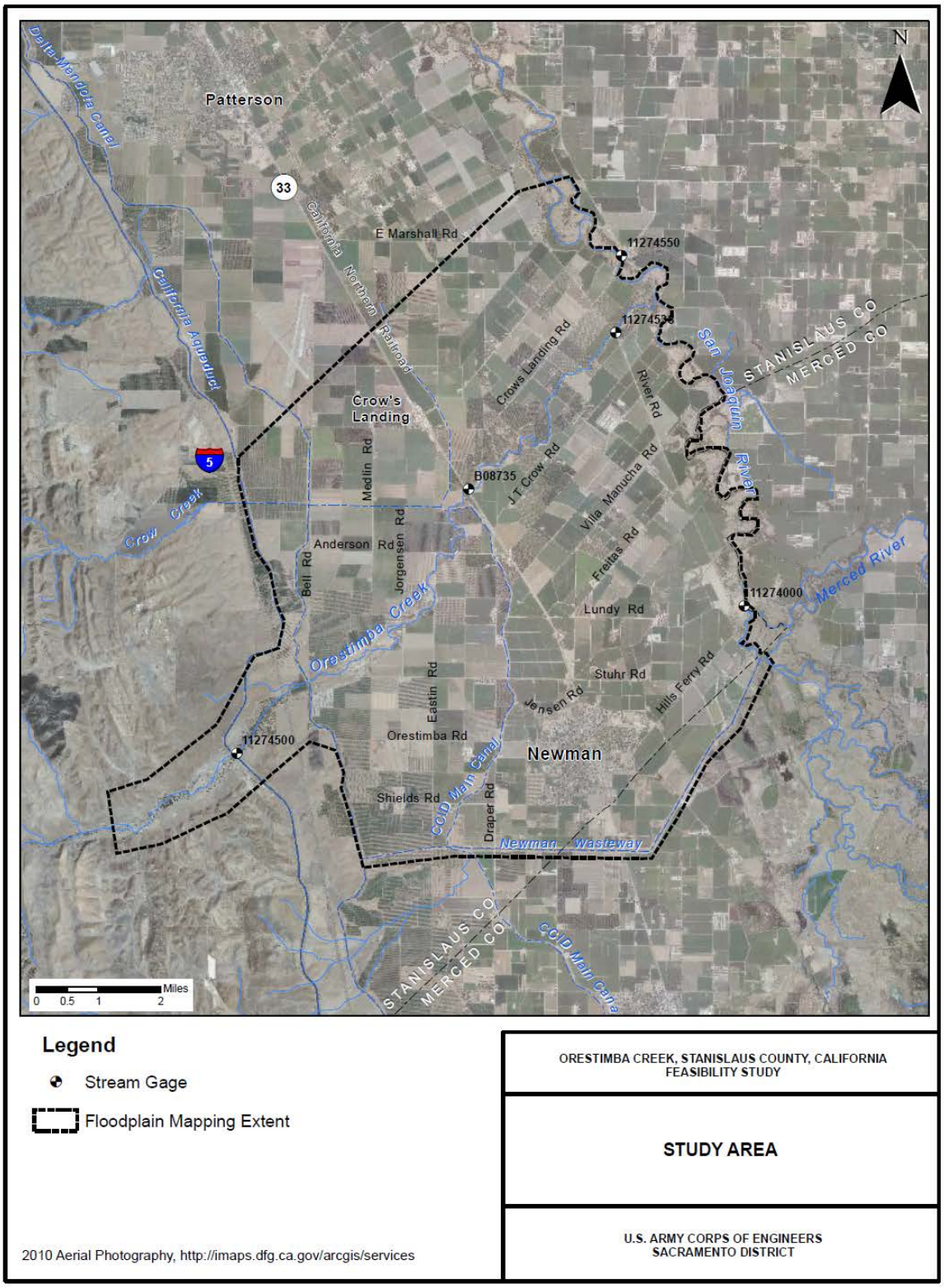


Figure S-1: The Orestimba Creek Study Area

Rather than a single feature fix to solve the flooding problems, the project delivery team (PDT) and local stakeholder group developed a series of plans which combined smaller versions of the preliminary alternatives into hybrid, or combined alternatives. The hybrid alternatives addressed the flooding problems in both the urban area of the City of Newman and the surrounding agricultural land. The result of this effort initially proved that the multi-feature approach was technically feasible and cost effective. The hybrid alternatives focused on a chevron levee which provided a high level of flood risk reduction to the town and channel modifications which provided a lesser amount of flood risk reduction to the agricultural areas. The added advantage of this dual approach was that the proposed alternative did not remove the agricultural area from the regulatory floodplain. If the project would provide flood risk reduction measures that would remove the agricultural area from the Federal Emergency Management Agency (FEMA) 1% floodplain, the landowners could petition for a change to the land use designation from agricultural to residential or commercial. As the study progressed to a more detailed design, it became apparent that the channel modifications, in the current design configuration, would not be incrementally justified. Therefore, in order to reduce the risk of flooding to the City of Newman as soon as possible, the study is progressing forward with only the Chevron Levee increment. The Channel Modification increment could be the focus of a later study focusing on ecosystem restoration of the creek or could be an initiative proposed by another agency or local group.

The Tentative National Economic Development Plan (Chevron Levee)

The National Economic Development (NED) plan consists of the construction of a chevron levee, or a partial ring levee, along the City of Newman's northwestern perimeter. The chevron levee maximizes benefits to the urban area by reducing flood damages associated with Orestimba Creek overflows. The north side of the chevron levee would be constructed along 1 mile of an unnamed farm road near Lundy Road, about 1 mile north of town. The western segment would be constructed along the eastern bank of the CCID Main Canal from the farm road south to the Newman Wasteway, a distance of about 4 miles. The chevron levee height would equate to about 112.8 feet in elevation (using the NAVD88 datum), which means the levee would be about 4 to 5 feet high, depending on the ground elevation changes along the levee alignment. This levee elevation captured the most benefits for the least amount of costs and was therefore identified as the elevation that would be included in the NED plan.

The NED plan also includes several non-structural features to further reduce the consequences of flooding. These include an advanced warning system based on stream gages at the several points where the creek historically has overflowed its banks. This flood warning system would be combined with an emergency evacuation plan. A reverse 911 system would alert surrounding residents of the flood threat, especially if the flood peak occurs during the night, as happened in 1995. Public educational materials would be distributed annually as part of the Orestimba Creek Flood Control District's assessment mailing. The materials would include a floodplain map and description of the nature and type of flooding. The material would also

describe the risks of traversing flooded roadways. Informational signs would be placed along roads which alert drivers to the possibility of flooding in the area.

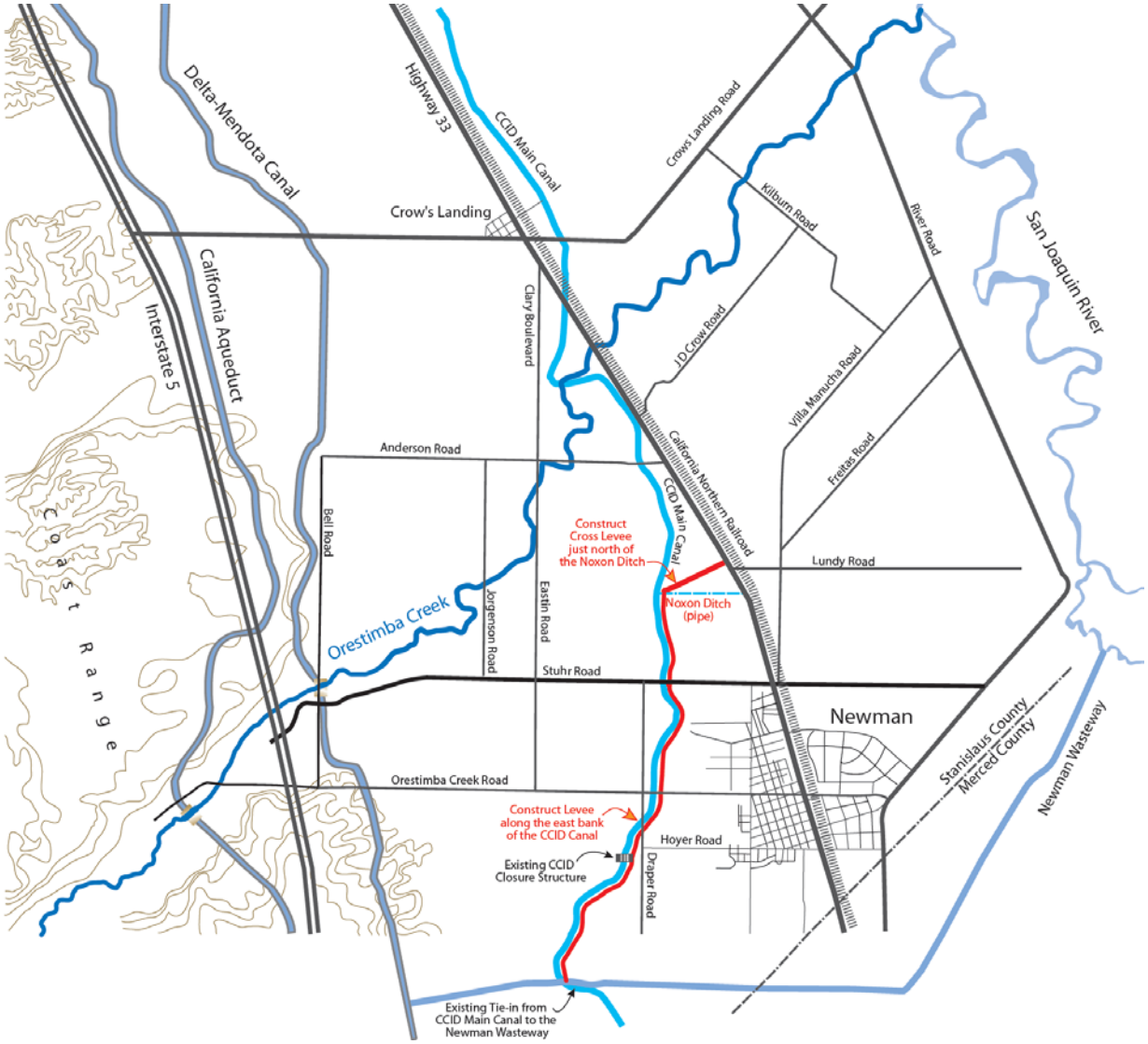


Figure S-2: The Tentative NED Plan

Various chevron levee alignments and heights were analyzed in the process of identifying the NED plan. Alignments which improved the Main Canal berm further to the north were also considered but were dropped because of the deeper floodplains which resulted. This northern alignment also directed floodflows to the opposite side of the creek, causing significant induced flooding. A levee alignment along Stuhr Road was also evaluated. There were several benefits

of locating the levee at the farm road location rather than the Stuhr Road location. The probability of induced flooding was found to be less for the farm road levee based on a review of existing condition flood inundation maps. In addition, the overall cost would be lower due to less material being required, fewer utilities to contend with, and no traffic to re-route during construction.

The Locally Preferred Plan (Chevron Levee with State of California Required Freeboard)

The Locally Preferred Plan (LPP) includes the same elements as the NED plan but raises the height of the chevron levee to include 3 feet of freeboard above the median 1/200 (ACE) water surface elevation. This freeboard was requested by the local sponsor in order to meet State of California requirements for an urban area which is identified as the 1/200 year median Water Surface Elevation (WSEL) plus 3 feet of freeboard. The LPP levee would be 6 to 7 feet tall, or about 2 feet taller than the NED levee.

For accreditation purposes, FEMA requires a levee to be either: a) 3 feet above the median 1% WSEL with a 90% assurance for the 1% event or b) 2 feet above the median 1% WSEL with 95 % assurance for the 1% event. The NED levee is about 1.5 feet shorter than these criteria; however, the LPP achieves it. The State of California requires urban and urbanizing areas (with a population of 10,000 or greater) to achieve 1/200 ACE year level of flood risk management in order to qualify for State funding of flood management projects. The State's urban levee design criteria (15 November 2011 Draft) requires 3 feet of freeboard above the median 1/200 ACE water surface elevation or higher if required for wind setup and wave run up. It was determined that additional freeboard to account for wind waves would not be required.

There is basically no quantifiable difference between the economic benefits attributed to the NED and the LPP; however, the LPP would allow the sponsor to meet State of California requirements as well as FEMA accreditation requirements.

The State criteria also specifies that civil engineers would be allowed and encouraged to adjust the Design Water Surface Elevation (DWSE) upward to account for climate change. Additional freeboard was not specified for climate change in the LPP. The 200-year median water surface profile was found to be relatively insensitive to increased flood discharge. The difference between the median 1/100 ACE and median 1/200 ACE water surface elevation was found to be less than 0.4 feet along the proposed levee.

The Tentatively Recommended Plan

The TRP is the LPP; however, Federal cost sharing will be capped at 65% of the NED plan. This plan is justified and has a benefit to cost ratio of 1.34. This plan allows the local community to meet both FEMA certification requirements and the State of California's criteria for funding of flood risk management projects. An exception from the Assistant Secretary of the Army for Civil Works (ASA(CW)) has been granted to allow USACE to recommend the LPP over the NED plan.

Due to the small increase in costs of the LPP over the NED this exception is warranted in order for the local community to meet FEMA and State of California requirements, in addition to reducing the residual risk associated with the project.

SIGNIFICANT ENVIRONMENTAL EFFECTS

An evaluation of environmental effects determined that the proposed action has the potential for adverse effects on a variety of environmental resource areas. A summary of impacts, mitigation measures, and level of impacts with mitigation is provided in Table S-2.

In all cases the potential adverse environmental effects would be reduced to a less than significant level through project design, construction practices, preconstruction surveys and analysis, regulatory requirements, and best management practices. No compensatory mitigation would be required. A geotechnical analysis of underlying substrates and water quality analysis of construction activities and methods would be conducted during the preconstruction, engineering, and design (PED) phase to further refine potential impact analysis. A National Pollutant Discharge Elimination System (NPDES) general construction permit and a San Joaquin Valley Flood Control District (SJVFCD) encroachment permit would be also be required. A Storm Water Pollution Prevention Plan (SWPPP) and Spill Prevention Control and Countermeasures Plan (SPCCP) would be developed by the contractor prior to construction.

The potential for impacts to wetlands, vegetation communities, and special status species has been greatly reduced through construction design. Direct impacts to nesting birds and other sensitive species would be avoided by implementing preconstruction surveys and scheduling of construction activities. The Draft Coordination Act Report received from the U.S. Fish & Wildlife Service (USFWS) states that USFWS has no recommendations for design refinement or mitigation for the project as currently proposed (USFWS 2012). USACE has determined that the project is not likely to adversely affect any special status species with the potential to occur in the project area. USFWS concurrence with the determination will be requested prior to project approval.

Table S-1. Summary of Potentially Significant Effects and Mitigation Measures

Potentially Significant Effects	Mitigation Measures	Effects with Mitigation
SEISMIC		
None	None	Less than significant
GEOLOGY		
Subsidence or liquifaction	1 – Pre-construction geotechnical study in PED to refine project design and ensure construction according to State and USACE guidelines	
SOILS		
Erosion during construction	1 – Development and	Less than significant

	implementation of a Storm Water Pollution Prevention Plan	
GEOMORPHOLOGY		
None	None	Less than significant
HYDROLOGY		
Reduction of risk of property loss, injury, and death involving flooding.	None	Beneficial
WATER QUALITY		
Run off from areas of ground distubance during construction	1 – Development and implementation of a Storm Water Pollution Prevention Plan	Less than significant
Reduction in the frequency and volume of polluted discharge and the reduction in exposure to pollutants would result in a net improvement to water quality	None	Beneficial
GROUNDWATER		
None	None	Less than significant
WATERS OF THE U.S. AND WETLANDS		
None	None	None
AIR QUALITY		
Temporary increase of criteria pollutants during construction	1 - Minimize construction footprint 2 - Wet soils when beneficial for the suppression of windborne dust 3 - Suitable excavated materials would be used in the construction of levees or would be spread on adjacent agricultural fields	Less than significant
VEGETATION		
None	None	None
WILDLIFE AND FISHERIES		
Short-term loss of wildlife habitat associated with agricultural margins, and impacts on water quality could impact local fish populations	1 - Hydroseed levee slopes and staging areas with native grasses 2 - Development and implementation of a Storm Water Pollution Prevention Plan	Less than significant
SPECIAL STATUS SPECIES		
Loss or degradation of wildlife habitat and displacement of common wildlife	1 – Pre-construction bird surveys (Swainson's hawk and burrowing owl) and coordination with USFWS 2 – Pre-constructin kit fox survey and coordination with USFWS 3 – Pre-construction elderberry survey and coordination with USFWS	Less than significant
INVASIVE PLANTS AND NOXIOUS WEEDS		
Promote the establishment of invasive plants and noxious weeds	None	Less than significant
SOCIOECONOMICS		

Reduce flood damage risk	None	Beneficial
Improve profitability of agricultural fields	None	Beneficial
Reduce insurance costs	None	Beneficial
LAND USE		
Unnecessary or unavoidable conversion of farmlands	None	Less than Significant
TRANSPORTATION		
Increased flood depths on roadways	1 - Install temporary barriers and signage to prevent motorists from entering roadways	Less than significant
UTILITIES AND PUBLIC SERVICES		
None	None	Less than significant
RECREATION		
None	None	None
AESTHETICS		
Short-term impacts from night lighting	1 - Avoid nighttime construction to the extent practicable 2 - Shield lighting away from residential areas 3 - Avoid the Newman Gateway	Less than significant
NOISE		
Increased noise levels near sensitive receptors	1 - Restrict night-time construction near residences 2 - Locate staging areas at least 700 feet from residential areas 3 - Design construction and detour routes that avoid noise-sensitive receptors to the extent practicable	Less than significant
HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTES		
Accident leaks or spills during construction	1 - Development and implementation of a Storm Water Pollution Prevention Plan 2 - Develop a SPCCP that would limit the potential for hazardous materials and toxic substances to impact soils or water bodies during construction 3 – Conduct Phase I Environmental Site Assessment prior to construction	Less than significant
CULTURAL RESOURCES		
Unanticipated discovery of cultural resources within Area of Potential Effects	None	Less than significant

ESTIMATED COST AND COST SHARING

Investment costs, annual costs, and annual benefits are displayed in Table S-2 below.

Table S-2: Comparison of Total Annual Benefits and Costs for the NED and LPP[1,2]

Item	NED Plan	LPP Plan
Investment Costs:		
Flood Risk Management First Costs	35,200,000	44,000,000
Less Cultural Resource Preservation[3]	-300,000	-350,000
Interest During Construction	2,100,000	2,700,000
Total	**37,000,000**	**46,350,000**
Annual Cost		
Interest and Amortization	1,726,000	2,159,000
OMRR&R[4]	164,000	180,000
Total	**1,890,000**	**2,339,000**
Annual Benefits	3,128,000	3,128,000
Net Annual Flood Risk Management Benefits	1,238,000	789,000
Benefit to Cost Ratio	1.66	1.34

[1] Based on October 2011 price levels, 4 percent rate of interest, and a 50-year period of analysis.
[2] Some numbers have been rounded and may be slightly different than those displayed in the appendices.
[3] Cultural Resource costs are contingency cost based on .4% of project first costs and are not cost shared.
[4] Operation, Maintenance, Repair, Replacement and Rehabilitation

The estimated total project first cost for the TRP is $44,000,000. Federal costs are capped at 65% of the NED plan which is estimated to cost $35,200,000. Cultural Resource Preservation costs of $350,000 will be added as part of the Federal costs. A summary of cost sharing responsibilities is presented in Table S-3.

Table S-3: Summary of Cost Sharing Responsibilities: Tentatively Recommended Plan[1]

Item	Federal[2]	Non-Federal
Flood Risk Management	22,880,000	21,100,000
Cultural Resource Preservation	350,000	
Total	23,230,000	21,100,000
Breakdown of Non-Federal		
LERRDs[3]		8,700,000
5% Cash Requirement		2,200,000
Remaining Cash		10,200,000
Total		21,100,000

[1] Based on October 2011 price levels, 4 percent rate of interest, and a 50-year period of analysis.
[2] Federal Project First Costs are based on 65% of the NED Plan of $35.2 million.
[3] Non-Federal interests must provide all LERRDs and a minimum cash contribution of 5% of the total project cost. Non-structural elements of the plan do not require the 5% cash contribution.

AREAS OF CONTROVERSY OR UNRESOLVED ISSUES

Increased Depth of Flooding

Based on the results of hydraulic modeling, the area north and east of the levee tie-in with the railroad might experience increased depths in some locations with implementation of the project. The depth of the potential increases during peak flows, which are projected to recede within 24 hours, would vary under each flood event scenario based on the existing topography. The range of depths under each frequency scenario is generally similar under both existing and with project conditions. The main difference would likely be during the 1/10 ACE, in which depths in some places could increase by up to 6 inches.

Agriculture (row crops) is the primary land use within the area that could experience increased flood depths. Four residences are also located within this area. The potential increased depth that could occur during the 1/10 ACE at each residence ranges from 3 to 6 inches. A windshield survey determined that each residence is on a raised foundation with several steps required to reach the first floor elevation. In addition, the structures are located on raised building sites, putting the first floor elevation well above the modeled potential depths. The potential for increased depths in areas already flooded under existing conditions was analyzed by USACE real estate specialists and was determined not to constitute a taking of private land for public use.

Coordination with Union Pacific Railroad

The current design includes a closure structure across the Railroad tracks to prevent floodwater from overtopping the levee at this point. The Union Pacific Railroad, which owns the tracks, has stated that the preferred method of dealing with the floodwater would be to raise the railroad berm rather than include a closure structure. The costs associated with raising the railroad berm, along with the additional levee height that would be required to implement this measure, means this measure would not be economically justified.

Recommendation of the LPP as the Tentatively Recommended Plan

The TRP in this report is the LPP, which is larger than the NED plan. Cost sharing of the TRP would remain at 65% of the NED plan. The LPP is recommended instead of the NED in order for the community to meet FEMA and State of California requirements. The ASA(CW) has granted the exception required to recommend the LPP over the NED.

MAJOR CONCLUSIONS

The preliminary recommendation of the District Engineer of the Sacramento District, U.S. Army Corps of Engineers is that the recommended plan be authorized for implementation as a Federal project. The estimated first cost of the tentatively recommended plan is $44,000,000 and the estimated annual OMRR&R cost is $180,000 (October 2011 price levels). The Federal portion of the estimated first cost is $23,230,000 and is based on the cost sharing level established by the NED plan. The estimated fully funded Federal first cost, based on projected inflation rates specified by Corps budget guidance, is $24,900,000.

The non-Federal sponsor portion of the estimated first cost is $21,100,000. The non-Federal sponsor shall agree to provide all lands, easements, rights-of-way, relocations, and suitable borrow and disposal areas. The non-Federal sponsor shall also assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project. The non-Federal sponsor shall publicize floodplain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the floodplain and in adopting such regulations as may be necessary to ensure compatibility between future development and protection levels provided by the project.

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* *NOTE TO THE READER: The Environmental Assessment for this study has been integrated into the following Feasibility Report in accordance with ER 1105-2-100. Sections of the report that are required for compliance with the National Environmental Policy Act (NEPA) are noted by an asterisk (*) in the Table of Contents.*

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ACRONYMS AND ABBREVIATIONS

Term	Definition
ACE	Average Chance Exceedance
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
ADA	Americans with Disabilities Act
ADT	average daily traffic
APE	Area of Potential Effects
BSC	Building Standards Commission
CALFED	CALFED Bay-Delta Program
CalTrans	California Department of Transportation
CARB	California Air Resources Board
CCIC	Central California Information Center
CCID	Central California Irrigation District
CDFG	California Department of Fish and Game
CDPR	California Department of Pesticide Regulation
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFC	chlorofluorocarbons
CFCP	California Farmland Conservancy Program
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CNRR	California Northern Railroad
CO	carbon monoxide
CO_2	carbon dioxide
CVFPA	Central Valley Flood Protection Act
CVFPB	Central Valley Flood Protection Board
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
dB	decibel
dBA	A-weighted decibel scale
DNL	day-night level
DPS	Distinct Population Segment
DWR	Department of Water Resources
EA/IS	Environmental Assessment/Initial Study

Term	Definition
EDR	Environmental Data Resources, Inc.
EFH	Essential Fish Habitat
EO	Executive Order
FEMA	Federal Emergency Management Agency
FFA	Flood Frequency Analysis
FONSI	Finding of No Significant Impact
FR	Federal Register
FS	feasibility study
GHG	greenhouse gases
GSRC	Gulf South Research Corporation
HCFC	hydrochlorofluorocarbons
HEC	Hydraulic Engineering Center
HTRW	hazardous, toxic, and radioactive waste
I-5	Interstate 5
LAFCO	Local Agency Formation Commission
LESA	Land Evaluation and Site Assessment
LPP	Locally Preferred Plan
LOS	level of service
MCL	maximum contaminant levels
mgd	million gallons per day
NCRR	Northern California Railroad
NED	National Economic Development
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries Service
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
O_3	ozone
OMRR&R	operation, maintenance, repair, replacement and rehabilitation
OSE	other social effects
P&G	Principles and Guidelines
PA	programmatic agreement
PDT	project delivery team
PED	preconstruction engineering and design

Term	Definition
PL	Public Law
$PM_{2.5}$	particulate matter of 2.5 microns or less in diameter
PM_{10}	particulate matter equal to or less than 10 microns in diameter
RED	Regional Economic Development
SB	Senate Bill
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_4	sulfates
SOI	sphere of influence
SSC	species of special concern
SWPPP	Storm Water Pollution Prevention Plan
TMDL	total maximum daily loads
TNC	The Nature Conservancy
USC	United States Government Code
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	U. S. Geological Survey
UST	underground storage tank
Valley Air District	San Joaquin Valley Air Pollution Control District
VELB	valley elderberry longhorn beetle
VOC	volatile organic carbon
WSEL	water surface elevation
WWTDF	waste water and disposal facility

CHAPTER 1 – STUDY INFORMATION

1.1 PURPOSE AND NEED FOR THE PROJECT AND REPORT

The purpose of the Orestimba Creek project is to investigate and determine the extent of Federal interest in plans that reduce flood risk in the City of Newman and the surrounding agricultural areas, which have experienced multiple flooding events in the past 75 years since records have been maintained. This report: (1) assesses the risk of flooding to the City of Newman and the surrounding agricultural areas; (2) describes a range of alternatives formulated to reduce flood risk; and (3) identifies a tentatively recommended plan for implementation. This report constitutes both a draft Feasibility Report that describes the planning process followed to identify the tentatively recommended plan and an Environmental Assessment/Initial Study, as required to comply with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). Following public and governmental agency review, this draft report will be finalized and submitted to higher U.S. Army Corps of Engineers (USACE) authority for review and approval, then transmitted to Congress for potential project authorization and funding of the Federal share of the project.

1.2 STUDY AUTHORITY

This investigation is being conducted under the authority of the Flood Control Act of 1936 (Public Law [PL] 74-738). Section 2 of this Act states "that, hereafter, Federal investigations and improvements of river and other waterways for flood control and allied purposes shall be under the jurisdiction of and shall be prosecuted by the War Department under the direction of the Secretary of War and supervision of the Chief of Engineers…". Section 6 of the 1936 Flood Control Act states: "The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control at the following named localities… Provided further, That after the regular or formal reports made as authorized on any examination, survey, project, or work under way or proposed are submitted to Congress, no supplemental or additional report or estimate shall be made unless authorized by law or by resolution of the Committee on Flood Control of the House of Representatives or the Committee on Commerce of the Senate:. Sacramento and San Joaquin River Valleys, California

House Document No. 367, dated October 13, 1949, is a Letter from the Secretary of the Army on the Sacramento – San Joaquin Basin Streams, California which states: "A Letter from the Chief of Engineers, United States Army, Dated July 27, 1948, submitting a report, together with accompanying papers and illustrations, on preliminary examinations and surveys of Sacramento-San Joaquin River Basin Streams, California. For Flood Control and allied purposes listed in the Report. This investigation was authorized by the Flood Control Acts of June 22, 1936 and June 28, 1938."

A House Resolution was adopted on May 8, 1964 which stated: "Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report on Sacramento-San Joaquin Basin Streams, California, published as House Document No. 367, 81st Congress, 1st Session, and other reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time, with particular reference to further coordinated development of the water resources in the San Joaquin River Basin, California."

This study will only partially address the San Joaquin River Basin Authority. Therefore, the Orestimba Creek Feasibility Study will be called an “Interim Feasibility Report” which indicates that the study is addressing the water resource issues of a specific area within the authority, rather than the entire area authorized for study.

Funds to initiate the study were provided in the Energy and Water Development Appropriations Bill, (HR 104-679) 1997, for the San Joaquin River Basin, West Stanislaus County, California. Beginning in 2003 funding was provided specifically for San Joaquin River Basin, West Stanislaus County, Orestimba Creek.

1.3 STUDY LOCATION

The study area (see Figures 1-1 & 1-2) is located on the west side of the San Joaquin River in Stanislaus County, California. It encompasses approximately 186 square miles of rangeland and very productive irrigated cropland. The largest community in the study area is the city of Newman, which is located along State Highway 33. Modesto, the county seat is located 20 miles from the city of Newman. Orestimba Creek is a "west side tributary" to the San Joaquin River, and originates from the eastern slopes of the Diablo Range, a section of the larger Coast Range of California. Orestimba Creek is traversed by U.S. Interstate Highway 5 (I-5), the California Aqueduct, the Delta-Mendota Canal, State Highway 33, the Northern California Railroad (NCRR), and the Central California Irrigation District (CCID) Main Canal. Elevations vary from 45 feet above sea level at the San Joaquin River to about 3,600 feet at the headwaters of Orestimba Creek. The creek is ephemeral, with high flows normally occurring in late winter, and irrigation drainage accounting for low flows during the summer months. The creek flows in a northeasterly direction through steep mountain canyons until it emerges at the edge of the foothills. Here, on the gently sloping valley floor, the decreased slope and size of the streambed reduces the creek’s channel capacity. Flood flows spread over a wide undefined alluvial fan. Most west side tributary streambeds disappear in the area, join other creeks, or are confined to man made structures due to farming. Orestimba Creek is one of the few tributaries to maintain a definite open channel from the Coast Range to the San Joaquin River.

Figure 1-1. Regional Map

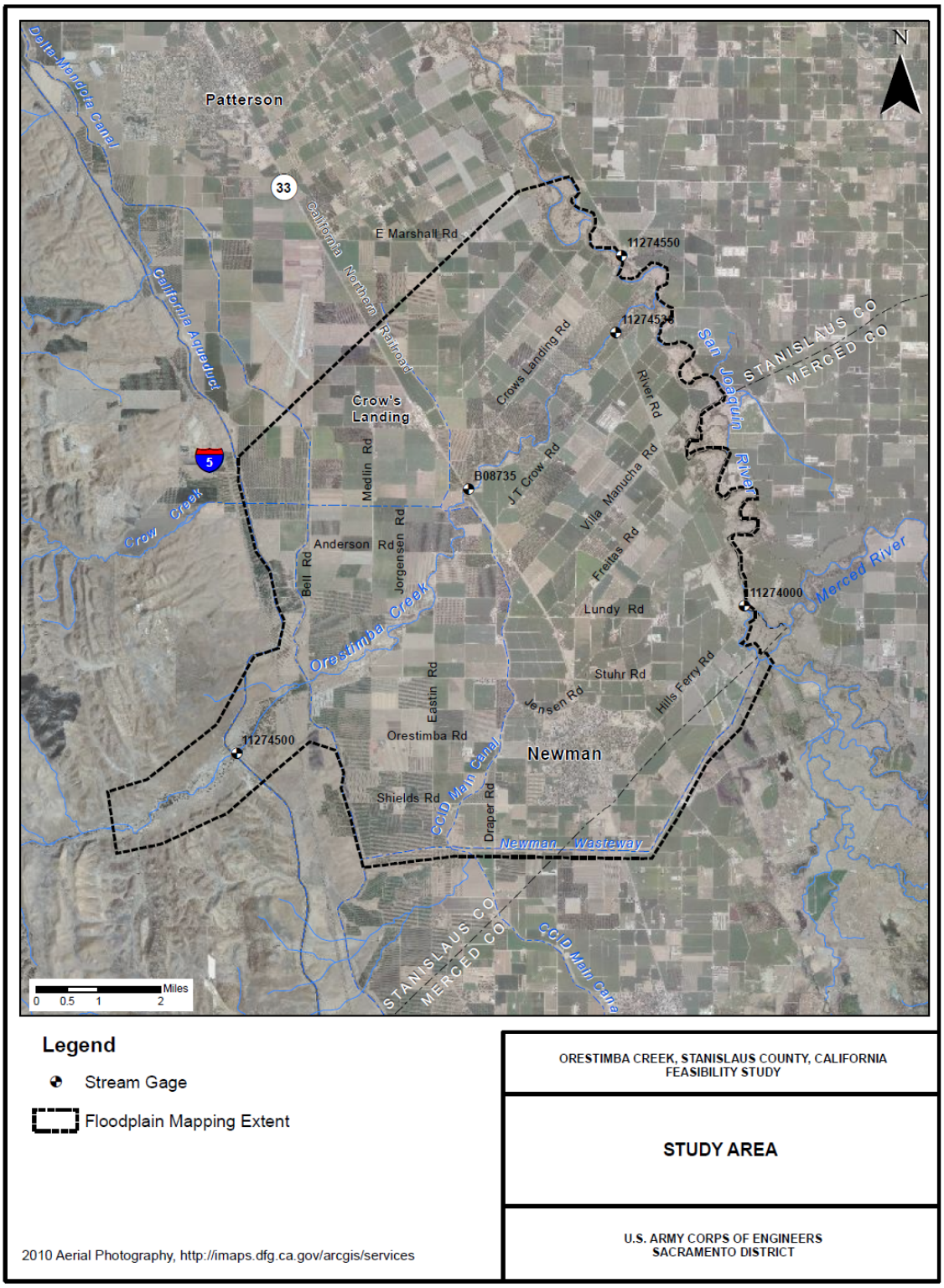

Figure 1-2 Orestimba Creek Study Area

Orestimba Creek is one of the last remaining wildlife corridor connections between the San Joaquin River and the Coast Range of California. For this reason, the California Department of Fish and Game has identified the creek as one of potential interest for conservation and restoration. Orestimba Creek is located between several large wildlife refuges owned and operated by the U.S. Fish and Wildlife Service (USFWS). The San Luis National Wildlife Refuge Complex – composed of the San Luis National Wildlife Refuge, Merced National Wildlife Refuge, San Joaquin River National Wildlife Refuge and the Grasslands Wildlife Management Area – consists of nearly 45,000 acres of wetlands, grasslands and riparian habitats, as well as over 90,000 acres of conservation easements on private lands for the protection and benefit of wildlife. The refuge units are located in the northern San Joaquin Valley of California in Merced and Stanislaus Counties.

The Complex is located within the Pacific Flyway, a major route for migrating birds, including waterfowl. The extensive wetlands of the Complex and surrounding lands provide habitat for up to a million waterfowl that arrive here each winter. Of the 30 species of waterfowl using the Complex, the most common include Ross' geese, Aleutian cackling geese, Snow geese, Green-winged Teals, Mallards, Northern Pintails, Gadwalls, American wigeons, Northern Shovelers, and White-fronted geese. The Complex is an integral part of a mosaic of Federal, State, and private lands in Merced County that together constitute the largest contiguous freshwater wetlands remaining in California.

The Nature Conservancy (TNC) owns and operates a large ranch upstream of the study area in which they have designed a stream restoration project along Orestimba Creek to improve the water quality and allow for the establishment of seedling trees and natural regeneration of native plants. This rugged and sparsely populated area is experiencing significant development pressure from the San Francisco Bay Area to the west and the Central Valley to the east. Orestimba Creek is a critical natural link between the conservation areas in the Coast Range and the Refuge lands along the San Joaquin River.

Figure 1-3: Regional Conservation Lands

1.4 STUDY SPONSOR AND PARTICIPANTS

USACE initiated the Feasibility Study at the request of Stanislaus County, the non-Federal sponsor for the study. The State of California Department of Water Resources (DWR) has contributed funding in support of the non-Federal share of the study costs. USACE and Stanislaus County are the lead agencies in the Feasibility Study, with USACE taking the lead under NEPA activities and Stanislaus County taking the lead under CEQA.

The local coordination partners in the Feasibility Study are the City of Newman and the Orestimba Creek Flood Control District. Numerous other agencies, organizations, and individuals participated in the study including local landowners and residents, CCID, DWR, the California Department of Fish and Game (CDFG), USFWS, and TNC. Congressmen Dennis Cardoza and Jeff Denham, along with Assembly Member Anthony Canella, and their staff have been actively involved with the study.

1.5 HISTORY OF ORESTIMBA CREEK INVESTIGATIONS

As a result of flooding along Orestimba Creek in February 1980, the Reclamation Board of the State of California (now known as the Central Valley Flood Protection Board [CVFPB]) requested that USACE investigate potential solutions to the flooding problems. A reconnaissance investigation by USACE was completed in July 1980 which resulted in a finding that a viable solution may exist to the flooding along Orestimba Creek. This study was not pursued due to lack of landowner support for the project. In March 1995, Orestimba Creek experienced the largest storm over 78 years of record (1932 to 2010). At that time, 12,000 cubic feet per second (cfs) was recorded at the U.S. Geological Survey (USGS) gauge on Orestimba Creek near the California Aqueduct. The floodwater overwhelmed the channel and flowed overland across agricultural fields, backing up against a railroad embankment, and inundating the City of Newman. Stanislaus County subsequently prepared a Hazard Mitigation Grant Application dated January 1996. At the request of Stanislaus County, USACE initiated a Section 905(b) Analysis in April 1997, which is a reconnaissance level investigation based on existing information. This investigation determined there was likely a Federal interest in flood risk reduction measures for Orestimba Creek including increasing the capacity of the Creek and a potential upstream detention facility. The Feasibility Phase was initiated in September 1998.

1.6 EXISTING PROGRAMS, STUDIES, AND PROJECTS

There are several ongoing water resources related programs, projects, and studies that could affect flood risk management and ecosystem conditions in the San Joaquin River Basin. Those efforts that pertain to this feasibility study are summarized in the sections below.

1.6.1 Programs

CALFED Bay-Delta Program (CALFED). CALFED was established in May 1995 as a cooperative effort among the State and Federal agencies that handle management and regulatory responsibilities in the Sacramento and San Joaquin River Delta, commonly referred to as the Bay-Delta. CALFED's mission is to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta. In July 2003, the State of California formalized the cooperative effort by creating the CALFED Bay-Delta Authority, a State agency responsible for overseeing implementation of the Bay-Delta Program.

Central Valley Project Improvement Act (CVPIA). The Central Valley Project (CVP) was authorized by Congress in 1937 as a multipurpose development to store and transfer surplus water primarily from the Sacramento and Trinity River basins to the water-deficient lands of the San Joaquin River and Tulare Lake Basins. The project is operated by the U.S. Bureau of Reclamation (USBR). The CVPIA amended the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes, having equal priority with irrigation and domestic water supply uses, fish and wildlife enhancement, and power generation. The CVPIA gives first priority to measures that protect and

restore natural channel and riparian habitat values through habitat restoration actions.

Federal Emergency Management Agency (FEMA), Flood Mitigation Assistance Program and the Hazard Mitigation Grant Program. These programs seek to reduce or eliminate the loss of life and property damage resulting from natural and human-caused hazards. In order to qualify for these programs, a community must be enrolled in the National Flood Insurance Program (NFIP) and have a Flood Mitigation Plan approved by the FEMA Regional Director. This plan must include a description of the existing flood hazard and identification of the flood risk including estimates of the number and type of structures at risk, repetitive loss properties, and the extent of flood depth and damage potential. A project must be cost-effective, not costing more than the anticipated value of the reduction in both direct damages and subsequent negative impacts to the area if future flooding were to occur, computed on a net present value basis. Applicants for these programs must compete for the funding. The City of Newman and Stanislaus County are both enrolled in the NFIP. Stanislaus County's enrollment covers the unincorporated areas of the County, which includes the study area outside of the Newman City limits.

Designated Floodway Program. The Central Valley Flood Protection Board (CVFPB) of the State of California administers the Designated Floodway Program, which addresses land use management within the floodway. This program provides a nonstructural way to keep development from encroaching into flood-prone areas. It also reduces future potential flood damages by preserving the reasonable flood passage capacities of natural watercourses. The CVFPB controls the Designated Floodway Program by adopting floodway boundaries, developing plans for modifications of boundaries, and approving changes in acceptable use and types of structures within the floodways. Within the study area, the low elevation lands along the San Joaquin River are part of the designated floodway in lieu of project levees.

1.6.2 Projects

The Nature Conservancy, Mount Hamilton Area. This area, east of San Jose between Highway 101 and Interstate 5, is a unique, intact California landscape of oak woodlands, sycamore valleys, stream-fed canyons, and pine-topped ridges. Yet this biologically rich habitat is seriously threatened, by the encroachment of two burgeoning population centers: the Silicon Valley to the west and the Central Valley to the east. TNC's strategy is to connect the extensive public lands in the area by securing the permanent protection of key private properties that surround and link them. These private lands, which are largely cattle ranches, will create a circle of protection around the core of the wilderness. TNC has been working to ensure permanent conservation management of nearly 500,000 acres within the Mt. Hamilton area by protecting high-priority private properties from fragmentation and development, developing prescriptions for compatible land uses in the project area, and building the capacity of local institutions for long-term conservation management.

The Nature Conservancy, Simon-Newman Ranch. This 33,000-acre property, owned by TNC as part of the Mount Hamilton Project, is located in the upper watershed of Orestimba Creek. Protection of this site will serve as a major wildlife corridor in this central part of the Diablo Mountain Range. Upon the sale of the Simon-Newman Ranch, TNC will reserve a conservation easement on the property. The easement will eliminate future subdivision and development, with the exception of negotiated residential structures, horse corrals, and paddocks and barns. A detailed Grazing Management Plan has been prepared to integrate cattle ranching and strategic protection of TNC's Conservation Values. CDFG will be allowed to have annual controlled public hunting programs 30 days a year.

U.S. Fish and Wildlife Service. San Joaquin River National Wildlife Refuge. The San Joaquin River National Wildlife Refuge is located within the historic floodplain of the confluences of the San Joaquin, Stanislaus, and Tuolumne Rivers and downstream from the confluence with Orestimba Creek. Refuge lands consist of oak-cottonwood-willow riparian forest, pastures, agricultural fields, and wetlands. This refuge was established in 1987 under authority of the Endangered Species Act, the Land and Water Conservation Fund Act, and the Migratory Bird Conservation Act. The original refuge land base of 1,638 acres has grown tremendously. Through recent land acquisitions, the refuge has increased to 6,642 acres within an approved refuge boundary of 12,877 acres.

U.S. Fish and Wildlife Service. San Luis National Wildlife Refuge. This 26,609-acre refuge is a mixture of managed seasonal and permanent wetlands, riparian habitat associated with three major watercourses, and native grasslands/alkali sinks/vernal pools. The refuge is primarily managed to provide habitats for migratory and wintering birds. The largest concentration of mallards, pintails, and green-winged teal in the San Joaquin Valley are found here. One of only 22 herds of the indigenous Tule elk is located here, as are a variety of endangered, threatened, and sensitive species.

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) Wetland Reserve Program. California's Wetlands Reserve Program has focused on the restoration of a variety of wetland types throughout the state, including seasonal wetlands, semi-permanent marshes, and vernal pools along the perimeter of the Central Valley, riparian corridors, and tidally-influenced wetlands. The Wetland reserve program has been used to restore land along the San Joaquin River that has experienced flooding.

1.6.3 Studies

Several previous studies with information specific to the project area are listed here.

U. S. Army Corps of Engineers. Detailed Project Report for Flood Control on Orestimba Creek Stanislaus County, California. 1981. This study was conducted under the authority of Section 208 of the Flood Control Act of 1954, as amended and pursuant to ER 1105-2-50. It was conducted in response to a request from the California Reclamation Board (now known as the CVFPB). The proposed plan to reduce flooding along Orestimba Creek included clearing of vegetation and excavation of about 54,000 cubic yards of material from the stream channel between Highway 33 and Morris Road. This plan would increase the flow capacity of Orestimba Creek from about 2,800 cubic feet per second (cfs) to about 4,000 cfs. An annual maintenance program would be required to keep the channel clear of sediments and vegetation. The State Reclamation Board, as the non-federal sponsor, informally agreed to proceed with the project although the project was later terminated because property owners along the creek would not consent to rights-of-entry for the study investigation.

Stanislaus County, Department of Public Works. Orestimba Creek Flood Hazard Mitigation Project. A Hazard Mitigation Grant Program Application with the State of California Office of Emergency Services. January 1996. This grant application, which was not funded, consisted of three proposed elements, called phases, designed to reduce flood damages from Orestimba Creek in and around the City of Newman. Phase 1 consisted of an intertie pipeline facility between the Newman Wasteway and the CCID Canal. Flood waters from Orestimba Creek flow surge out of the creek channel and run parallel and occasionally flow in to the CCID Canal. The Canal intersects the Newman Wasteway south of Newman where the proposed project element would enable floodwaters to enter the wasteway and be transported to the San Joaquin River. This feature has since been constructed as a joint effort between the CCID and the City of Newman. Phase 2 would consist of improving the Orestimba Creek flow capacity under California Northern Railroad (CNRR) trestle. Phase 3 would include a short levee along the Creek in an area with minimal channel capacity, a siphon to evacuate floodwater collecting on the uphill side of the CCID canal, and the replacement of a privately owned bridge.

Numerous other prior studies and reports have valuable background information for the Feasibility Study. These studies and reports are listed in Chapter 12.

1.7 PLANNING PROCESS AND REPORT ORGANIZATION

The planning process consists of six major steps: (1) specification of water and related land resources problems and opportunities; (2) inventory, forecast, and analysis of water and related land resources conditions within the study area; (3) formulation of alternative plans; (4)

evaluation of the effects of the alternative plans; (5) comparison of the alternative plans; and (6) selection of the tentatively recommended plan based upon the comparison of the alternative plans.

This report documents the study process. It also serves as the environmental document for compliance with NEPA and CEQA. The chapter headings and order in this report generally follow the outline of an Environmental Assessment/Initial Study (EA/IS). The report chapters relate to the six steps of the planning process as follows:

- The second chapter of this report, Need for and Objectives of Action, covers the first step in the planning process (specification of water and related land resources problems and opportunities. It also covers the second step of the planning process (inventory and forecast) to the extent necessary to establish the future without project condition prior to development of the alternatives.
- The third chapter of this report, Alternative Plans, is the heart of the report and is therefore placed before the more detailed discussions of resources and effects. It covers the third step in the planning process (formulation of alternative plans), the fifth step in the planning process (comparison of alternative plans), and the sixth step of the planning process (selection of the recommended plan based upon the comparison of the alternative plans).
- The fourth chapter of this report, Affected Environment, covers the second step of the planning process (inventory, forecast and analysis of water and related land resources) in greater detail than what was covered in Chapter 2.
- The fifth chapter of this report, Environmental Consequences, covers the fourth step of the planning process (evaluation of the effects of the alternative plans).
- The remaining chapters of the report discuss public involvement, review, and consultation (Chapter 6); list the report preparers (Chapter 7); describe compliance with applicable laws, policies, and plans (Chapter 8); present a description of the recommended plan (Chapter 9); present the study recommendation (Chapter 10); list the recipients of the draft feasibility report (Chapter 11); and, a list of references (Chapter 12). A list of acronyms and abbreviations and a glossary of terms precede Chapter 1. An index is at the end of the report.

CHAPTER 2 – NEED FOR AND OBJECTIVES OF ACTION*

The USACE planning process follows the six-step process defined in the "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implemental Studies," also known as the Principles and Guidelines (P&G), issued by the Water Resource Council on March 10, 1983 (P&G, ER 1105-2-100). The planning process is a structured approach to problem solving which provides a rational framework for sound decision-making. The six-step process is used for all planning studies conducted by USACE. The first step in the process is the identification of problems and opportunities.

2.1 PROBLEMS AND OPPORTUNITIES

A problem is an existing undesirable condition to be changed. An opportunity is a chance to create a future condition that is desirable. Within the context of solving problems, opportunities contribute to the overall beneficial outcome of the project. The difference between problems and opportunities is often indistinct, but in both cases a changed future condition is preferred. The purpose of the feasibility study is to identify, evaluate, and recommend to decision makers an appropriate, coordinated, and implementable solution to the identified water and related land resources problems and opportunities for Orestimba Creek. The following key problems were identified during the first three steps of the planning process by the study team and concerned stakeholders.

2.1.1 Flooding Problems

Problem: There is a high probability of flooding which threatens public health and safety in the City of Newman and surrounding rural areas.

Flooding in the study area has required extensive emergency operations, including levee construction, evacuation, road closure, monitoring, and traffic control. Flood overflows from Orestimba Creek cause flooding in the town of Newman. Orestimba Creek is located on a broad alluvial fan and floods larger than a 1/3 median ACE event exceed the channel capacity and distribute out over the unconfined floodplain. The topography of the floodplain is shown in Figure 2-1. Flood flows first exceed channel capacity downstream of Jorgenson Road. Although Newman is situated approximately 2.5 miles from the channel, the unconfined flood overflows are diverted along roads, a railroad embankment, and other features into town. This overland flow collects along the uphill (west) side of the CCID Main Canal and the CNRR embankments. Floodwaters are conveyed south along Highway 33 and the CNRR berm, eventually inundating the town of Newman. Flood flow overtops the highway and railroad berm and then continues down slope across fields and farm roads until it reaches the San Joaquin River (Figure 2-2).

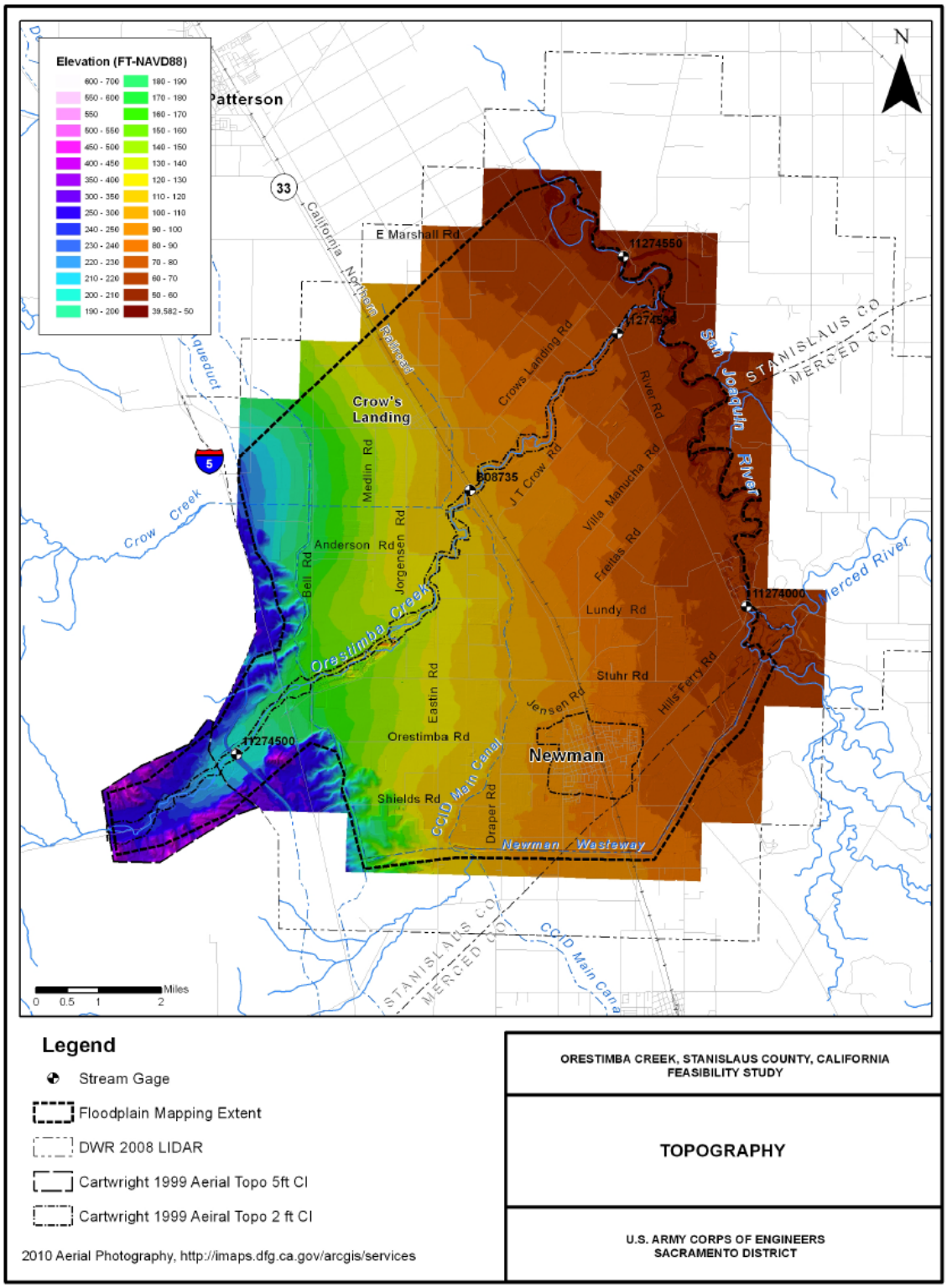

Figure 2-1: Topography of the Orestimba Creek Floodplain

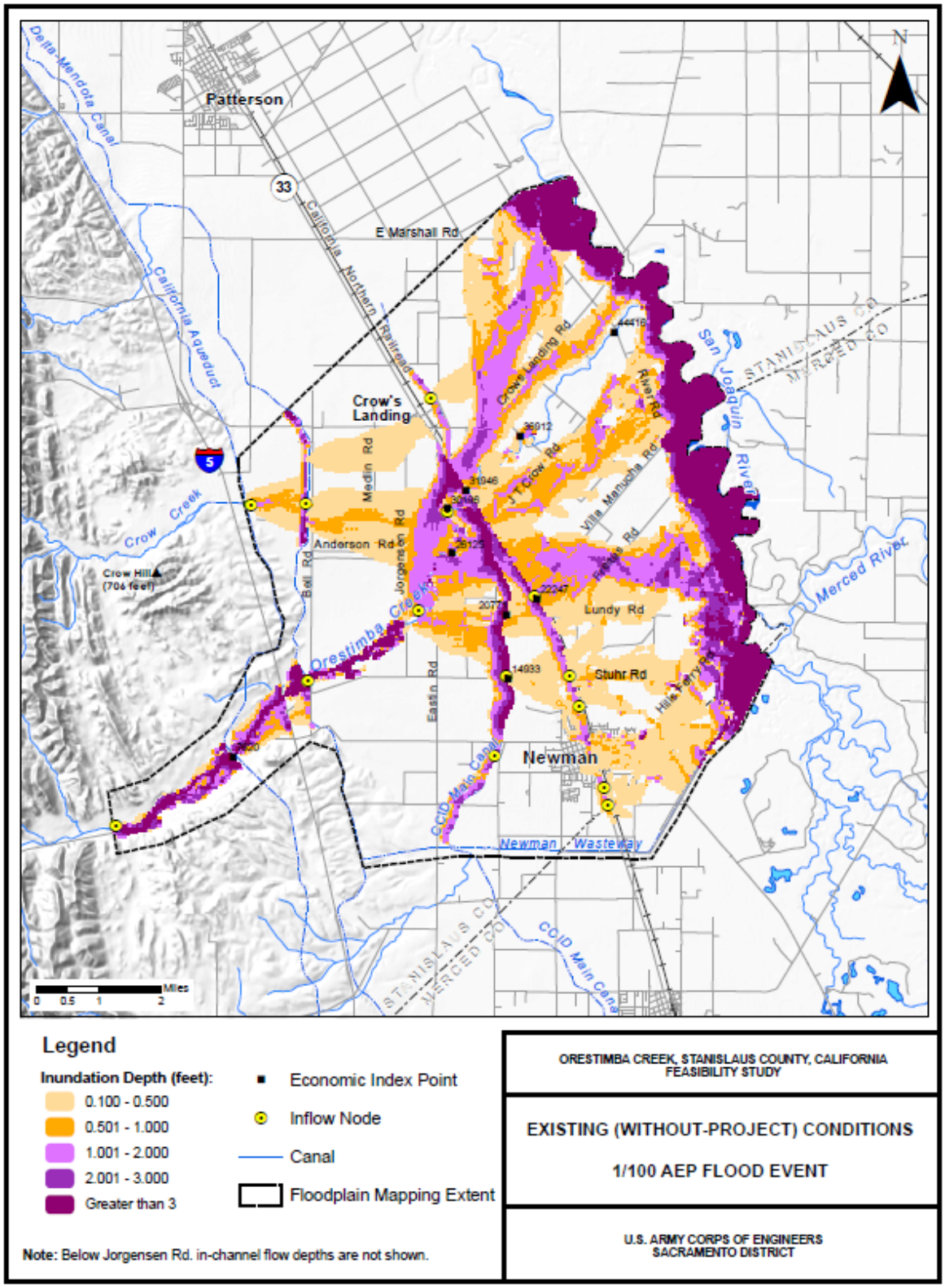

Figure 2-2: Orestimba Creek 1/100 Median ACE Floodplain

It is estimated that floods less than a 1/3 median ACE are confined to the channel, floods between 1/3 median ACE and 1/10 median ACE are located within agricultural areas and floods greater than a 1/10 median ACE reach the town of Newman. The flooding from Orestimba Creek is shallow unconfined flooding as opposed to riverine flooding which could be deeper but would also be confined by topography to a fairly narrow area along a river. Riverine flooding would be like pouring water from a glass into a bowl. A bigger glass would result in approximately the same flooded area but higher water levels. The final location of the water is predictable. With shallow unconfined flooding, it is like pouring water from a glass onto a table. A bigger glass of water equals a larger flooded area but the same water level. The final location of the water is unpredictable. In addition, the Orestimba Creek alluvial fan floodplain is like a tilted table with many agricultural berms and furrows that cause the floodwater to change course and these features change very often making it very difficult to predict exactly where the floodwater will flow.

Stream flow records at USGS Gage 11274500 Orestimba Creek near Newman indicate annual peak flows have exceeded the estimated channel capacity of 1,600 cfs 34 times from 1932 to 2010, while approximately 12 floods exceeded a 1/10 median ACE event and would have reached the town of Newman. The five largest floods from 1932 to 2010 occurred in 1958, 1963, 1986, 1995 and 1998. A comparison of annual peak flows to hydrologic frequency is provided in Figure 2-3.

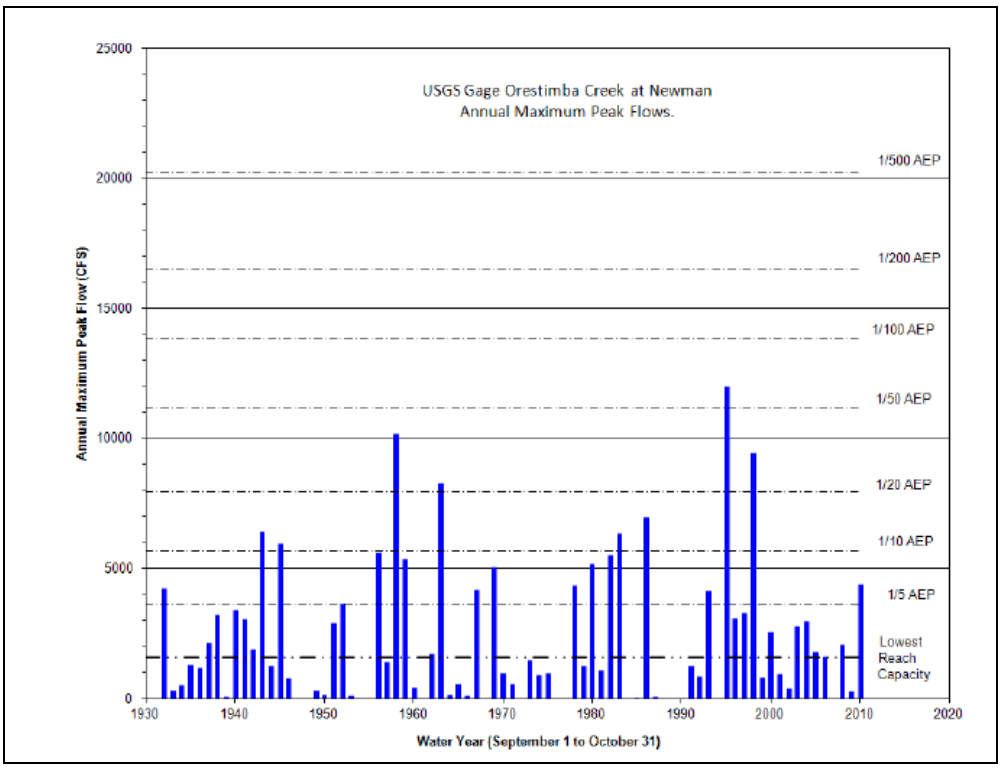

Figure 2-3: Peak Annual Flows - Orestimba Creek near Newman

In March 1995, Newman experienced the worst flood in its 107-year history. On March 10, 1995, the USGS gauge upstream of the California Aqueduct registered a peak flow of 12,000 cfs (Figure 2-4). On the same date, the USGS gauging station Orestimba Creek at River Road registered a peak flow of 2,650 cfs. This shows that significant flood volume was conveyed overland across agricultural fields with a portion of the flow inundating the City of Newman (Figure 2-5). Structures within the town were flooded by over two feet of sediment-laden water. A convalescent hospital located on the north side of the city was entirely inundated by 2 feet of water in the building and 4 feet of water in the parking lot. Sixty-five residents were evacuated by a Medi-Flight helicopter after a failed attempt to use two ambulances and a school bus. Many public streets and highways, including State Highway 33, were closed. These road closures limited or, in some cases, prevented access for emergency vehicles which resulted in diminished local and regional emergency response capabilities. Similar public health risks caused by area flooding included floodwater affected domestic water wells and individual septic systems, many of which were rendered unusable.

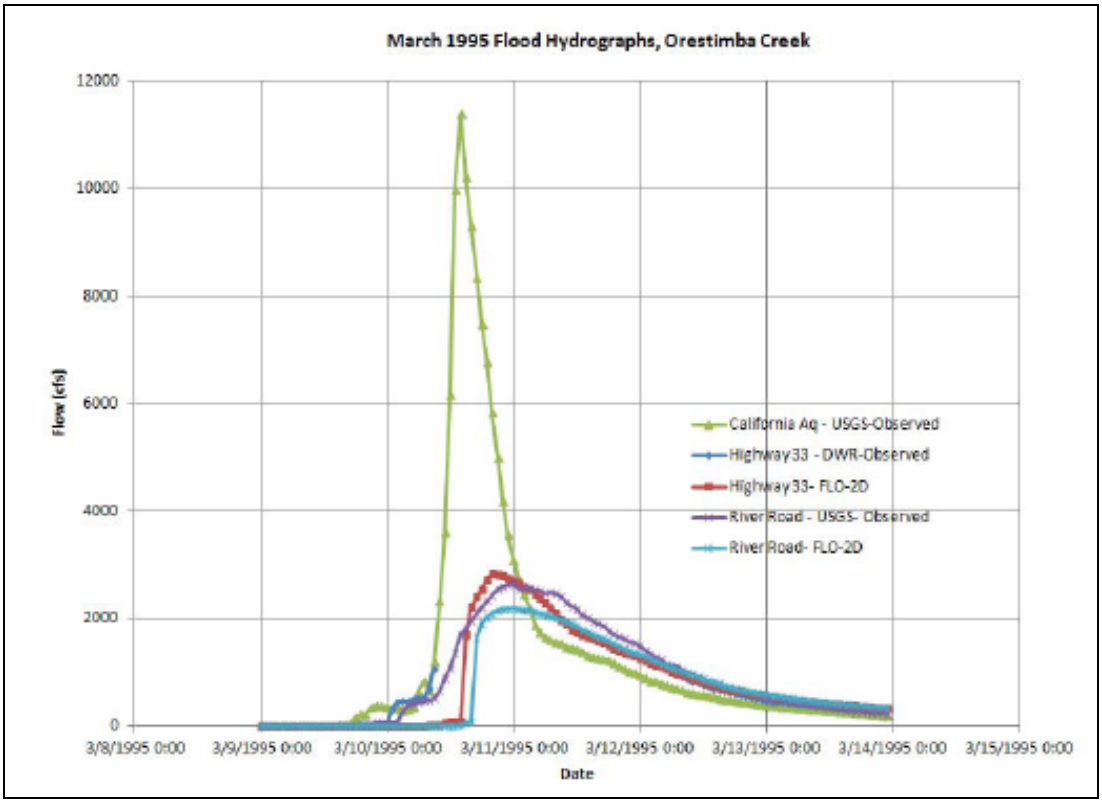

Figure 2-4: March 1995 Hourly Flood Hydrographs, Orestimba Creek

The 3 February 1998 storm event produced the third largest peak runoff of the 1932 to 2007 record (Figure 2-6). The event had a peak flow of 9,470 cfs at the Orestimba Creek at Newman gage and peak flow of 2,340 cfs at the Orestimba Creek near River road gage. Similar to the 1995 event, this shows the substantial volume of floodwaters that was conveyed by the floodplain.

There are three low water crossings of Orestimba Creek where the road dips down into the creek channel and only a small culvert allows the creek flow to pass under the road. When flow in the creek increases beyond what the culverts can contain, water flows up and over the road, easily reaching depths of several feet. These low water crossings at Bell, Jorgenson, and Eastin Roads were identified during the study process as having potentially high risk for anyone needing to cross the creek at these locations. Tragically, in January 2006, a motorist was killed at one of these crossings when attempting to cross the road during high flows in the creek. Subsequently, Stanislaus County installed emergency road closure crossing guards to warn motorists of the danger of crossing the creek at these locations when the water is high.

Figure 2-5: March 1995 Flooding from Orestimba Creek in the City of Newman

Problem: The City of Newman and surrounding agricultural land have incurred damages from past flooding.

Floodwaters have damaged agricultural land and crops, residential and commercial properties, the Delta-Mendota Canal, the CCID Main Canal, bridges, and road crossings. Reported damages from the March 1995 event totaled approximately $7.8 million (2011 prices). A crop storage facility located just north of downtown experienced extensive flood damages that amounted to $500,000 and caused the business to file for bankruptcy shortly after the flood. Damages from the 1998 flood event are unknown. Additional information on the computation of flood damages for this study can be found in Appendix E: Economics.

A structural inventory was completed based on data gathered from the assessor's parcel data and onsite inspection of structures within the flood plain. Table 2-1 documents the potential damageable property within the study area.

Table 2-1: Orestimba Creek Structural Inventory

Economic Impact Area	Residential	Commercial	Industrial	Public	Total
Rural	158	0	0	0	158
Urban	1,122	62	16	7	1,207
Total	**1,280**	**62**	**16**	**7**	**1,365**

The total value of damageable property is comprised of the structural and content values described for the parcels within the 1/500 median ACE flood plain. Table 2-2 shows the total structure and content values by category and economic impact area. In total, the study area has just over $300 million in estimated damageable property.

Table 2-2: Value of Damageable Property within the 1/500 Annual Chance Exceedance Floodplain, October 2011 Price Levels ($1,000s)

Land Use	Structural Value		Content Value		Total
	Rural	Urban	Rural	Urban	
Residential	17,706	123,204	8,853	61,602	211,365
Commercial	0	23,732	0	25,030	$48,763
Industrial	0	13,593	0	20,014	$33,607
Public	0	4,541	0	2,123	$6,664
Total	**$17,706**	**$165,070**	**$8,853**	**$108,769**	**$300,398**

Figure 2-6: February 1998 Flooding from Orestimba Creek in the vicinity of the CCID Main Canal Siphon

Problem: The Orestimba Creek channel has been altered by human activity.

Sand and gravel extraction activities have increased the capacity of the channel between the Delta-Mendota Canal and Jorgensen Road. Reduction of channel slope downstream between Jorgenson Road and Morris Road, with an attendant drop in water velocity, has decreased carrying capacity and increased sediment deposition. This deposition has decreased the sediment supply to reaches of the channel downstream of Morris Road, contributing to down cutting of the channel and exposure of bridge supports. Flow velocities are high enough to move considerable quantities of bed material. The significant transport capacity and reduced sediment load downstream of Jorgensen Road may be the cause of some changes in channel geometry evident in recent years.

In many areas along Orestimba Creek, farming activities have encroached upon the banks of the creek (see Figure 2-7). Riparian vegetation has been removed and it appears that the creek banks have been mechanically altered. Small private levees exist along portions of the creek but there are no levees in the study area belonging to the State or Federal network of levees.

Figure 2-7: Orestimba Creek Downstream of the Railroad Trestle

2.1.2 Opportunities

Opportunity: Reduce the risk of flooding and flood damages through the use of proven environmental design methods for structural and/or non-structural features.

There is an opportunity to reduce the risk to public safety and damages due to flooding from Orestimba Creek.

Opportunity: Sustain and improve aquatic, riparian, and adjacent terrestrial habitats consisting of native plants for use by fish and wildlife.

There is an opportunity to sustain and improve the ecosystem along Orestimba Creek because remnants of the native habitat still exist and could be expanded.

Opportunity: Reduce the risk of flooding and flood damages through the least environmentally damaging structural or non-structural method.

There is an opportunity to reduce the risk to public safety and damages due to flooding from Orestimba Creek.

Opportunity: Restore aquatic, riparian, and adjacent terrestrial habitats consisting of native plants for use by fish and wildlife.

There is an opportunity to restore the ecosystem along Orestimba Creek because remnants of the native habitat still exist and could be expanded.

2.2 OBJECTIVES AND CONSTRAINTS

2.2.1 Federal Objectives

In the Flood Control Act of 1970, Congress identified four equal national objectives for use in water resources development planning. These objectives are: national economic development (NED), regional economic development (RED), environmental equality (EQ), and social well being (OSE, other social effects). These four categories are known as the System of Accounts, whereby each proposed plan can be easily compared to the no action plan and other alternatives. The Federal objective identified in the P&G is:

> "The Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statues, applicable executive orders, and other Federal planning requirements."

In Section 2031 of WRDA 2007, Congress instructed the Secretary of the Army to develop a new P&G for USACE (Public Law 110-114). In an effort to modernize the approach to water resources development, the Obama Administration is expanding the scope of the P&G to cover all Federal agencies that undertake water resource projects. The revised P&G include a number of important changes. These changes are expressed in the following proposed new Federal objectives statement:

> "The national objective of water and related land resources planning is to foster environmentally sound, efficient use of the Nation's resources consistent with public safety. This can be accomplished through watershed analyses that recognize the interdependency of water uses. This is strengthened by capitalizing on a collaborative planning and implementation process which incorporates fully informed participation from Federal agencies, non-Federal interests, non-governmental organizations, State and local and Tribal governments, and a full range of water users and stakeholders."
>
> "Water and related land resources planning that is consistent with the national planning objective seeks to incorporate some or all of these elements: facilitate sustainable national economic development, encourage wise use of water and related land resources – including flood plains, and flood-prone coastal areas, support the protection and restoration of significant aquatic ecosystems, promote the integration and improvement of how the Nation's water resources are managed; and reduce vulnerabilities and losses due to natural disasters."

The Federal objective is not specific enough for the development of a water resource project. The formulation of alternative plans requires the identification of study specific planning objectives.

2.2.2 Non-Federal Objectives

The State of California, recognizing the continuing risk of flooding within the Central Valley, has enacted the Central Valley Flood Protection Act (CVFPA) and other related legislation, which establishes in California law the objective of providing 200 year protection to urban and urbanizing areas. Additionally, the CVFPA requires an immediate analysis of the condition of the system levees, an action plan for achieving the desired level of protection, and associated actions to reduce residual risks to development within the protected area. The State is partnering with Stanislaus County, the study sponsor, to fund the non-Federal portion of the Orestimba Creek Feasibility Study.

2.2.3 Planning Objectives

Planning objectives are more specific than the Federal and non-Federal objectives and reflect the problems and opportunities in the study area; an objective is developed to address each of the identified problems and opportunities. Planning objectives represent desired positive changes in the without-project future conditions. All of the objectives focus on activity within the study area and within the 50 year period of analysis.

The planning objectives are:

- Reduce the probability of Orestimba Creek flooding in the study area consistent with existing land use patterns.
- Reduce the consequence of flooding in the study area with an emphasis on public safety.
- Include environmentally sustainable design during construction of the recommended plan.
- Increase natural functions of Orestimba Creek as an incidental benefit while reducing flood risk in the study area.

2.2.4 Planning Constraints

A planning constraint is a restriction that limits the extent of the planning process. It is a statement of things the alternative plans must avoid. Constraints are designed to avoid undesirable changes between without and with-project future conditions.

The planning constraints are:

- Comply with all applicable Federal laws, regulations, and policies.
- Avoid adverse effects to Federal and California State listed species in the area including the Valley Elderberry Longhorn Beetle (VELB) and the San Joaquin Kit fox.

2.3 INVENTORY AND FORECAST OF FUTURE WITHOUT PROJECT CONDITIONS

The future without project condition is the most likely condition expected to exist in the future in the absence of a proposed water resource project. The future without project condition defines the benchmark against which the alternative plans are evaluated. While most of the documentation of the inventory and forecast of affected resources is located in Chapter 4, a few critical assumptions that affect the plan formulation have been highlighted in this section.

Critical assumptions in defining the future without project conditions include:

- Habitat diversity and quality along Orestimba Creek are anticipated to decrease in the future. There are currently no known plans to restore and preserve land within the lower watershed and on the alluvial fan surface.
- Flood events would continue to erode the bed and banks of Orestimba Creek, removing vegetation, causing banks to collapse, and threatening infrastructure. This condition is usually addressed with the placement of broken concrete or rock, which has little to no habitat value. A decline in resource values within the creek and adjoining properties may be expected to continue in the future.
- Sand and gravel mining within Orestimba Creek would continue to reduce the amount of sediment transported by the creek to downstream reaches causing the creek channel to become further incised. This has tended to be accompanied by a general narrowing of the channel historically. Channel velocities may increase slightly with the deepening and narrowing of the channel, which may allow for an increase in sediment transport capacity. The creek sinuosity and meander-width ratio may also change as the channel system continues to adjust to changing sediment-input conditions.
- The City of Newman and surrounding agricultural areas would continue to accrue flood damages. Expected annual damages are approximately $3,400,000.
- The City of Newman and surrounding agricultural areas would continue to be at risk of flooding from Orestimba Creek.
- Hydrology would not substantially change. The study area would primarily remain non-urban so runoff would not increase. The potential impacts of climate change are estimated to be more significant in the without project condition than with the proposed project. This is because the damages with the project in place were found to be relatively insensitive to peak flow. As a result, the benefits of the

project would be under estimated if flood magnitudes were to increase in the future.

- There would be limited development within the urban area.
- Critical infrastructure, including the California Aqueduct, the Delta-Mendota Canal, the CCID Main Canal, Highway 33, the CNRR, and the existing county roads would remain in place.

Existing Non-Structural Features

There are a number of small non-structural features that have been constructed by private landowners or local or regional governments to reduce the consequences of flooding in the study area. It is assumed that all of these features would remain in place in the future without project condition.

As discussed above in Subsection 2.1.1, there are three low water crossings of Orestimba Creek where the road dips down into the creek channel and only a small culvert allows the creek flow to pass under the road (Figure 2-8). It is assumed that these crossings would remain in the future without project condition.

Figure 2-8: High Water Road Closure on Eastin Road

Several other examples of non-structural approaches to flood risk management exist in the study area. Several floodwalls and small berms have been constructed to prevent floodwater from entering rural residences. (Figure 2-9)

Figure 2-9: Flood Wall Risk Reduction Measure at a Rural Residence near Orestimba Creek

CHAPTER 3 – ALTERNATIVE PLANS*

This chapter, Alternative Plans, includes the main activities of the plan formulation process. The formulation, evaluation, and comparison of alternative plans comprise the third, fourth, and fifth steps of the USACE planning process. These steps are often referred to collectively as plan formulation. Plan formulation is a structured and highly iterative process that involves cycling through the formulation, evaluation, and comparison steps many times to develop and refine a reasonable range of alternative plans. Those plans are then narrowed down to a final array of feasible plans from which a single plan can be recommended for authorization and implementation.

3.1 FLOOD RISK MANAGEMENT MEASURES

A measure is a feature or an activity that can be implemented at a specific geographic site to address one or more planning objectives. Table 3-1 lists the preliminary management measures identified for the feasibility study and identifies the individual objectives to which they contribute.

Measures are the building blocks that are grouped together to form alternative plans. The measures listed below were screened to determine whether each measure should be retained for use in the formulation of alternative plans. Descriptions of the measures and the decision to retain or drop each measure from further consideration are presented next.

These measures primarily achieve flood risk management objectives in the study area, but may also contribute to the environmental quality objectives through sound environmental design of the project. Flood risk management measures can be nonstructural or structural. Nonstructural measures reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from nonstructural measures is accomplished by changing the use of the floodplains, or by accommodating existing uses to the flood hazard. In contrast, structural measures alter the nature or extent of flooding. Structural measures accomplish flood risk management by modifying the magnitude, duration, extent, or timing of flooding.

When considering if there are opportunities to apply flood risk management measures in the study area, an understanding of the basic magnitude of costs to construct the measures is useful when compared to the maximum potential flood risk management benefits possible. Reduction in flood damages translates into monetary benefits that are used to determine if the benefits of doing something outweigh the costs, which in turn helps determine if the Federal government can participate in a project. For a frame of reference, the maximum flood risk management benefits possible in the Orestimba area would not economically justify flood risk management measures exceeding about $70 million in total costs.

Table 3-1: Initial Screening of Management Measures and Their Effectiveness in Meeting Planning Objectives

General Measures	Objectives			
	Reduce flood risk	Reduce flood damages	Promote Sustainable Environmental Design	Increase natural functions
Early Flood Warning & Evacuation	x	x		
Raise/Floodproof Community	x	x		
Raise/Floodproof Individual Structure		x		
Dry Floodproof Individual Structures		x		
Relocate Community	x	x		
Relocate Individual Structures	x	x		
Acquire Easements or Fee Title in Floodplain Lands	x	x		
Create Bypass Channel	x	x		
Enlarge Orestimba Creek Channel	x	x		x
Construct Standard Levees	x	x		
Construct Setback Levees	x	x		
Construct Chevron Levee	x	x		
Construct Upstream Floodwater Attenuation Basin	x	x		
Construct Downstream Floodwater Attenuation Basin	x	x		
Construct Training Dike	x	x		
Remove Orestimba Creek Channel Constrictions	x	x		x
Use Canals for Flood Conveyance	x	x		
Use Farm Drains for Flood Conveyance	x	x		
Clearing and Snagging	x	x		
Restore Native Vegetation			x	
Removal of invasive plant species[1]			x	

The only invasive species of concern identified in the report is the Giant Reed Bamboo (*Arundo donax*) which is limited to the creek channel.

3.1.1 Non-Structural Measures

Early Flood Warning and Evacuation

Retained for further consideration. This measure would involve the development of an emergency response plan for the watershed. An emergency plan would contain instructions as to where and when residents should be informed as to potentially dangerous situations, how public agencies should respond to a potential flood emergency, what roads might be blocked off to prevent residents from driving into dangerous water crossings, & other information that would assist in an orderly response to the problem. Installation of stream gages and rain gages connected to an electronic system could also help to warn residents of the floodplain as to an impending flood. This would allow residents some time to remove limited household property to a safer location prior to a flood event. Flood warning systems can be integrated into a larger flood response plan, potentially in conjunction with evacuation plans. Stanislaus County has installed automated closures at 3 road crossings to reduce the chance that drivers would attempt to cross the creek when it is flooded.

Raise/Floodproof Community

Dropped from further consideration. There is little community support for this measure as the method of reducing flood damages. This measure reduces the threat to public safety within the community but the flood risk remains in the rural areas. This measure is not cost effective on a large scale, based upon the current number of structures within the floodplain. The current number of structures within the floodplain ranges from 1,300 to 2,000. At an average cost of $65,000 to raise each structure, the total cost of this measure would fall between $90 and $130 million.

Raise/Floodproof Individual Structures

Retained for further consideration. This measure would involve the raising of individual structures above the level of floodwater reached during a flood event. Each structure would be elevated sufficiently to prevent floodwater intrusion into the structure. Commonly, the structure would be raised and a new foundation constructed beneath it at a higher elevation. This could be a cost effective solution since the floodwater is relatively shallow. This measure would not appreciably reduce flood risk since these individual structures would be isolated during high water events and transportation to and from the structure could be dangerous.

Dry Flood Proofing Around Individual Structures

Retained for further consideration. Dry flood proofing involves sealing building walls with waterproofing compounds, impermeable sheeting, or other materials, and using shields for covering and protecting openings from floodwaters. In areas of shallow, low velocity flooding, shields can be used on doors, windows, vents, and other building openings. Dry flood proofing should be employed on buildings constructed of concrete block or brick veneer on a

wood frame. Weaker construction materials, such as a wood frame, will fail at much lower water depths from hydrostatic pressure. This measure could be employed by individual property owners to reduce flood damages.

Relocate Community

Dropped from further consideration. There is little community support for this measure as a method of reducing flood damages and it is not cost effective on a large scale, based upon the current number of structures within the floodplain. The current number of structures within the floodplain ranges from 1,300 to 2,000. At an average cost of $150,000 to relocate each structure, the total cost of this measure would fall between $200 and $300 million.

Relocate Individual Structures Subject to Flooding

Retained for further consideration. This measure consists of relocation by physically moving existing homes and structures that lie within flood-prone areas. There are cases where relocation is not physically and/or economically feasible. In such an event, property owners would be compensated for the value of buildings and urged to move from the flood-prone area. A successful evacuation and resettlement program requires adequate flood-free replacement housing, nonresidential sites, and the willingness of the residents to participate. Many residents depend on the land for their living and cannot be located at distance from the land that they must maintain daily.

Acquire Flowage Easements or Fee Title Interest in Floodplain Lands

Retained for further consideration. Acquiring flowage easements or purchasing lands in fee title to allow flooding and limit future development can reduce flood damages and provide opportunities for improved environmental quality. The availability of willing sellers is uncertain for some potential project lands.

3.1.2 Structural Measures

Bypass Channel

Retained for further consideration. This measure would involve the construction of a channel downstream of the fan apex that would serve to convey excess flows (flows of a magnitude beyond that which can be accommodated by the existing channel) safely down the fan to the San Joaquin River. The bypass channel would consist of a newly constructed channel that would only convey flow when the existing channel exceeded the maximum flow rate possible without breakout. This measure has the potential of routing floodflows from the upper part of the watershed through the affected properties on the fan to a safe discharge location. A channel capable of conveying up to the 1/100 median ACE event would be potentially five to six times the width of the existing channel in its narrowest locations. The

channel would have to occupy a topographically low point on the fan to make best use of its potential.

Channel Enlargement

Retained for further consideration. This measure would involve the enlargement of the existing channel, entirely below the existing level of the floodplain, through excavation for additional capacity. The existing channel would be widened throughout its length between the fan apex and the San Joaquin River. Additional rights-of-way would need to be acquired through the purchase of property from existing landowners. This land would be required to construct the additional channel width. The channel enlargement would also require the replacement of approximately a dozen bridges, which would greatly increase the project cost. The goal of this measure would be to accommodate any excess flow within the Orestimba Creek channel, such that breakouts would not occur up to events beyond the design level. A channel like this could be constructed to almost any dimension. This measure has the potential of routing floodflows from the upper part of the watershed through the affected properties on the fan to the river. A channel capable of conveying all flows up to 1/100 median ACE event could be potentially six times the width of the existing channel in its narrowest locations.

Levees Along Creek

Dropped from further consideration. This measure would involve the construction of earthen levees adjacent to the channel throughout its length between the fan apex and the San Joaquin River. Additional rights-of-way would need to be acquired by purchase of property from existing landowners. This land would be required to construct the levees on top of the existing channel banks. Construction of standard levees immediately adjacent to the channel would likely cause significant environmental effects to existing riparian habitat along the channel without creating opportunities for habitat replacement. Construction of these levees would also require the replacement of approximately a dozen bridges, which would greatly increase the project cost. Standard levees would also require a substantial amount of rock to be placed on the waterside of the levee to reduce the risk of erosion to the levee. The requirement for rock on the levee makes this measure cost prohibitive. Initial cost estimates for the standard levees ranged between $70 and $100 million, which exceeded the potential benefits of this measure.

Setback Levees

Retained for further consideration. This measure would involve the construction of earthen levees on either side of the channel, where needed, to contain flows between the fan apex and the San Joaquin River, but at some distance from the existing channel. This type of levee would create additional capacity without the height requirement needed for traditional levees, while allowing limited inundation of the floodplain in areas on either side of the channel and contribute to improve environmental quality. In addition, the setback levees would be less

susceptible to failure due to bank erosion. Additional rights-of-way would need to be acquired by purchase of property from existing landowners. These lands would be required to construct the levees at some distance away from the existing channel banks. Constructing a setback levee could reduce flood risk and flood damages. Early analysis efforts indicate that it is not likely cost effective for a single-purpose flood risk management project. However, construction of a setback levee would provide an opportunity to restore riparian and other floodplain habitat along the creek. Construction of any levee would include acquiring a flood protection easement for the levee itself and flowage easements for land on the waterside of the levee.

Chevron Levee

Retained for further consideration. This measure, and variations also known as "ring levees", would involve the construction of an earthen levee on the upstream side and flanks of the town of Newman. This measure would protect the town of Newman from flows up to a design-level event. The levee would divert flow away from the town and down a less developed flow path toward the San Joaquin River. This measure would require a right-of-way on which to construct the levee. The chevron levee would require the raising of roads and some other features to accommodate the levee's increased height above the natural ground. This measure would reduce the risk of flood inundation in the City of Newman and agricultural areas east of town, but would not reduce the flood risk to surrounding agricultural land to the north and west of town. This measure may result in increased flow depths in those areas currently inundated that are outside of the proposed levee confines. These increased depths would be analyzed to determine effects and if a takings analysis would be required.

Upstream Floodwater Detention Basin

Retained for further consideration. This measure would involve the construction of a floodwater detention basin upstream of the California Aqueduct. The basin would be created by constructing a dam embankment across Orestimba Creek, which would create a flood pool in the upstream valley. A floodwater detention basin reduces peak discharges by temporarily storing floodwaters in the flood pool by restricting discharge through an outlet. As no gated control structure would be constructed, flow downstream would be entirely a function of the outlet size and depth of water/volume (head) stored behind the dam. A floodwater detention basin may retain some sediment delivered during large flood events, but would retain no more than the existing condition under lesser flow events. A floodwater detention basin may cause impact to the Sycamore Alluvial Woodland within the inundation area of the flood pool. Four versions of this measure were developed and analyzed to determine which version provided the most benefits for the least cost. The four versions are:

- <u>2,000 cfs Outlet.</u> This version would involve the construction of a floodwater detention basin with an outlet capable of passing 2,000 cubic feet per second (cfs). An outflow of 2,000 cfs would allow the majority of flood events to pass through the outlet while not exceeding existing downstream channel capacity. This means that all flows up to

approximately 2,000 cfs would be routed through the structure without detention or storage of floodwaters. The time of detention would be very short for smaller flood events, but could extend up to several days depending on the design flood event applied. A structure that would retain a 1/100 ACE median design flood event would be 40 to 50 feet in height. Events larger than design would be routed over a spillway crest at the top of the embankment. This version of the floodwater attenuation basin would require a storage volume of over 20,000 acre-feet to detain the 1/100 ACE median design flood outflow within the existing downstream channel capacity.

- 4,000 cfs Outlet. This version would involve the construction of a floodwater detention basin with an outlet capable of passing 4,000 cfs. This means that all flows up to approximately 4,000 cfs would be routed through the structure without detention of floodwaters. Because the existing channel downstream of the structure is incapable of passing 4,000 cfs within its banks, this version would require the enlargement of the channel in constricted locations to provide a uniform capacity of 4,000 cfs or more in the downstream reaches. The time of detention could extend up to 72 hours depending on the design level applied. A structure that would contain a 1/100 median ACE design flood event would be 30 to 40 feet in height. This version of the floodwater attenuation basin would require a storage volume of somewhat less than 20,000 acre-feet to contain the 1/100 median ACE design flood outflow within the improved downstream channel.
- 8,000 cfs Outlet. This version was created to minimize effects to Sycamore Alluvial Woodland, both at the head of the fan upstream of the California Aqueduct, and also in the riparian zone between the California Aqueduct and Delta-Mendota Canal downstream. This version maintains the extent, frequency, and duration of flooding in the riparian zone between the Aqueduct and Delta-Mendota Canal, and minimizes changes in the duration of flooding to the Sycamore Alluvial Woodlands at the head of the fan upstream of the California Aqueduct. It also minimizes changes in the behavior of sediment and runoff in all of the Sycamore Alluvial Woodland areas. This 8,000 cfs outlet version would require enlargement of the existing channel downstream of the Delta-Mendota Canal. The Basin would detain flow above 8,000 cfs. The basin embankment would be approximately 38 feet tall at its highest point with a length of over 4,000 feet. The emergency overflow spillway would be approximately 1,000 feet wide and 7 feet high.
- 10,000 cfs Outlet. A basin with a 10,000-cfs outlet would allow discharge into the downstream channel at a flow rate similar to that currently contained in the channel. This alternative would result in minimal changes to channel behavior, sediment content, and in-channel vegetation or habitat effects, as the in-channel flow rate would be almost duplicative of that currently experienced during large flood events. The duration of flow would be increased somewhat due to the increased detention time of floodwaters upstream. The 10,000 cfs outlet basin was also designed to be a “dry” structure. No significant ponding of water would occur in this basin, as all flow that

entered the inundated area behind the embankment would drain out naturally to the channel downstream.

Downstream Floodwater Detention Basin

Retained for further consideration. This measure would involve the construction of a dry detention basin downstream of the Delta-Mendota Canal. Since the topography in this location does not provide the means to contain stored water, this structure would be larger than that of a detention basin upstream of the Aqueduct. The analysis conducted on this measure was also formulated for a structure that would hold water only during times in which the downstream channel capacity would be exceeded. This means that all flows up to approximately 2,000 cfs would be routed through the structure without detention, or "stored" floodflows. The time of detention would be very short for smaller flood events, but would extend up to several days depending on the design level applied. As no gated control structure would be constructed, flow downstream would be entirely a function of the outlet size and depth of water/volume within the structure. The structure, at 1/100 median ACE design event, would require an embankment length of approximately 4 miles and a height of between 40 to 50 feet. A detention basin would require a storage volume of over 20,000 acre-feet to contain the 1/100 median ACE design flood outflow within the existing downstream channel.

Construct Training Dike

Retained for future consideration. A training dike, considerably less costly than a levee due to its size, could be cost effective based on damages prevented. Construction of a training dike would include acquiring a flood protection easement.

Remove Constriction from Orestimba Creek Channel

Retained for further consideration. Analysis of the without project channel capacity indicates the CNRR trestle over the creek increases the probability of overbank flooding due to debris capture. The wooden support piers for the trestle are skewed to the flow of the creek. During high water events, woody debris become lodged on the piers, blocking the flow path of the creek and causing the water surface elevation to rise. Floodwater then overtops the creek banks on the upstream side of the railroad trestle and flows laterally along the uphill side of the embankment into the town of Newman.

Use of Canals for Flood Conveyance

Dropped from further consideration. This measure would involve the use of both the California Aqueduct and Delta-Mendota Canal for floodwater conveyance. Floodwaters would be routed into one or both of the canals for discharge to a safer location, thus preventing overflow into those areas currently at risk downstream. The capacity of the canal would be inadequate to substantially reduce flood risk. In addition, floodwater can carry large amounts of sediment, which would be costly to remove from the water supply facilities. This measure

does not have the support of the agencies which operate and maintain these facilities (State of California, Department of Water Resources and the Bureau of Reclamation). The cost of removing sediment and debris from the drinking water supply for Southern California outweighs the potential local flood benefits.

Use of Farm Irrigation Supply Canals and Drains for Flood Conveyance

Retained for further consideration. This measure would involve the upgrading and interconnection of farm drains into a comprehensive storm water drainage system for flood protection. At a fully developed condition, this measure could be used to route floodwaters away from affected properties and into a system of drains capable of containing large flood events. The canals have limited excess capacity, so the focus would be on dispersing the flows among several canals so that together, they could effectively transport floodwaters. Some of the canals flow along the topographic contour rather than downstream to a point of discharge, so some additional canals would need to be constructed for use in flood flow conveyance.

Clearing and Snagging

Dropped from further consideration. This measure focuses on increasing capacity of the channel through clearance of impediments to flow, including vegetation, organic and inorganic debris, and human-generated detritus. Analysis of this measure indicates that clearing and snagging in the channel would not significantly increase the capacity of the channel. In fact, no reasonable amount of clearing and snagging would be capable of increasing the channel capacity above a level of 1/5 ACE median event (3,630 cfs). Clearance of vegetation and debris would be needed on a regular basis to maintain any expanded capacity. It would also subject the channel to increased probability of bank erosion and channel instability which would threaten agricultural infrastructure. Regular removal of the riparian vegetation growing along Orestimba Creek would have significant negative environmental effects. The maintenance would be expensive and would conceivably require individual permits each and every time it was needed. However, some limited removal of impediments to flow, specifically non-native invasive vegetation, may be required as part of any alternative carried forward.

Restore Native Vegetation

Retained for further consideration. As part of any channel modifications, restoration of native vegetation could be implemented within the context of environmentally sustainable design.

Removal of Invasive Plant Species

Retained for further consideration. As part of any channel modification alternative, the removal of invasive plant species could be included in order to increase habitat value and reduce roughness within the creek. This measure would be accomplished within the context of environmentally sustainable design.

The next step in the plan formulation process is to formulate alternative plans. Table 3-2 summarizes the measures screening process.

Table 3-2: Summary of Management Measures Retained or Dropped

Measures	Retained	Dropped	Reason for Dropping
Non-Structural Measures			
Early Flood Warning & Evacuation	X		
Raise/Floodproof Community		X	Not cost effective to raise several thousand structures.
Raise/Floodproof Individual Structures	X		
Dry Floodproof Individual Structures	x		
Relocate Community		X	Not cost effective or supported by community.
Relocate Individual Structures	X		
Acquire Flowage Easements or Fee Title in Floodplain Lands	X		
Structural Measures			
Create Bypass Channel	X		
Enlarge Orestimba Creek Channel	X		
Construct Levees along Creek		X	Significant environmental effects, need for rock makes this not cost effective.
Construct Setback Levees	X		
Construct Chevron Levee	X		
Construct Upstream Floodwater Attenuation Basin	X		
Construct Downstream Floodwater Attenuation Basin	X		
Construct Training Dike	X		
Remove Orestimba Creek Channel Constrictions	X		
Use Canals for Flood Conveyance		X	Insufficient capacity. Sediment in floodwaters would contaminate water supply.
Use Farm Drains for Flood Conveyance	X		Use network of multiple irrigation canals and drains to disperse flows.
Clearing and Snagging		X	Increased risk of bank erosion and instability. Doesn't significantly increase channel capacity. Environmentally damaging.
Restore Native Vegetation	X		
Removal of invasive plant species	X		

3.2 FORMULATION AND EVALUATION OF PRELIMINARY FLOOD RISK MANAGEMENT ALTERNATIVE PLANS

A preliminary array of flood risk management alternative plans was developed, and evaluated and compared to identify a plan that reasonably maximizes the net benefits (benefits minus costs). This preliminary array of flood risk management alternative plans primarily consists of various upstream and downstream dry dam configurations, bypass alignments, setback levees, a ring levee, and channel modifications.

The retained measures generally needed to be combined with other retained measures in order to develop complete preliminary alternative plans. Table 3-3 illustrates which measures were combined to form the various preliminary alternative plans. While each individual measure contributes to one or more of the flood risk management objectives, most need to be applied in combination with the others in order to provide a complete plan that achieves the multiple objectives identified by the study. A description of each of the preliminary alternative plans follows Table 3-3.

Table 3-3: Inclusion of Measures in Preliminary Alternative Plans

Measures	**Alt 1** Enlarge Channel/ Remove Constrictions	**Alt 2** Setback Levees	**Alt.3** Chevron Levee	**Alt.4** Bypass Channel	**Alt.5** Up-stream Basin	**Alt.6** Down-stream Basin	**Alt. 7** Chevron Levee & Chan. mods	**Alt 8** Chevron. Levee, Chan Mods and IC	**Alt 9 –** Non-Struct.
Early Floodwarning & Evacuation	X	X	X	X	X	X	X	X	X
Raise/Floodproof Individual Structure	X		X				X	X	X
Relocate Individual Structures	X	X	X				X	X	X
Acquire Flowage Easements or Fee Title in Floodplain Lands	X	X	X	X	X	X	X	X	X
Create Bypass Channel				X					
Enlarge Orestimba Creek	X	X			X	X	X	X	
Construct Setback Levees		X			X	X			
Construct Chevron Levee			X				X	X	
Construct U.S. Floodwater Detention Basin					X				
Construct D.S. Floodwater Detention Basin						X			
Construct Training Dike		X	X						
Remove Or. Creek Channel Constrictions	X	X			X	X	X	X	
Restore Native Vegetation	X	X			X	X	X	X	
Removal of invasive plant species	X	X			X	X	X	X	

3.2.1 Alternative 1 – Enlarge Channel – Remove Constrictions

This alternative would enlarge the existing Orestimba Creek Channel below the existing level of the floodplain, through excavation for additional capacity. The existing channel would be widened throughout its length, where needed, between the fan apex and the San Joaquin River. Additional right-of-way would require purchase of property from existing landowners to construct this alternative. The goal of this alternative would be to accommodate floodflows within the Orestimba Creek channel, so that breakouts would not occur up to events beyond the design level. A channel like this could be constructed to almost any dimension. This measure has the potential of routing floodflows from the upper part of the watershed, through the affected properties on the fan, to the river. A channel capable of conveying all flows up to an assumed median 1/100 ACE event would be potentially six times the width of the existing channel in its narrowest locations. The approximate reach of improvements is between Eastin Road and one mile downstream of the Highway 33 Bridge, a distance of about five miles. Alternative 1 is shown in Figure 3-1

Analysis of the without project channel capacity indicates that the CNRR trestle over the creek increases the probability of overbank flooding due to debris capture. The wooden support piers for the trestle are skewed to the flow of the creek. During high water events, woody debris become lodged on the piers, blocking the flow path of the creek and causing the water surface elevation to rise. Floodwater then overtops the creek banks on the upstream side of the railroad trestle and flows laterally along the uphill side of the embankment into the town of Newman. In addition to the railroad trestle, a number of public and private bridges along this reach of the creek also restrict the channel capacity and would need to be replaced.

Alternative Evaluation

This alternative raises concerns about the channel stability downstream of the modifications. From a geomorphic standpoint, this would be a difficult alternative to implement since the creek is still trying to find equilibrium. Extensive modeling would be needed to determine how the channel would react to changes in channel dimensions. In order to handle large flows (median 1/100 ACE event), the channel would have to be excavated to a size about six times its current geometry. Permitting this excavation work would be difficult due to the existing remnant vegetation along the creek, which would need to be removed. The team decided that this alternative as a stand alone alternative would be eliminated but that parts of it could be incorporated in to other alternatives to form a hybrid alternative.

Historically, a natural channel on an alluvial fan would not be large enough to handle the rare very large flows. This alternative would attempt to create a solution that did not naturally occur. In a natural pattern, the creek would carry the flow during most years, but during very high flow years, flow would overtop and spill out across the floodplain.

Figure 3-1: Alternative 1 – Enlarge Channel – Remove Constrictions

3.2.2 Alternative 2 – Setback Levees along Orestimba Creek

A "setback" levee is a levee constructed at some distance from the river or creek channel. In this case, a setback levee would be two roughly parallel structures, one on either side of the channel, set back from the channel banks of Orestimba Creek at a determined distance. Setback levees require more real estate than a standard levee that is close the channel bank, as the area between the levees would be inundated during a flood event, therefore purchase of the property or a flooding easement would be necessary. A setback levee would require some relocation of structures or infrastructure currently close to the channel. A setback levee would require the same physical characteristics as a standard levee due to the chance that the channel may shift to a location closer to the levee.

The Setback Levee Alternative was initially designed to provide a median 1/100 ACE level of flood risk management for the entire floodplain downstream of Bell Road. Reformulation of the setback levee option resulted in the decision to conduct a cost optimization. This was used to determine the most economical spacing of the levees. The width between the levees was set between 200 and 600 feet apart, in 100-foot increments. The results indicated that a spacing of 300 feet between the inside toes of the levees provided the best combination of levee size and land usage.

Setback levee bottom widths were varied between 200 feet and 600 feet, as measured from the inside toes. Levees were generally centered on the existing main channel. Water surface profiles were computed for the median 1/100 ACE event (14,000 cfs) and the median 1/500 ACE event peak discharges (20,000 cfs). Figure 3-2 shows a map of the setback levee alignment.

The levees would extend from the San Joaquin River confluence to a point where most of the flow is contained within the main channel just below the Delta Mendota Canal. The overall leveed channel length would be approximately 10 miles. For simplicity, it was conservatively assumed that the levee length on both sides of the creek is equivalent to the channel length. There would likely be sections where bends within the creek would be contained within a less sinuous levee alignment.

The modified reach includes 10 bridges. It is assumed that all of the bridges would be modified to span the distance between levees to provide all weather crossings.

Alternative Evaluation

This alternative would include a high level of land acquisition depending on the distance of the setback levees. The preliminary cost estimates indicated that this would be a very expensive alternative to implement compared to other alternatives, mostly due to the number of bridges that would have to be replaced.

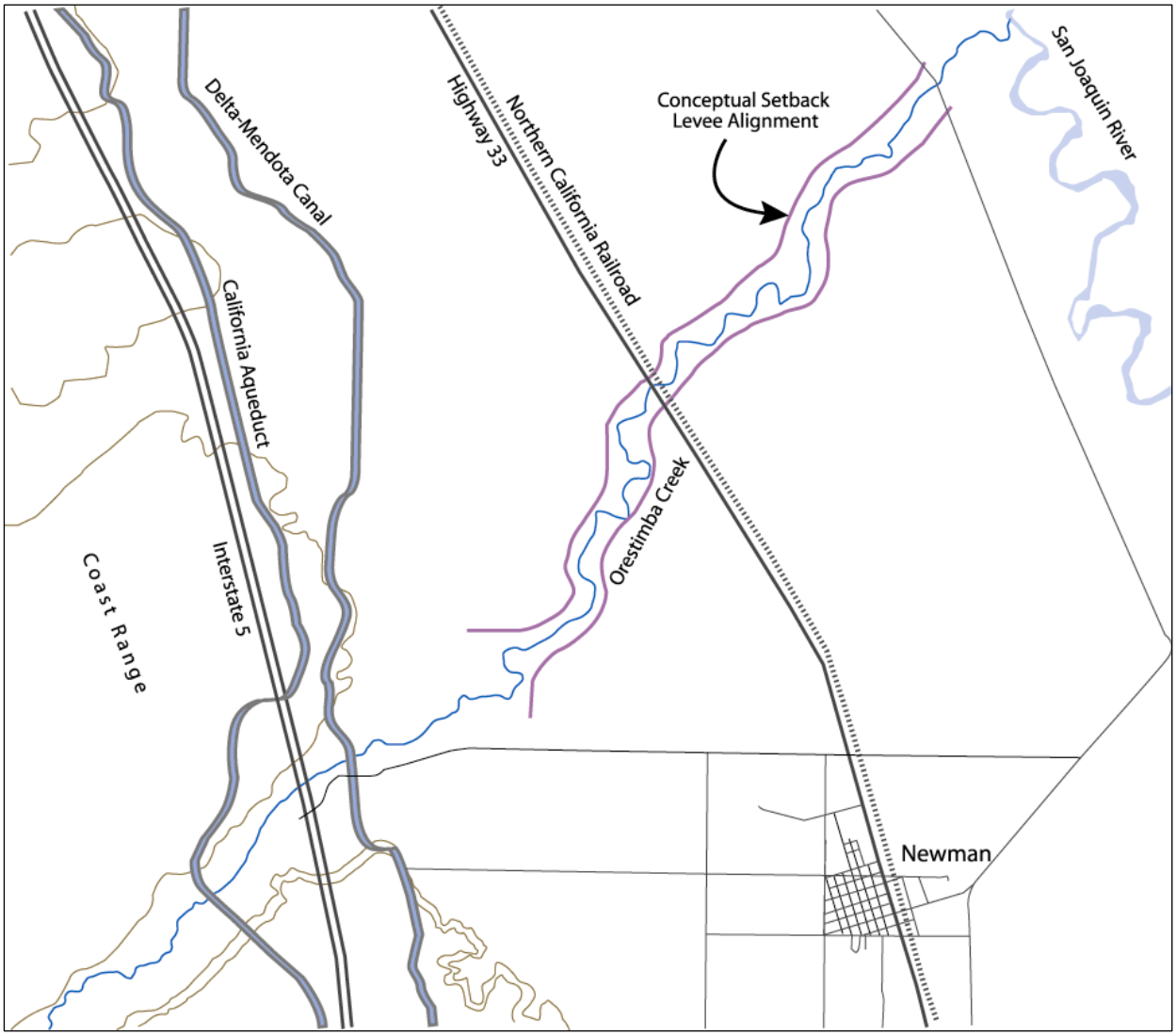

Figure 3-2: Alternative 2 – Setback Levees along Orestimba Creek

3.2.3 Alternative 3 – Chevron Levee

A partial ring levee would be constructed to reduce the risk of flooding to the majority of structures within the City of Newman. The levee would be somewhat horseshoe-shaped, with the open end facing downstream (toward the San Joaquin River). It would divert floodflows that flow overland across the alluvial fan around the City of Newman.

The Newman Chevron Levee Alternative protects the town of Newman from flows that break out of the channel of Orestimba Creek. As shown in Figure 3-3, the levee would start near Highway 33 about 1 mile north of the town, near an unnamed farm road. It would continue to the west in the direction of the CCID Main Canal, and then would run south in a parallel alignment to the canal until it intersects with the Newman Wasteway. The team also designed an alignment with the northern portion of the levee paralleling Stuhr Road. This alignment proved to be more costly than the northern farm road because of the numerous utilities and residences along Stuhr Road that would be affected.

Alternative Evaluation

Given its location outside the channel area of Orestimba Creek, it is anticipated that most effects of the chevron levee would be cultural and social, rather than environmental.

The addition of the chevron levee creates a condition of increased flood depth on the water side of the levee since the flow is diverted from its original flow path. This could result in areas experiencing a higher probability of increased depth and extent of flooding. Several features were analyzed in order to reduce this effect. An interceptor channel was analyzed that could capture the flows just downstream of the Railroad berm and convey the flows to the San Joaquin River. The second measure looked at a bypass just downstream of the Delta-Mendota Canal. Both of these features would require extensive real estate acquisitions and were found to cost more than the benefits they provided. Therefore, these features would not be recommended.

The Chevron Levee Alternative is cost effective and reduces damages in the City of Newman and the rural area east of Newman, but does not reduce damages in the remainder of the study area. A hybrid version of this alternative would combine it with setback levees and channel improvements, which would allow the channel to convey more flow than it currently does. This would reduce the flood risk to the agricultural area, while the chevron levee would provide a higher level of flood risk management to the City of Newman.

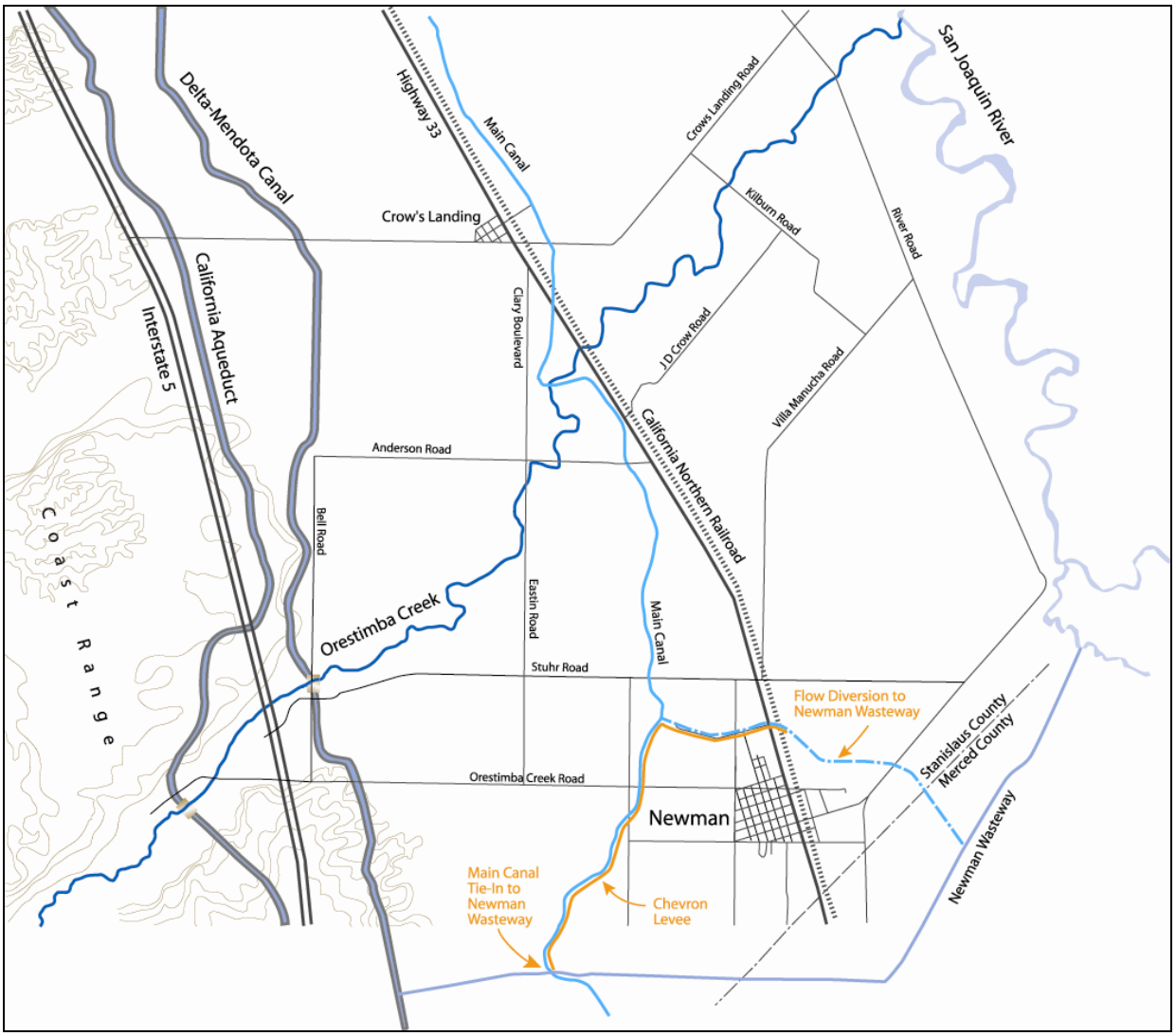

Figure 3-3: Alternative 3 – Chevron Levee

3.2.4 Alternative 4 – Bypass Channel

The Bypass Channel Alternative would mimic the natural flow of floodwaters as they leave the Orestimba Creek channel and spread out on the alluvial fan. This alternative would include the construction of multiple small to midsize channels that collect floodflows and transport them to the San Joaquin River. The bypass channels would be located in the lower half on the alluvial fan where the majority of the flows break out of the creek channel.

As shown in Figure 3-4, six channel alignments were investigated between Orestimba Creek and the City of Newman. The channel alignments were selected to follow general topographic "swales" and to utilize existing agricultural water supply and drainage canals. In some areas, a limited number of new channel lengths would be constructed, and in these cases the alignments would connect existing canals or run parallel to existing roadways to minimize disturbance to existing land uses. Five of the alignments would discharge to the San Joaquin River at three different points. The sixth bypass channel would discharge in to the Newman Wasteway, an overflow channel from the California Aqueduct, which then flows in to the San Joaquin River near the Merced River Confluence.

The channel base widths were selected to optimize channel efficiency and maintain non-erosive velocities to avoid the need for armoring. The channel sizes (bottom widths and depths) and resulting velocities were very similar for each of the alignments. The major difference between the alignments is in the overall channel lengths, which would significantly affect construction costs and impact (channel footprint) areas. This alternative was analyzed to determine the optimal number of bypass channels required and the amount of flow each channel would accommodate. In addition to the construction of the bypass channels, new roadway crossings would also be required for at least some of the existing roads.

The outlets of these channels would concentrate the release of flow to different points along the San Joaquin River. For peak storm events, the current Orestimba Creek floodplain delivers flow to San Joaquin River at a large number of locations with only a small portion of the flood flow actually concentrated in Orestimba Creek at the outlet.

Alternative Evaluation

Alterations to the outlet conditions to the San Joaquin River, either by concentrating the overflow in bypass channels or by changing the location of the outflow, could impact the flow characteristics and habitat along the impacted reach of the river. While the distributed discharge of flow in the without project condition could have localized erosion effects due to the uncontrolled nature of the discharge point, the discharge of high flows at a new location may have effects at that point and downstream. These may include local scour, channel bank erosion, sedimentation within the channel, and vegetation removal by scour effects.

The Bypass Channel Alternative would attempt to control the flows at the point of break out from the creek. Because this is an ephemeral stream with many dry years or years of low runoff, the ideal system would be one in which the natural channel could handle the runoff

during most years, and an auxiliary system could be used in years of heavy runoff. The flood control system could grow as needed. A series of small bypasses that use existing irrigation ditches could form a network of flood flow drainage paths. Each one could be sized for several thousand cfs, and each additional bypass could be put to use as the need arises.

This alternative was found to be infeasible due to its high cost. To achieve substantial reductions in flood risk, the bypass alternative would need to provide a network of significantly sized bypass channels. For example, in order to convey a median 1/100 ACE event, approximately eight additional bypass channels similar in size to the existing creek channel would be required. Due to real estate and construction concerns, in addition to public acceptance, the team did not feel this was a workable option because of the large amount of land that would be required and the numerous features that would need to be constructed.

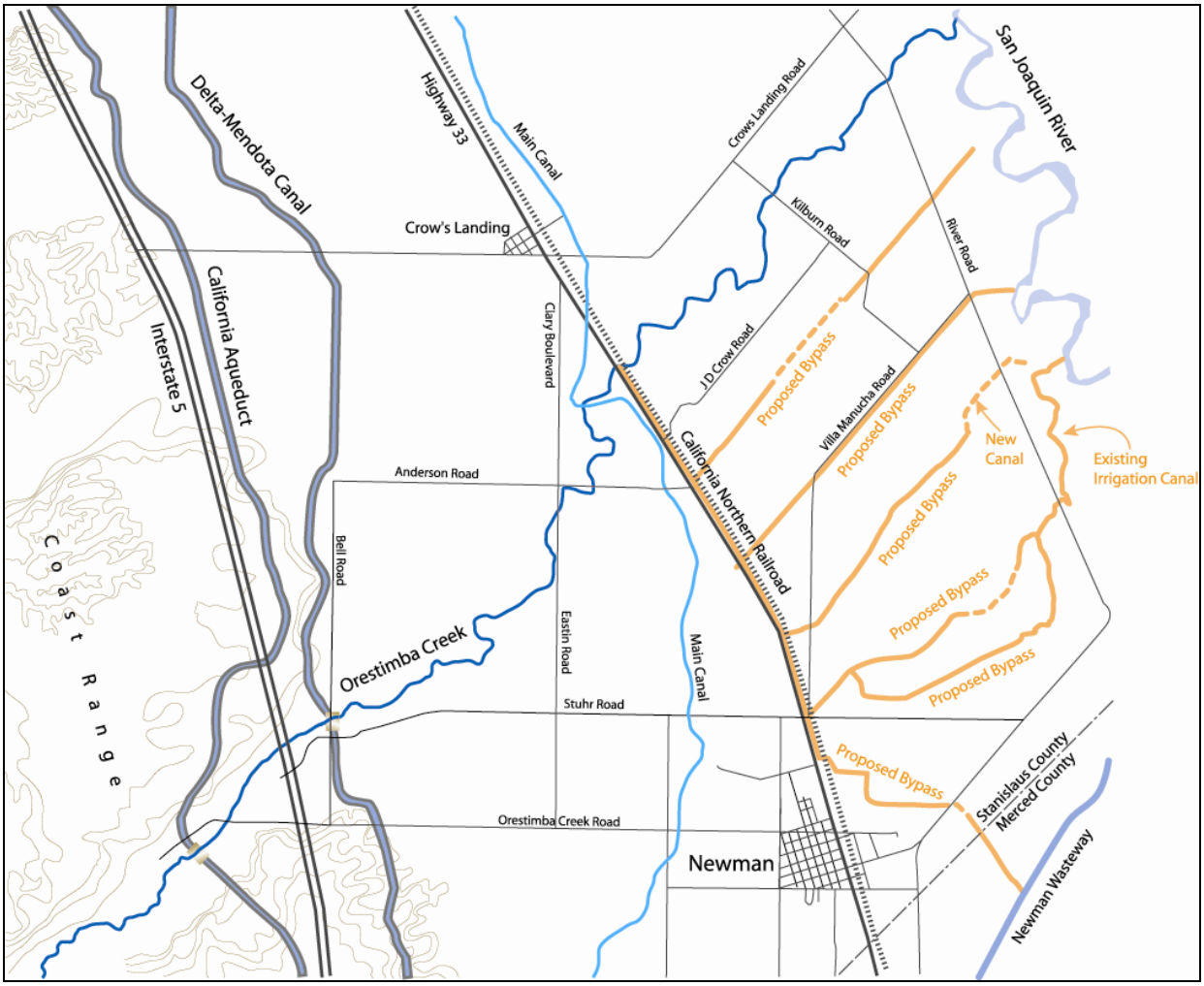

Figure 3-4: Alternative 4 – Bypass Channel

3.2.5 Alternative 5 – Upstream Flood Detention Basin

A floodwater detention basin could be constructed upstream of the California Aqueduct to provide protection from flood events to all properties downstream of the Aqueduct. The site upstream of the Aqueduct is efficient at detaining peak floodflows and releasing the flows at channel capacity. The location within the narrow confines of the hills provides a minimum embankment length for the storage required (Figure 3-5). The floodwater detention basin was designed to be a "dry" structure. Extended storage of water would not occur in this type of basin, as all flow that entered the inundated area behind the embankment would be released immediately following the flood event. No water supply storage was considered. The outlet structure would be ungated. Four versions of this alternative were developed and optimized to determine which version would be carried forward.

Alternative Evaluation

A basin with a 2,200-cfs outlet would allow discharge into the downstream channel at a flow rate similar to that currently contained in the channel. This would minimize any change that would tend to affect channel behavior, sediment content, and in-channel vegetation or habitat effects, as the in-channel flow rate would be duplicated. A basin with a 4,200-cfs outlet would allow discharge into the downstream channel at a flow rate similar to that currently contained in the channel, with enlargement of the channel in certain locations. This would result in greater effects to channel behavior, sediment content, and in-channel vegetation or habitat effects, as the in-channel flow rate would be almost doubled from that currently experienced during large flood events. Basins with an 8,000-cfs outlet and 10,000-cfs outlet were also analyzed but were not carried forward due to the extensive infrastructure and associated costs required downstream.

Potential significant effects may exist, both during and following construction, to the Federally-listed San Joaquin kit fox and California red-legged frog, as well as to the Sycamore Alluvial Woodland at the head of the fan, a CDFG-designated rare natural community. San Joaquin kit foxes are negatively affected by their proximity to the construction and basin/detention pool site. Conservation measures for the kit fox and the California red-legged frog would be incorporated into the analysis of this alternative, should it proceed to the final array of alternatives. The Sycamore Alluvial Woodland would be negatively affected by the removal of some trees at the dry dam construction site, and could be affected by the additional time that the grove would be inundated by floodwater during large flood events. In addition, the Sycamore Alluvial Woodland could be affected by sediment that the floodflows would deposit within the grove, thus affecting surface conditions and subsurface moisture content. Basin reconfiguration was briefly evaluated to determine ways to minimize any significant effects, but no logical alternative was identified. During coordination, USFWS staff communicated their determination that these negative effects to the Sycamore Alluvial Woodland were immitigable.

As the refinement of alternatives continued, it became clear that the costs of constructing a dry dam upstream of the California Aqueduct outweighed the potential benefits. The dam would be required to include a spillway designed to safely pass the probable maximum flood without compromising the integrity of the dam. This translated into a dam that would be 1 mile wide and 60 feet tall. Additional safety concerns were associated with the California Aqueduct, located just downstream from the dam site. The costs of the dry dam approached $75 million, not including mitigation costs. Since other options to protect the City of Newman and the surrounding agricultural land existed, these were examined in detail and the dry dam was not carried forward as part of the preliminary array of alternatives.

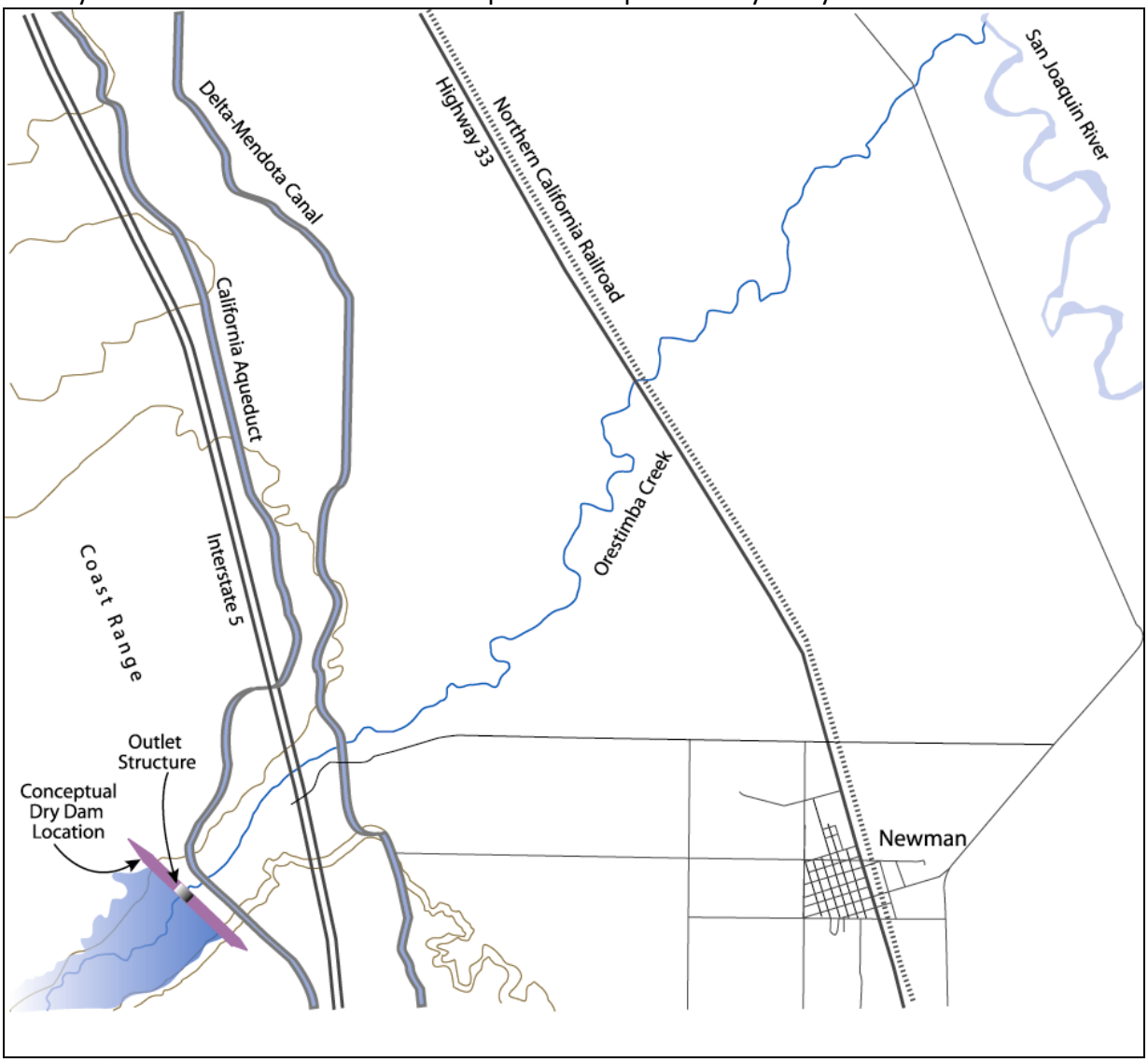

Figure 3-5: Alternative 5 – Upstream Flood Detention Basin

3.2.6 Alternative 6 – Downstream Flood Attenuation Basin

A floodwater attenuation basin could be constructed immediately downstream of the Delta-Mendota Canal and upstream of Jorgensen Road to provide flood risk reduction to properties downstream of that site. The site would require a larger horseshoe-shaped embankment (Figure 3-6). The basin would be designed to be a "dry" structure. Extended storage of water would not occur in this type of basin, as all flow that entered the inundated area behind the embankment would be released immediately following the flood event. No water supply storage was considered. The outlet structure would be ungated.

Alternative Evaluation

The flood attenuation basin would be significantly less cost efficient than the upstream detention basin because of the higher cost of embankment relative to the storage obtained. In addition, the downstream site would require greater real estate acquisitions than the upstream site.

The volume of flow in Orestimba Creek would be increased due to the increased detention time of floodwaters upstream. This increased time of in-channel flow may have effects related to greater amounts of contact time with the water. It would be expected that erosion of the channel could increase, and that water recharge within the channel area would be enhanced. The maintenance of in-channel vegetation would minimize the effects of erosion, and no vegetation removal was considered in this alternative.

This alternative would be located at the site of an existing sand and gravel extraction facility. Coordinated operation of the flood attenuation basin and the sand and gravel extraction facility could be feasible.

Coordination with USFWS staff indicated potential adverse effects, both during and following construction, to the Federally-listed San Joaquin kit fox. Kit fox habitat is located within 10 miles of the construction and basin/detention pool site. Potential impacts would need to be fully investigated under this alternative.

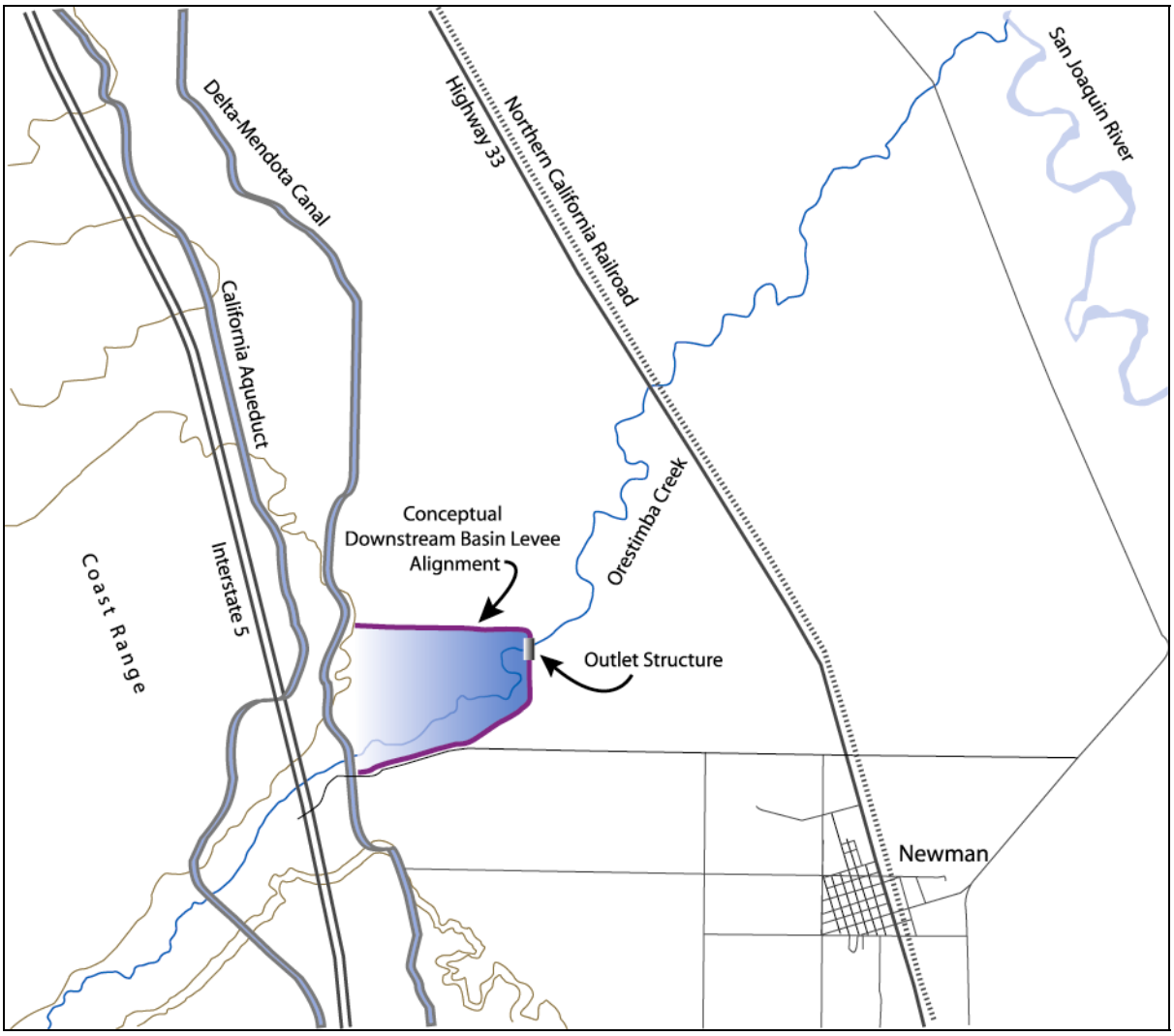

Figure 3-6: Alternative 6 – Downstream Flood Detention Basin

3.2.7 Alternative 7 – Chevron Levee and Channel Modifications

One of the measures identified early in the study process was a chevron levee that would specifically provide flood risk reduction to the City of Newman by directing floodflows away from the urban area. The levee would divert floodflows that break out of Orestimba Creek and flow overland across the alluvial fan. The levee would be comprised of two segments. The first segment of the levee would be constructed north of town along an east-west alignment to intercept floodflows that accumulate along the railroad berm. The second segment would be constructed adjacent to the CCID Main Canal that runs north to south to prevent floodflows from overtopping the canal embankment and flowing into town. Two alignments for the first segment of the Chevron levee were identified: one along Stuhr Road, an existing county road on the northern boundary of the planning area for the City of Newman, and the other alignment about 1 mile north along an unnamed farm road near Lundy Road. These alignments are shown in Figure 3-7. Both alignments would incorporate construction of a levee parallel to the CCID Main Canal.

Stuhr Road Alignment

The Stuhr Road levee would begin where Stuhr Road crosses over the CCID Main Canal. The levee would continue for about 2 miles along the Stuhr Road alignment, ending at the point where floodwaters no longer wrap around the levee and flow in to town. The levee would be constructed just to the north of Stuhr Road and run parallel to it. The levee would intersect both Highway 33 and the CNRR berm, which would both be raised to accommodate the levee. There are numerous utilities along this alignment since it is right at the edge of the urban area. This alignment would require the purchase or relocation of at least seven structures that would be within the levee footprint. This alignment reduced the urban damages, but actually caused an increase of damages to residences located along Stuhr Road east of the CNRR.

Farm Road Alignment

In an effort to reduce the construction costs due to the high amount of utilities and other relocations associated with the Stuhr Road alignment and realize more of the urban benefits near the edge of town, a new alignment was identified along an unnamed farm road located about one mile north of the Stuhr Road alignment. The benefit of locating the levee at this location would be the reduction in overall cost because: (1) less material would be required; (2) there would be fewer utilities to contend with; and (3) re-routing traffic would not be required during construction. Less fill material would be necessary to construct the levee because the top width of this levee would be 12 feet, whereas the Stuhr Road levee width requirement would be 35 feet to replace the existing width of the county road. This alignment allows the levee to tie in to the railroad berm near the location of an existing culvert and natural swale. The probability of induced flooding was found to be less for the farm road levee based on a review of existing condition flood inundation maps.

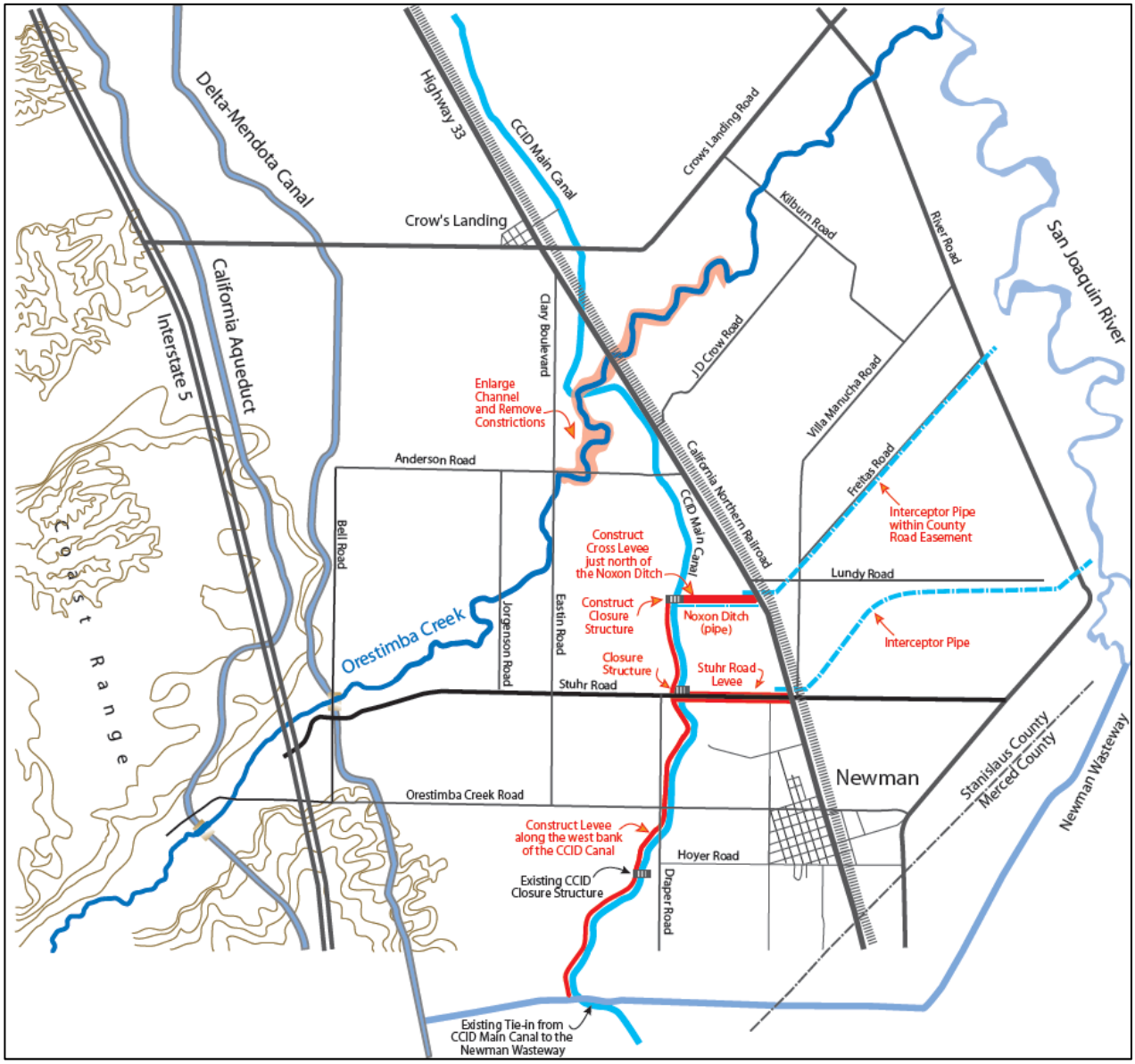

Figure 3-7: Alternative 7 – Chevron Levee and Channel Modifications

Channel Modifications

Construction of a chevron levee reduces damages in the City of Newman and agricultural areas east of town but would not reduce the flood risk to surrounding agricultural land to the north and west of town. In order to reduce the level of flood risk to the agricultural area, modifications to enlarge the Orestimba Creek channel were examined.

The alternative would increase the Orestimba Creek channel capacity between Eastin Road and Morris Road to a capacity similar to the downstream reach. The project would

involve excavating a larger channel cross section and constructing berms along several reaches. The goal of this alternative would be to accommodate flows up to 3,500 cfs within the Orestimba Creek channel; flows higher than this design level would overtop the creek channel and flow overland. The chevron levee would provide the City of Newman with additional flood risk reduction from these overland flows. The approximate reach of the channel modifications is about 5 miles. This increment is shown in Figure 3-8.

The channel modifications target the middle reach of the creek in which the capacity is most constricted (Figure 3-8). Both upstream and downstream the natural channel has the capacity to accommodate larger flows. In order to ensure that the channel modifications do not increase the flood potential for properties along the creek downstream of the channel work, this measure would also include the removal of non-native invasive plant species such as giant reed (*Arundo donax*) which can impede flow in the creek and reduce channel capacity.

Channel stability downstream of the modifications was analyzed to determine how the channel would react to changes in channel dimensions. Large scale channel modification could potentially create instability in the creek. Therefore, the channel modifications were designed to create a sustainable creek channel to optimize the amount of flood water that could be conveyed, while at the same time working within the existing infrastructure constraints such as bridges and siphons.

Historically, the natural channel on the alluvial fan would not be large enough to handle significant flows. The natural flooding pattern would be for the creek to carry the flow most years, and in large flood events high flow would overtop the banks and distribute out across the floodplain. This increment is designed to increase the volume of flow that can be conveyed in the channel, thereby reducing the frequency of flooding in the agricultural area.

Alternative Evaluation

Due to the fact that the chevron levee provided flood risk reduction mainly to the urban area of Newman, there was very little local support for this alternative. The hydraulic and economic modeling of the channel modifications showed that as a stand alone option, it could not provide a high level of flood risk management to Newman. However, when the channel modifications were combined with the chevron levee alternatives, the channel modifications could reduce agricultural damages that the chevron levee alternative could not. By combining these two options into a hybrid alternative, more overall benefits could be achieved. The PDT analyzed several different hybrid options in order to optimize the increments.

As the study progressed in to more detailed design, it became apparent that the channel modifications, in the current design configuration, would not be incrementally justified. The updated cost estimates showed that the channel modifications would be significantly more costly than anticipated at the preliminary design level. The channel modifications provide benefits primarily to the agricultural area. The benefits of reducing flood risk in the agricultural area were about one-half of the costs required to construct the channel modifications. This

means that the channel modifications portion is not incrementally justified and has costs greater than the benefits it provides. Therefore, this alternative was not carried forward to the final array of alternatives.

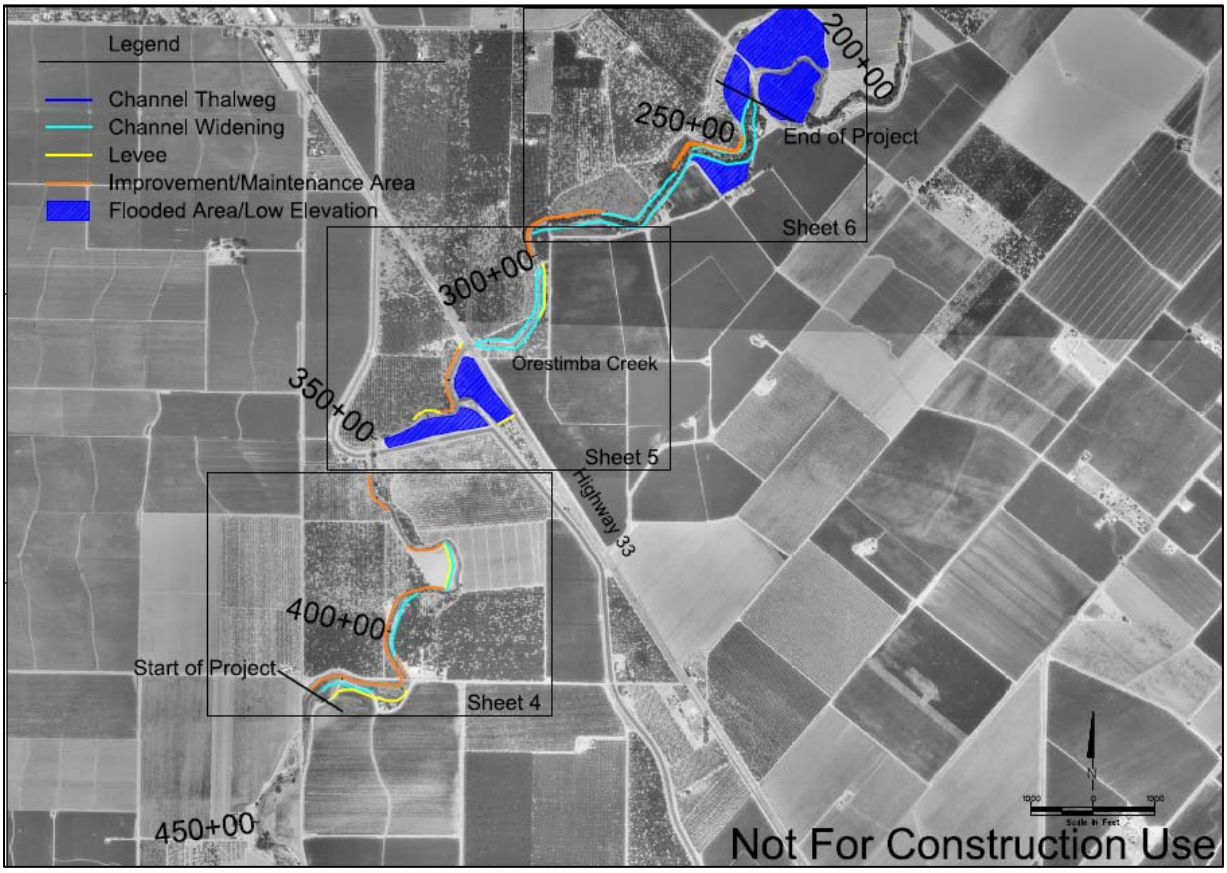

Figure 3-8: Channel Modification Locations

3.2.8 Alternative 8 – Non-Structural Features to Reduce Flood Consequences

The shallow flooding from Orestimba Creek can be effectively managed in part through non-structural measures. Several non-structural flood risk management elements could be added to any of the final array of flood risk management alternative plans to further reduce flood risk and flood damages. Whereas structural project features, such as levees and channel improvements, can reduce the risk of flooding, non-structural features can reduce the consequences of flooding. The combination of both structural and non-structural elements should ideally be used to reduce the flood risk to an area. Figure 3-10 shows this stepped incremental approach to reducing flood risk.

Stanislaus County currently has a floodplain ordinance which restricts development in flood hazard areas as defined by the Federal Emergency Management Agency (FEMA). The floodplain ordinance also specifies building codes for structures in the flood hazard area. Additional non-structural features that could be added to further reduce the consequences of flooding include an advanced warning system based on stream gages at the several points where the creek historically has overflowed its banks. A reverse 911 system could alert surrounding residents of the flood threat, especially if the flood peak occurs during the night, as happened in 1995. Public educational materials could be distributed annually as part of the Orestimba Creek Flood Control District's assessment mailing. The materials should include a floodplain map and description of the nature and type of flooding. The material should also describe the risks of traversing flooded roadways. Informational signs could be placed along roads which alert drivers to the possibility of flooding in the area.

Alternative Evaluation

These features are cost effective and can be implemented as part of any recommended plan.

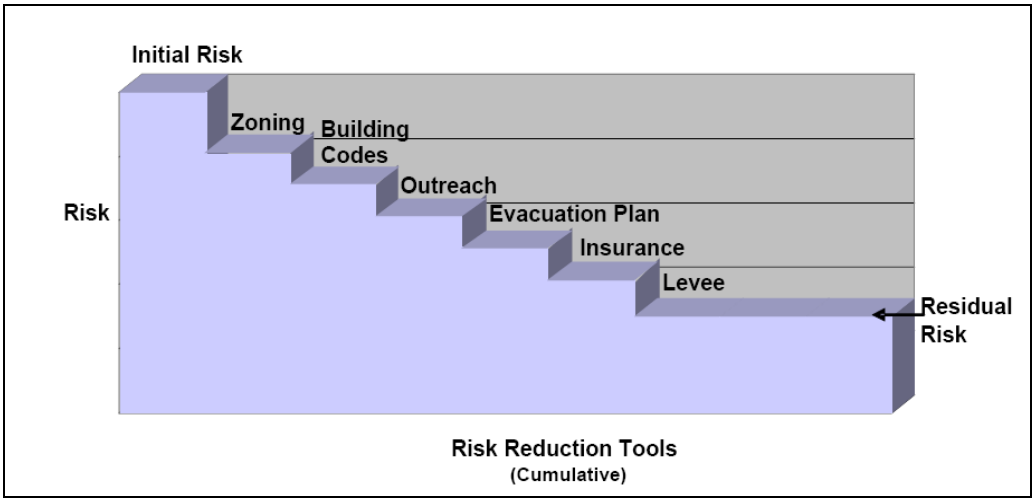

Figure 3-10: Incremental Approach to Flood Risk Reduction

3.3 SCREENING OF THE PRELIMINARY ARRAY OF ALTERNATIVE PLANS

Planning criteria are used to formulate, screen, evaluate, and compare measures and alternative plans. Four specific screening criteria are required in USACE water resource studies: completeness, effectiveness, efficiency, and acceptability. These criteria are generally subjective and are useful in narrowing down the array of possible alternative plans. Other criteria may be identified as well.

Measures and plans that passed the screening criteria were evaluated and compared against more specific evaluation criteria. Evaluation criteria can include costs, outputs, or effects and reflect the planning objectives or constraints. Some or all of the evaluation criteria may be used at various stages in the plan formulation process to compare alternative plans. Effective evaluation criteria must be measurable and reveal differences or trade-offs between alternative plans.

The preliminary alternative plans were screened against the four planning criteria. Standards have been established to determine if the alternative plans meet each planning criteria. The No-Action Alternative plan was not included in this screening process because it must be carried forward in the process in order to serve as the baseline against which all retained alternative plans are compared.

Standards established for each criterion are:

Completeness. To be complete, an alternative must not rely on other activities to function. An alternative plan is either complete or it is not complete. Each alternative plan is considered to be complete.

Effectiveness. An alternative must contribute to at least one of the flood risk management objectives to be considered effective enough to be retained for further consideration. Each alternative plan's ability to meet those objectives is identified in Table 3-4. Each of the alternative plans would meet at least one of the flood risk management planning objectives.

Efficiency. To be considered efficient, an alternative plan must be cost effective. For this screening, all cost effective plans are retained. Cost effective means that for a given level of benefits, no other plan costs less and no other plan yields more benefits for less money.

Acceptability. Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public, as well as compatibility with existing laws, regulations, and public policies. An alternative plan must be considered within these parameters to be a satisfactory way of addressing problems identified. For the purposes of this screening, the question asked is, "In general, do the State, local entities, and public find channel enlargement/removal of constrictions, construction of a flood attenuation basin, flood bypass, setback levees, and/or habitat restoration to be an acceptable method of accomplishing flood risk management, consistent with existing laws, regulations and public policies?" An alternative plan is either considered acceptable or not acceptable.

Table 3-4: Effectiveness of Preliminary Alternatives in Attaining Flood Risk Management Planning Objectives

Preliminary Alternatives	Flood Risk Management Planning Objectives	
	Reduce Probability of Flooding	Reduce the Consequences of Flooding
1–Enlarge Channel/Remove Constrictions	Yes	Yes
2-Setback Levees along Creek	Yes	Yes
3-Chevron Levee to protect Newman	Yes	Yes
4-Bypass Channel	Yes	Yes
5-Upstream Flood Attenuation Basin	Yes	Yes
6-Downstream Flood Attenuation Basin	Yes	Yes
7- Chevron Levee & Channel Modifications	Yes	Yes
8 – Non-Structural	Yes	Yes

The results of the screening of preliminary flood risk management alternatives are shown in Table 3-5. Because the study team did not have actual benefit calculations for the entire preliminary array of alternatives, a more qualitative assessment and screening was done to reduce the number of alternatives carried forward to the final array. This analysis consisted of a relative comparison of the potential acreage of land required for each alternative, the amount of infrastructure or construction required, initial ranges of construction costs, resource agency concerns, and potential environmental mitigation requirements. The retained preliminary alternative plans were evaluated and compared to identify the National Economic Development (NED) plan.

The first round of the preliminary alternatives screenings focused on qualitative assessments of the benefits and effects of the proposed plans. This qualitative work was accomplished prior to the development of hydraulic and economic modeling efforts that would provide quantitative benefits, and also prior to the development of alternative specific costs. Landowners, agencies, and municipalities affected by the potential flood risk management project coordinated in this screening process. The process also applied Federal Water Resource Policy guidance as identified in ER 1105-2-100. Specifically, the PDT applied EO 11988, which seeks to preserve the beneficial uses of floodplains. The results of this screening process are captured in Table 3-6.

Table 3-5: Screening of Preliminary Flood Risk Management Alternative Plans

Preliminary Alternatives	Completeness	Effectiveness	Efficiency	Acceptability	Carried Forward?
1–Enlarge Channel/Remove Constrictions	Yes	Yes	Costly for land acquisition and structure removal	Little support for removal of structures and native vegetation	No
2-Setback Levees along Creek	Yes	Yes	Very costly for land acquisition	Agencies accepted but not locally preferred	No
3-Chevron Levee to protect Newman	Yes	Yes	Very cost effective	Agencies supportive but little local support	Yes
4-Bypass Channel	Yes	Yes	Expensive for land acquisition	Agencies supportive but little local support	No
5-Upstream Flood Attenuation Basin	Yes	Yes	Very expensive with potentially immitigable environmental effects	Local support but agencies opposed to this based on environmental and safety concerns	No
6-Downstream Flood Attenuation Basin	Yes	Yes	Very expensive – land value of mining sites very high	Some local support but agencies less opposed to this as to upstream dam	No
7 – Chevron Levee & Channel Modifications	Yes	Yes	Channel Mods not incrementally justified	Local support	Yes
8- Non-structural	Yes	Yes	Yes	Yes	Yes

Table 3-6: Summary of First Screening of Preliminary Alternative Plans

Preliminary Alternatives	Screening Summary	Carried Forward?
1–Enlarge Channel/Remove Constrictions	Technically difficult to ensure performance of this alternative due to potential channel instability. To handle large flows (median 1/100 ACE event), the channel would have to be excavated to a size about six times its current geometry. Permitting this excavation work would be difficult due to the existing remnant vegetation along the creek, which would need to be removed. Concerns with ramifications to land use changes (EO 11988).	No
2-Setback Levees along Creek	High construction cost for about 12 miles of new levees. Hydraulic mitigation would be required for conveying more water downstream. High real estate costs including land and removal of residences. At least 6 bridges would have to be replaced. Concerns with ramifications to land use changes (EO 11988).	No
3-Chevron Levee to protect Newman	Reduces flood risk in the City of Newman. Benefits exceed the costs.	Yes
4-Bypass Channel	To convey a median 1/100 ACE event, approximately eight additional bypass channels similar in size to the existing creek channel would be required. High real estate costs. New bridges would be required to cross bypass areas. Concerns with ramifications to land use changes (EO 11988).	No
5-Upstream Flood Attenuation Basin	Dam would be 1 mile long and 60 feet tall. Very high construction costs (greater than $75 million). State of California opposed to this alternative due to location immediately upstream of the California Aqueduct – a dam failure could jeopardize Southern California's water supply which is transported by the aqueduct. Concerns with ramifications to land use changes (EO 11988).	No
6-Downstream Flood Attenuation Basin	Very high construction costs (greater than $75 million) in addition to high real estate costs (site of existing gravel mining operation). Concerns with ramifications to land use changes (EO 11988).	No
7 – Chevron Levee & Channel Modifications	Combining the channel modifications with the chevron levee provides a high level of protection for the City of Newman and also reduces damages in the agricultural area. By combining these two options into a hybrid alternative, more overall benefits could be achieved.	Yes

Preliminary Alternatives	Screening Summary	Carried Forward?
8- Non-structural	The shallow flooding from Orestimba Creek can be effectively managed in part through non-structural measures. These features are cost effective and can be implemented as part of any recommended plan.	Yes

Second Screening of Study Alternatives

The chevron levee, a hybrid alternative that combined the chevron levee with other features, and the non-structural alternatives were carried forward for further consideration.

The chevron levee provided protection mainly to the urban area of Newman, thus, there was little local support for this alternative among the rural agricultural landowners. The hydraulic and economic modeling of the channel modifications showed that as a standalone option, it could not provide a high level of flood protection to Newman. However, when the channel modifications were combined with the chevron levee alternatives, the channel modifications could prevent agricultural damages that the chevron levees alternatives could not. By combining these two options into a hybrid alternative, more overall benefits could be achieved.

Various chevron levee alignments and heights were analyzed in the process of identifying the NED plan. Since the topography of the floodplain slopes from the west to the east, only a partial ring levee on the upslope side would be required, rather than a complete ring levee around the town. Flooding threatens the community of Newman only from the west and the north.

Along the west side of town, the CCID Main Canal berm captures flood flows. The berm, in effect, has already established where much of the flooding occurs in the study area. The levee alignment parallel to the CCID Main Canal retains the pattern of flooding that has been established in the rural area. The alignment along the CCID Main Canal is the only alignment which does not induce flooding in the without project condition.

The levee must extend some distance both north and south of Newman to direct flows away from the urban area and prevent flows from wrapping around behind the levee. On the southern side of town, the levee must either extend south to tie in to the Newman Wasteway berm, or the levee would need to be extended along the southern edge of town to prevent wrap-around flooding from the south. Having the levee tie in to the Newman Wasteway berm is preferred because this alignment is shorter, does not induce flooding, and causes effects to fewer existing structures.

On the north side of town, alignments along Stuhr Road and Lundy Road were analyzed. Stuhr Road marks the northern limits of the City of Newman and is a heavily traveled county road which is the most direct transportation route to Interstate 5. Stuhr Road also has

numerous utilities, an irrigation ditch and a number of residences located immediately to the north side of the road. If the levee were constructed along the north side of Stuhr Road, the levee would need to extend east for about 3 miles to reduce the chance of wrap around flooding from the north. The levee alignment would directly affect about a dozen structures located on the north side of Stuhr Road. Lundy Road is located about 1 mile north of town and has very light local traffic. Lundy Road is located near a slight topographic ridge which serves to direct floodflows into a swale which currently conveys flows in the without project condition via an existing culvert. Much like the portion of levee along the CCID Main Canal berm, the Lundy Road alignment is the alternative which most mimics the without project floodplain and therefore has the least effects in terms of induced damages and potential takings of existing structures.

Alignments in which the chevron levee continued further to the north toward Orestimba Creek were also considered but were dropped because the levee would constrict the flood flows and cause deeper flooding than in the without project condition. This northern alignment also directed floodflows to the opposite side of the creek, causing significant induced flooding.

The Lundy Road alignment was identified as the optimal location for the northern segment of the levee. It is located at a topographic high point, near an existing culvert, has the lowest potential for increases of flood depth, and has the least effects to existing infrastructure and private properties when compared to other alignments. The Lundy Road levee would also be shorter in length than either the Stuhr Road alignment or an alignment closer to the creek.

Although the channel modification (and associated hybrid plans) appeared to be incrementally justified during the preliminary screening of alternatives, more detailed cost estimates showed the increment to be significantly more costly. Because the channel modifications are an additional increment to the project after the chevron levee, the benefits for this increment come from the rural damage areas and the ability of the modified creek to better contain some of the more frequent event flows, which cause more significant flooding under existing conditions. The Hydraulics Appendix (Appendix C-2) includes floodplain maps and more detailed information about this residual flooding.

Updated floodplains and economics showed the incremental annual benefits (Table 3-7) for the channel modifications to be around $500,000. Updated (but not completed) costs for the channel modifications were estimated to be around $1.3 million in annual costs ($28 million first costs) on the lower end. These costs are on the low end because they did not yet include environmental mitigation; operations, maintenance, repair, replacement, and rehabilitation (OMRR&R); or real estate costs, which could add another $1 million in annual costs to the increment. Before these additional costs are added to the channel modifications, it has an incremental benefit-to-cost ratio of 0.39 to 1, and thus the hybrid plan was dropped from the consideration as being economically infeasible. Development of more detailed costs for this increment was not done. With the hybrid plan dropping out as economically unjustified, the only remaining plans to move forward were the Chevron Levee Alternative and the Non-structural Alternative. The measures which comprise the Non-structural Alternative have been

folded in to the Chevron Levee Alternative and are carried forward in both the NED and locally preferred plan (LPP) versions of the Chevron Levee Alternative.

Table 3-7: Incremental Annual Benefits of Remaining Alternatives

Alternative	Annual Damages	Annual Benefits	Incremental Benefits
Without Project	5,413	0	0
1. Chevron Levee	2,285	3,128	3,128
2. Chevron Levee + Channel Mods	1,800	3,613	484
3. Local Plan (Levee + Mods)	1,800	3,613	0

3.4 ANALYSIS OF FINAL ARRAY OF FLOOD RISK MANAGEMENT ALTERNATIVE PLANS

As the study progressed into more detailed design, it became apparent that the channel modifications, in the current design configuration, would not be incrementally justified. In order to reduce the risk of flooding to the City of Newman as soon as possible, the study is progressing forward with the chevron levee increment only. The channel modification increment could be the focus of a later study focusing on improving the environmental quality of the creek or could be an initiative proposed by another agency or local group.

Table 3-8 below shows the economic optimization of the chevron levee height along the CCID Main Canal near Lundy Road. The levee elevation heights correspond to the median ACE flood event water surface elevations in the left column. This table shows that there is very little variation in the water surface elevations for the various events. This is due to the fact that flood waters on an alluvial fan spread out over a large area. The levee height optimized at an elevation of 112.8 feet NAVD88, as highlighted in the table below. This is identified as the NED levee.

Table 3-8: Optimization of the Chevron Levee Height (at unnamed farm road and the CCID Canal)

Median Annual Exceedance Probability	**Levee Elevation (feet-NAVD88)**	**Annual Benefits (1,000's)**	**Annual Costs ($1,000's)**	**Net Benefits ($1,000's)**
1/50	111.12	2,172	1568	604
	111.25	2,281	1629	652
	111.5	2,505	1690	815
	111.75	2,705	1751	954
1/500	112	2,878	1812	1,066
	112.25	3,003	1862	1,141
	112.5	3,083	1907	1,176
NED	112.75[1]	3,128	1942	1,186
	113	3,128	2003	1,125
	113.25	3,128	2064	1,064
	113.5	3,128	2125	1,003
	113.75	3,128	2186	942
	114	3,128	2247	881
	114.25	3,128	2308	820
1/200 +3ft	114.8	3,128	2372	756

Notes:
[1] The height of the optimized NED levee height has been rounded to 112.8 FT-NAVD88
[2] Costs and benefits have been interpolated between known points.

The chevron levee height was optimized by inserting incrementally higher levees into the Economic model (HEC-FDA) and comparing the increased benefits to the estimated incremental costs. Costs were estimated by Cost Engineering for a levee equal to the 50-year mean water surface elevation (WSEL) and the 200-year mean WSEL with 3 feet of freeboard. These two values were then used to create a linear interpolation between the two points in order to estimate the cost of incrementally higher levees. This analysis is solely used for optimization of the levee height in order for costs and residual benefits to be determined in more detail on only one plan. As shown in Table 3-8 above, the optimal elevation for the top of levee at this location near Stuhr Road is determined to be around 112.75 feet NAVD88, which equates to a levee 5.5 to 8 feet tall depending on the ground elevation changes along the levee alignment. It is noted here that this height is higher than the mean 1/500-year WSEL, but because of the alluvial fan type of flooding, the mean 1/500-year WSEL is only 9 inches higher than the 1/50-year mean WSEL.

3.4.1 The No Action Plan (Final Alternative 1)

The No Action Plan would essentially be the same as the without project condition described in Section 2.3. The City of Newman and the surrounding agricultural area would remain at risk of flooding.

3.4.2 The Tentative NED Plan (Final Alternative 2 – Levee Elevation at 112.8 feet NAVD88)

The NED plan consists of the construction of a chevron levee along the city of Newman's northwestern perimeter (Figure 3-11). The chevron levee maximizes benefits to the urban area by reducing flood damages associated with Orestimba Creek overflows. The north side of the chevron levee would be constructed along approximately 1 mile of an unnamed farm road about 1 mile north of town. The elevation of the northern segment of levee would increase from where it ties in to the railroad berm to the point at which it meets the CCID Main Canal berm. The western segment would be constructed parallel to the eastern bank of the CCID Main Canal from the farm road south to the Newman Wasteway, a distance of about approximately 4 miles. The design includes four road/railroad stoplog closure structures. The height of the chevron levee would equate to about elevation 112.8 feet NAVD88, which means the levee would be about 5 to 8 feet high, depending on the ground elevation changes along the levee alignment. This levee elevation captured the most benefits for the least amount of costs and was therefore identified as the elevation that would be included in the NED plan.

Various chevron levee alignments and heights were analyzed in the process of identifying the NED plan. Alignments in which the Chevron Levee construction continued further to the north were also considered, but were dropped because of the deeper floodplains which resulted. This northern alignment also directed floodflows to the opposite side of the creek, causing significant induced flooding. A levee alignment along Stuhr Road was also evaluated. The benefit of locating the levee at the farm road location rather than the Stuhr Road location is the reduction in overall cost that would come from less material being required, fewer utilities to contend with, and less traffic to re-route during construction. Less fill material would be required to construct the levee because the top width of this levee only needs to be 16 feet wide, whereas the Stuhr Road levee would need to be 35 feet wide to replace the existing width of the county road. The farm road segment of the levee was refined to a diagonal alignment in order to tie in to the CNRR embankment near an existing culvert to reduce the frequency and duration of floodwater ponding on the north side of the levee.

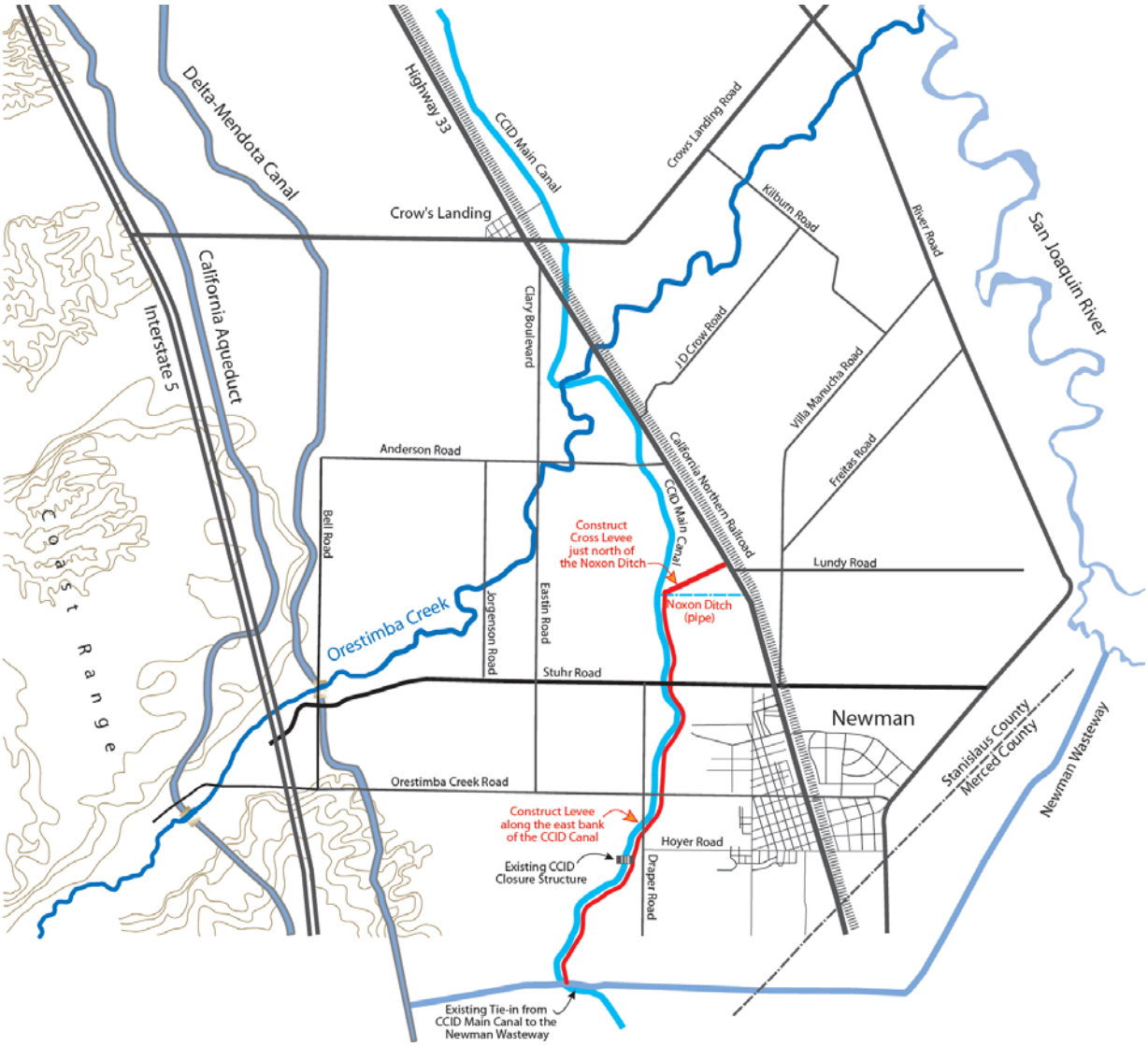

Figure 3-11: The Tentative NED Plan

Based on the results of hydraulic modeling, the area north and east of the levee tie-in with the railroad might experience increased depths in some locations with implementation of the project. The depth of the potential increases during peak flows, which are projected to recede within 24 hours, would vary under each flood event scenario based on the existing topography. The range of depths under each frequency scenario is generally similar under both existing and with project conditions. The main difference would likely be during the 1/10 ACE, in which depths in some places could increase by up to six inches.

Agriculture (row crops) is the primary land use within the area that could experience increased flood depths. Four residences are also located within this area. The potential increased depth

that could occur during the 1/10 ACE at each residence ranges from 3 to 6 inches. A windshield survey determined that each residence is on a raised foundation with several steps required to reach the first floor elevation. In addition, the structures are located on raised building sites, putting the first floor elevation well above the modeled potential depths. The potential for increased depths in areas already flooded under existing conditions was analyzed by USACE real estate specialists and determined not to constitute a taking.

Increased depths of flooding for the 10% (1/10) to 5% (1/20) annual chance exceedance event range from 0 to 0.5 foot on top of an existing flooding between 0.1 to 1.3 feet. For flooding events less frequent than the 5% (1/20) annual chance exceedance event, induced flooding is less than 0.1 foot on average. The current aerial extent affects four residential structures, but it's important to note that alluvial fan flooding extent is uncertain and small changes to topography could impact these flooding boundaries. In general, structures within the vicinity of potential induced flooding are rural homes with an elevated first floor height of at least 1.5 feet. Non-structural mitigation measures were considered for these homes, such as flood proofing or raising at a cost of $15,000 to $50,000 per home ($697 to $2,325 annual cost). Because flooding is shallow and the homes already have a foundation height of 1.5 feet, induced damages are expected to be negligible. Taking into account the ranges listed above, even the worst case of induced flooding ($400,000 structure/contents with no elevated foundation height, zero existing flooding and 0.5 foot of induced flooding for the 10% (1/10) - 5% (1/20) annual chance events, induced annual damages would be around $600/home. Taking this extreme case, and comparing to the cost range, results in a benefit-cost ratio between 0.26 and 0.86. For the most likely scenario ($300,000 structure/contents, with 1.5-foot foundation height, 0.5 foot of existing flooding and about 0.2 foot of induced flooding), the induced annual damage is $170 with a benefit-cost ratio range from 0.07 to 0.24.

Implementation of the project would involve require the levee cross the CNRR embankment to prevent floodwaters from being conveyed south towards Newman. As a result, flood flows may overtop the railroad during more frequent events than under existing conditions. Based on recommendations in the Final Geotechnical Evaluation (Appendix C.5), the tie-in has been designed to mitigate through-seepage and provide erosion protection for the railroad embankment.

In addition to the structural features, the NED plan also includes several non-structural features to further reduce the consequences of flooding. These include an advanced warning system based on stream gages at the several points where the creek historically has overflowed its banks. This flood warning system would be combined with an emergency evacuation plan. A reverse 911 system would alert surrounding residents of the flood threat, especially if the flood peak occurs during the night, as happened in 1995. Public educational materials would be distributed annually as part of the Orestimba Creek Flood Control District's assessment mailing. The materials would describe the residual risk of flooding through the inclusion of a floodplain map and description of the nature and type of flooding. The material would also describe the

risks of traversing flooded roadways. Informational signs would be placed along roads which alert drivers to the possibility of flooding in the area.

3.4.3 The Locally Preferred Plan (Final Alternative 3 - Levee Elevation at 114.8 FT NAVD88)

The LPP includes the same elements as the NED plan (including overall length and number of closure structures), but raises the height of the chevron levee to include 3 feet of freeboard above the median 1/200 ACE water surface elevation. This freeboard was requested by the local sponsor in order to meet State of California requirements for an urban area, which is identified as the 1/200 year median Water Surface Elevation (WSEL) plus 3 feet of freeboard. The LPP levee would be 6 to 7 feet tall or about 2 feet taller than the NED levee.

Pursuant to 44 CFR, Part 65.10, FEMA requires a levee to be either: a) 3 feet above the median 1% WSEL with a 90% assurance for the 1% event or b) 2 feet above the median 1% WSEL with 95 % assurance for the 1% event. The NED levee is about 1.5 feet shorter than these criteria; however, the LPP achieves it. The State of California requires urban and urbanizing areas (with a population of 10,000 or greater) to achieve 1/200 ACE level of protection in order to qualify for State funding of flood management projects. The State's interim levee design guidelines require 3 feet of freeboard above the median 1/200 ACE water surface elevation or higher if required for wind setup and wave run up (Senate Bill [SB] 5, Government Code, Sections 65865.5, 65962, 66474.5). It was determined that additional freeboard to account for wind waves would not be required to meet the criteria. The State's interim urban levee design guidelines also allow for a reduction of freeboard to 2 feet above the median 1/200 ACE water surface elevation if 95% assurance can be provided. The LPP levee height may be reduced during PED if it is determined through more rigorous uncertainty analysis that it will meet FEMA's and the State of California's 95% assurance criteria. The State's "Urban Levee Design Criteria", contained in the "Draft Urban Level of Flood Protection Criteria" (2012), also specifies that civil engineers would be allowed and encouraged to adjust the Design WSEL upward to account for climate change. Additional freeboard was not specified for climate change in the LPP. The median 1/200 ACE water surface profile was found to be relatively insensitive to increased flood discharge.

The difference between the median 1/100 ACE and median 1/200 ACE water surface elevation was found to be less than 0.4 feet along the proposed levee. As discussed for the Tentative NED, construction of the chevron levee would alter the nature of the existing floodplain by increasing the depth of flooding to the north the area north and east of the proposed levee tie-in with the railroad. The potential for increased depths in areas already flooded under existing conditions was analyzed by USACE real estate specialists and determined not to constitute a taking. The tie-in has been designed to mitigate through-seepage and provide erosion protection for the CNRR bed.

In addition to the structural features, the tentatively recommended plan also includes several non-structural features to further reduce the consequences of flooding. These include an advanced warning system based on stream gages at the several points where the creek historically has overflowed its banks. This flood warning system would be combined with an emergency evacuation plan. A reverse 911 system would alert surrounding residents of the flood threat, especially if the flood peak occurs during the night, as happened in 1995. Public educational materials would be distributed annually as part of the Orestimba Creek Flood Control District's assessment mailing. The materials would describe the residual risk of flooding through the inclusion of a floodplain map and description of the nature and type of flooding. The material would also describe the risks of traversing flooded roadways. Informational signs would be placed along roads which alert drivers to the possibility of flooding in the area.

Table 3-9 below shows the economic benefits, costs, and net benefits of the final alternatives. There is basically no quantifiable difference between the benefits attributed to Final Alternative 2 and Final Alternative 3; however final Alternative 3 would allow the sponsor to meet State of California requirements as well as FEMA accreditation requirements. Investment costs, annual costs, and annual benefits for the NED and LPP plans are displayed in Table 3-10 below.

Table 3-9: Orestimba Creek Economic Summary

Alternative	Annual Benefits	Annual Costs	Net Benefits	B/C Ratio
Final Alternative 1 – No Action	0	0	0	0
Final Alternative 2 – Chevron Levee at elevation 112.8	3,128	1,942	1,187	1.61
Final Alternative 3 – Chevron Levee at elevation 114.8	3,128	2,372	756	1.34

Table 3-10: Comparison of Total Annual Benefits and Costs for the NED and LPP[1,2]

Item	NED Plan	LPP Plan
Investment Costs:		
Flood Risk Management First Costs	35,200,000	44,000,000
Less Cultural Resource Preservation[3]	-300,000	-350,000
Interest During Construction	2,100,000	2,700,000
Total	**37,000,000**	**46,350,000**
Annual Cost		
Interest and Amortization	1,726,000	2,159,000
OMRR&R	164,000	180,000
Total	**1,890,000**	**2,339,000**
Annual Benefits	3,128,000	3,128,000
Net Annual Flood Risk Management Benefits	1,238,000	789,000
Benefit to Cost Ratio	1.66	1.34

Notes:
[1] Based on October 2011 price levels, 4 percent rate of interest, and a 50-year period of analysis.
[2] some numbers have been rounded and may be slightly different than those displayed in the appendices.
[3] Cultural Resource costs are a contingency cost based on .4% of project first costs and are not cost shared.

Table 3-11 (Project Performance) shows that both the NED and LPP provide over 99% Assurance (described in the table as conditional non-exceedence probability) of passing the 1% ACE event. The FEMA requirement for accreditation within the NFIP is 95%. Both the NED and the LPP show very little probability of flooding in any given year with an Annual Exceedence Probability of less than 0.04% (1/2,500). Additional information on project performance is located in the Economic Appendix (Appendix E).

Table 3-11: Project Performance – Urban Economic Impact Area

Alternative	Annual Exceedence Probability		Long-Term Risk			Assurance (Conditional Non-Exceedence Probability)			
	Median	Expected	10 year Period	30 year Period	50 year Period	10%	2%	1%	0.20%
No Action	14.43%	15.13%	81%	98%	99%	13%	0%	0%	0%
NED Plan (Chevron Levee at 112.8 feet)	0.01%	0.04%	0%	1%	2%	99%	99%	99%	98%
LPP Plan (Chevron Levee at 114.8 feet)	0.00%	0.00%	0%	0%	0%	99%	99%	99%	99%

Executive Order (EO) 11988

The objective of the study is to reduce flood risk within the study area. EO 11988 has an objective of "avoidance, to the extent possible, of long- and short-term adverse impacts associated with the occupancy and modification of the base flood plain and the avoidance of direct and indirect support of development in the base flood plain wherever there is a practicable alternative". The study is responsive to the EO 11988 objective because the proposed features focus on reducing the threat of flooding to the existing urban area, altering a very small area within the floodplain. These features would reduce the hazard and risk associated with floods thereby minimizing the effects of floods on life safety, health, and welfare, and would preserve the natural and beneficial values of the base floodplain. For these reasons the proposed plan is in compliance with EO 11988.

The proposed project has been optimized to reduce the risk of flooding to the community while removing the minimal amount of land from the floodplain which would preserve the natural and beneficial uses of the vast majority of the remainder of the floodplain. However, since floodplain depths in the study area are shallow, any new construction currently could be elevated above the FEMA base floodplain for a reasonable cost. The team calculated the acres of potentially developable land. The primary assumption is that future development within the floodplain would be limited to areas where a structure's first floor elevation could be economically constructed above the FEMA base floodplain (1% ACE flood depths). The PDT assumed that 3 feet is a reasonable economic limit to raise the 1st floor elevation. Of the remaining un-developed parcels in the study area, all areas that have 100-year flood depths less than 3 feet were identified. These areas were assumed to be potentially developable. The summary of potentially developable land is:

- Without Project = 39,834 acres
- With Chevron Levee Alternative = 39,826.

The results indicate that the 1% ACE flood depth is an insignificant factor in the potential development within the floodplain. This is due to the relatively shallow flood depths. The computation indicates a net eight-acre reduction in potentially developable land. This is probably related to slight increases in temporary flood depths on existing agricultural lands outside the chevron levee.

3.5 SYSTEM OF ACCOUNTS ANALYSIS AND COMPARISON

The system of accounts is a set of categories which provide a comprehensive framework to demonstrate both the positive and negative effects of each plan. The intent is to provide decision makers with plan rankings based on advantages and disadvantages of each alternative. In addition, the accounts provide a visual display and assessment of the effects as required by NEPA.

National Economic Development (NED)

The NED account includes the estimates of project benefits and costs used to calculate net economic benefits. A full display of the analysis for the NED account is located in the Economic Appendix. This analysis establishes the economic feasibility of each plan and is used to identify Federal interest. The NED analysis dates back to the Flood Control Act of 1936 in which Congress determined that the Federal Government should participate in flood management and determine the benefits and costs of those activities. The analysis has been documented and refined over the years in various publications, including the Principles and Standards for Planning Water and Related Land Resources (P&S) and the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). It was in the P&G that the following additional accounts were identified.

Environmental Quality (EQ)

The EQ account displays the effects on the ecological, cultural, aesthetic, and other attributes of natural and cultural resources. The environmental effects of the various alternatives are classified as direct and indirect. Direct effects result immediately from constructing and operating the project. Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air, water, and other natural systems, including ecosystems. Additional information on the EQ analysis is captured in Chapters 4 and 5 of this report.

Regional Economic Development (RED)

The RED analysis measures changes in the distribution of regional economic activity that result from alternative plans. Changes in economic activity and employment that occur locally or regionally when a project is implemented are excluded from the NED Account to the extent that they are offset through transfers of this economic activity and employment to other regions of the Nation. The effects on the regional economy, including income effects, income transfers, and employment effects not addressed in the NED account are evaluated in the RED. Two measures of the effects of the plan on regional economies are used in the account:

regional income and regional employment. Additional information on the RED analysis performed for this study can be found in Attachment C of the Economic Appendix.

National Flood Insurance Program: The LPP would provide RED benefits related to a reduction in NFIP Premiums. The NFIP requires flood insurance for those residential properties with Federally-backed mortgages that are deemed as being within FEMA's regulatory 1% Annual Chance Exceedence event floodplain. Those outside the regulatory floodplain are eligible to purchase flood insurance at the preferred rate, which is significantly less than the standard rate charged to those within the regulatory floodplain area. Discussion with a local insurance representative in Newman indicates that the preferred rate for single family housing, outside the regulatory 1% Annual Chance Exceedence floodplain is $250 annually for insurance for both structure and contents; while structures without adequate certification required annual insurance premium of $900 to $950. The savings of approximately $700 annually is recognized as significant to those residents located in Newman.

Current evaluation of the Newman floodplains shows 1,062 residential structures in the 1% (1/100) ACE floodplain. Theoretically, these 1,062 structures could be in the standard rate area if FEMA was re-mapped. Accordingly, an annual savings of $743,000 ($700 x 1,062) could be attributed to the LPP as a direct result of accommodating the FEMA flood requirements. There are currently approximately 700 residents paying the standard rate, but FEMA is currently re-mapping floodplains.

Other Social Effects (OSE)

OSE relates to the quality of life, health, and safety in the community. Destruction or disruption of the built environment, esthetic values, community cohesion, and availability of public facilities and services has also been analyzed. These include displacement effects to people and businesses, the general population (including minorities and special interest groups), and public health and safety. Assessments of beneficial and adverse effects are based on comparisons of the with project alternative to the without project alternative conditions expected to prevail in the future in the absence of the project. The social effects of the alternatives have both direct effects and indirect effects. Direct effects result immediately from constructing the project. Indirect effects result from the effects of the project on existing patterns, including ecosystem patterns, in the study area. Additional information on the OSE analysis performed for this study can be found in Attachment D of the Economic Appendix.

Table 3-12: Summary System of Accounts Comparison of Final Array of Alternative Plans

	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 NED PLAN	ALTERNATIVE 3 LOCALLY PREFERRED PLAN
1. PLAN DESCRIPTION			
	The No Action provides no physical project constructed by the Federal Government or local interests.	The NED plan is the chevron levee with a top of levee elevation constructed to about 112.8' (NAVD88)	The LPP plan is the chevron levee with a top of levee elevation constructed to about 114.8' (NAVD88)
2. IMPACT ASSESSEMENT			
A. National Economic Development (NED)			
1. Project Cost	$0	$37,000,000	46,350,000
2. Annual Cost	$0	$1,890,000	2,339,000
3. Total Annual Benefit	$0	$3,128,000	$3,128,000
4. Annual Net Benefits	$0	$1,238,000	$789,000
5. Benefit - Cost Ratio	N/A	1.66	1.34
B. Environmental Quality (EQ)			
1. Air/Noise	No construction activities present; Normal noise levels created by traffic, business, and industrial activities.	Temporary increase of criteria pollutants and noise levels during estimated 2 year construction period.	Temporary increased noise levels during estimated 2 year construction period.
2. Water Quality	Significant impacts possible due to chemical storage area flooding.	Reduction chemical storage areas exposure to flooding.	Same as NED.
3. Environmental habitat connectivity	Existing vegetation and habitat typical for agricultural area in the San Joaquin River Basin.	Temporary loss of connectivity due to construction activities.	Same as described for NED.
4. Threatened & Endangered Species	No increased impacts sensitive species.	Temporary disturbance caused by construction. Surveys and monitoring for mitigation.	Same as described for NED
5. Cumulative Effects	No increased effects	Initial construction to effect project area.	Same as described for NED.
6. Cultural Resources & Historic Properties	No increased impacts.	Full coordination and monitoring during construction. Mitigated.	Full coordination and monitoring during construction. Mitigated.

C. Regional Economic Development (RED)			
1. Construction Activities	Future flooding would destroy part of infrastructure resulting in a loss in the region's ability to produce goods and services. Little to no RED benefits	Value added: .325 temporary jobs added within the region and 530 jobs added within the State. The gross regional product for the State is about $34 million while the nationwide amount is about $47 million.	Slightly higher Value added: .382 temporary jobs added within the region and 584 jobs added within the State. The gross regional product for the State is about $34 million while the nationwide amount is about $47 million.
2. Future Residential Development	Parts of the City of Newman lie outside of the FEMA regulatory floodplain and therefore have no development restrictions. New development must be built above the 1% flood elevation, which is economical to accomplish.	Future development associated with the construction of new homes would generate substantial economic activity in the study area. Levee construction would decrease the risk of flooding to the established downtown and older residential areas.	Future development associated with the construction of new homes would generate substantial economic activity in the study area. Levee construction would decrease the risk of flooding to the established downtown and older residential areas.
3. General Economic Gains	Emergency response and recovery activities and reconstructions and repairs. The economic stimulus generated would only be temporary and minor compared to overall losses.	The with project regional economic impacts would emerge from more gradual spending over an extended timeframe. Levee construction is expected to take place over a 2-year period.	The with project regional economic impacts would emerge from more gradual spending over an extended timeframe Levee construction is expected to take place over a 2-year period.
D. Other Social Effects (OSE)			
1. Life, Health, and Safety	Continued flood risk in the City of Newman.	Mitigated by Flood Warning Emergency Evacuation Plan.	Mitigated by Flood Warning Emergency Evacuation Plan.
2. Community Cohesion (displacement of people & businesses)	Future flooding would displace selected businesses and subject the community to potential catastrophic flood risk.	Increased level of protection to homes and businesses within the City of Newman but still within the FEMA regulatory floodplain.	200-year level of protection to homes and businesses within the City of Newman. The City is removed from the FEMA regulatory floodplain.
3. Residual Risk	Residual risk remains high throughout the study area	Residual risk reduced in the City of Newman	Residual risk reduced in the City of Newman.

3.6 The Tentatively Recommended Plan

The tentatively recommended plan is the LPP. Selection of this plan over the NED plan is justified due to overriding reasons based on State and local concerns. This plan allows the local community to meet both FEMA accreditation requirements and the State of California's criteria for funding of flood management projects. This plan meets the study objectives of reducing flood risk and flood damages.

In addition to the structural features, the tentatively recommended plan also includes several non-structural features to further reduce the consequences of flooding. These include an advanced warning system based on stream gages at the several points where the creek historically has overflowed its banks. This flood warning system would be combined with an emergency evacuation plan. A reverse 911 system would alert surrounding residents of the flood threat, especially if the flood peak occurs during the night, as happened in 1995. Public educational materials would be distributed annually as part of the Orestimba Creek Flood Control District's assessment mailing. The materials would describe the residual risk of flooding through the inclusion of a floodplain map and description of the nature and type of flooding. The material would also describe the risks of traversing flooded roadways. Informational signs would be placed along roads which alert drivers to the possibility of flooding in the area.

CHAPTER 4.0 - AFFECTED ENVIRONMENT*

4.1 INTRODUCTION

This chapter describes the existing environmental conditions within the range of potential effects occurring as a result of any alternative potentially being implemented, including the no action alternative. The assessment of baseline conditions for each resource provides a framework for comparison of the quantity and quality of potential impacts resulting from each project alternative. Existing conditions are described for each resource within a geographic boundary limited by the range of potential impacts on that resource. The study area of each affected resource can thus be limited to geologically defined boundaries such as the Orestimba Creek watershed, sociologically defined boundaries such as Stanislaus County, or some other boundary relative to the resource or subject being evaluated. Due to the scope of the project and its potential effects on the human and biological environment, each resource has been evaluated in detail. As noted in the previous chapter, the channel modifications portion of the project is no longer incrementally justified as currently designed. Since this increment was still under consideration when environmental effects were assessed, it is identified in the graphics prepared for this section. The discussion of impacts associated with the section was extracted and placed in Appendix B for reference, should work modifications to the channel be proposed in the future.

4.2 EXISTING CONDITIONS

4.2.1 Seismicity

Two active fault zones, Green Valley and Ortigalita, and one fault line, the San Joaquin, are associated with the Diablo Range and occur in Stanislaus County (U.S. Geological Survey [USGS] and California Geologic Survey, 2006). The San Joaquin fault is the eastern most of these faults and parrellels the Diablo Range near I-5 from Tracy to Newman, California (Figure 4-1). The Ortigalita fault zone is associated with an Alquist-Priolo Earthquake Fault Zone (California Geologic Survey, 2010). Since 1979, one earthquake has been recorded in the vicinity of the study area (USGS, 2008a). This 3.5 magnitude event occurred on February 25, 2007, approximately 2 miles west-southwest of Newman. Seismicity in the Orestimba Creek watershed is of low risk compared to other areas in the San Joaquin Valley. Although not currently a significant problem, seismic activity in the range results from the compression stress created by the collision of the Pacific and North American plates. This stress does create a high potential for landslides, particularly in the headwaters within the Diablo Range.

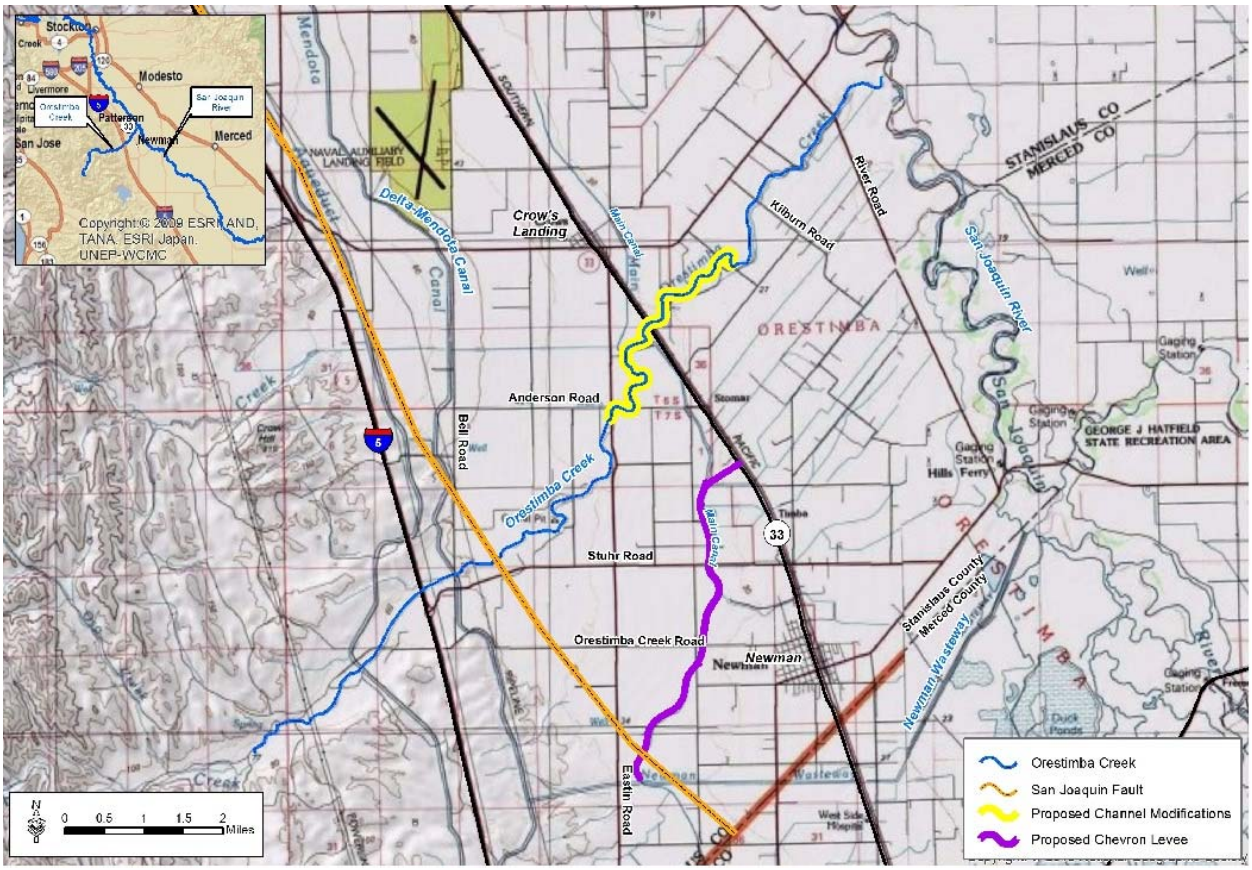

Figure 4-1: Seismic Hazards near the Study Area

4.2.2 Geology

Orestimba Creek drains the Diablo Range and flows west to the San Joaquin Valley. The Diablo Range is part of the Orestimba Block, one of the structural blocks of the California Coast Range (California Division of Mines and Geology, 1966; Wentworth et al., 1999). The California Coast Range consists primarily of deeply incised sedimentary and metamorphic materials of highly varied ages. The basement of the Diablo Range is made up of accreted Franciscan Complex, which is overlain by Coast Range ophiolites and marine clastics from the Mesozoic Great Valley Sequence. Both ranges are north-south trending features, uplifted as a result of tectonic forces. The high rate of uplift has resulted in a land surface that is over-steepened and highly eroded. Cone-shaped colluvial, or “slope wash” deposits lie at the foot of most slopes. The complex tectonic history of the region has created an exceedingly complex geologic setting, with numerous rock types in evidence within the watershed, including shale, serpentine, sandstone, conglomerates, graywacke, chert, and small amounts of limestone.

Orestimba Creek flows in an east-northeasterly direction through the Diablo Range before emerging at the foothills and entering the San Joaquin Valley (California Division of Mines and Geology, 1966). The San Joaquin Valley, approximately 450 miles from north to

south, is a massive elongated north-south trending basin extending all the way from the Sacramento-San Joaquin Delta to southern California. The San Joaquin Valley is dominated by interfingered alluvial fans resulting from erosion and subsequent downstream deposition of materials from the California Coast Range in the west and the Sierra Nevada to the east. The alluvial fans consist of very recent Quaternary materials at the surface, blended in places with older material redeposited from repeated erosion of areas further upstream in the watershed, underlain by sediments of Jurassic age at the foot of the basin.

From the foothills of the Diablo Range, Orestimba Creek flows northeasterly over its historic alluvial fan toward its confluence with the San Joaquin River. The historic alluvial fan surface is composed primarily of upper Holocene Patterson Alluvium and upper Pleistocene to Holocene San Luis Ranch Alluvium. Due to modification of Orestimba Creek's natural hydrology, material carried downstream from the Diablo Range is not typically deposited onto the alluvial surface, but is carried to the San Joaquin River. Some deposition likely occurs adjacent to the middle reach during high flow events, when the capacity of the creek is exceeded.

4.2.3 Soils and Prime Farmlands

Soils in the Orestimba Creek watershed (Figure 4-2) have been deposited as a result of erosion of the many rock types found in the watershed. According to an NRCS soil survey of west Stanislaus County, six general soil map units occur within the 100-year floodplain of Orestimba Creek (NRCS, 2002). General soil map units describe a unique natural landscape and are generally comprised of a soil complex of two or more soil series. A soil series describes soils that have nearly identical profiles and other physical properties.

Soils range from highly sandy to dominantly fine, with fine to extremely coarse gradations. Erosion and expansion potentials are moderate to high for the soil series in the study area. Erosion is not generally a concern in the area due to the relatively level terrain; however, wind can erode exposed and recently disturbed soils. Expansive soils contain a higher content of clay and expand and shrink depending on water content. Subsidence can occur locally as a result of seasonal changes in soil moisture content. Substantial groundwater-related subsidence has occurred throughout the San Joaquin Valley as drainage of lowlands has resulted in the decomposition of organic components in the soils. Avoiding subsidence can be achieved through irrigation management.

In general, soils are highly suitable for agriculture due to their drainage characteristics. Most of the soils in the study area, where irrigated, are considered prime farmland or farmland of statewide importance (NRCS, 2002). Some soils require protection from flooding, or must not be frequently flooded during the growing season, to be considered prime farmland. Flooding is considered frequent if it occurs on average more than once every 2 years (1/2 Annual Chance Exceedence [ACE]). Within Newman's sphere of influence (SOI) (see section 4.2.14 below), there are 1,729 acres of Prime Farmland, 710 acres of Unique Farmland, and 196 acres of Farmland of Local Importance. With implementation of Newman's General Plan, most

or all of these lands would be developed for urban uses in the future. The proposed footprint of the chevron levee is also within Newman's SOI and includes approximately 152 acres of soils classified as prime farmlands.

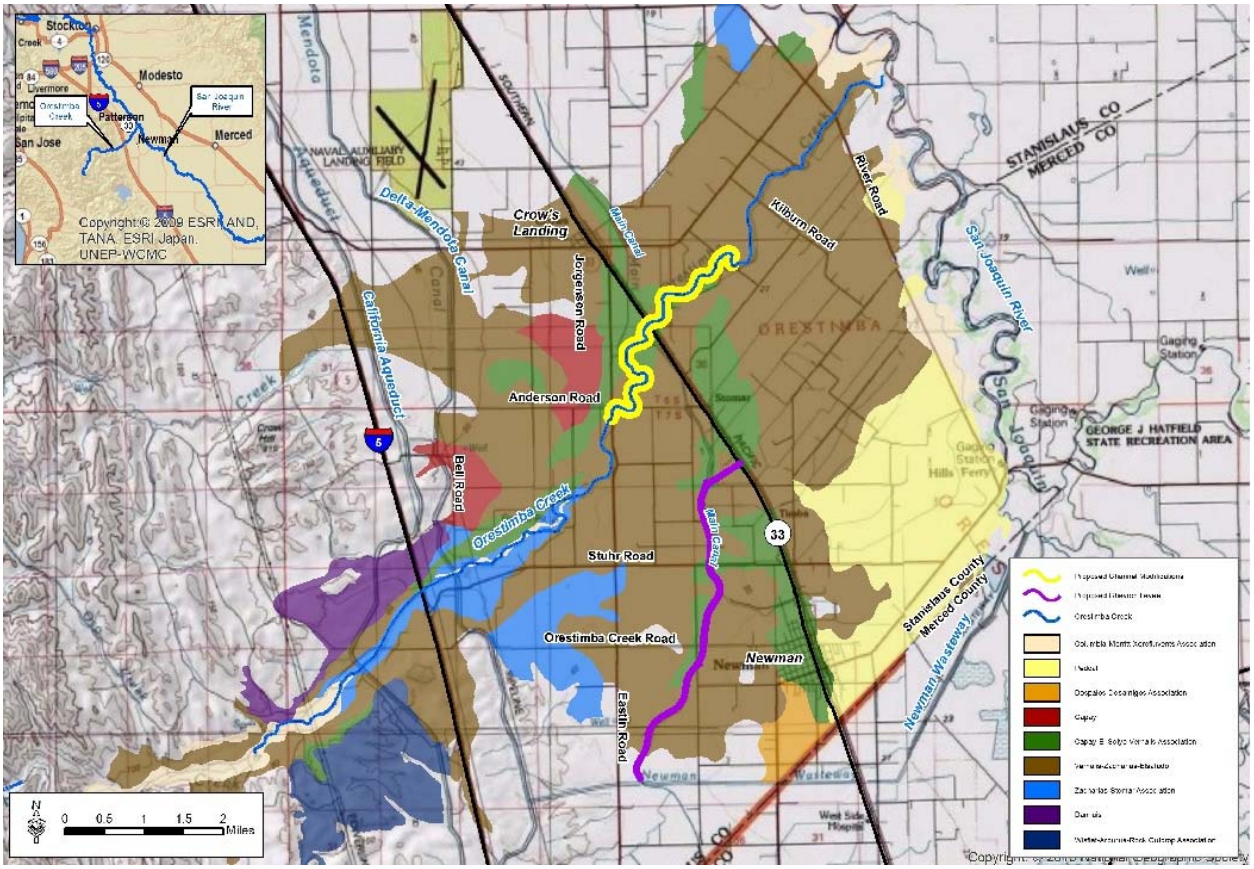

Figure 4-2: Soils within the Alluvial Fan of Orestimba Creek

4.2.4 Hydrology

Flow Gauges

There are two continuous record stream gauges in the Orestimba Creek watershed (USGS 2008a). Both gauges are located on the mainstem of Orestimba Creek: one 20 feet downstream of the California Aqueduct (USGS Gauge Orestimba Creek at Newman) and the other a short distance upstream of the San Joaquin River (USGS Gauge Orestimba Creek at River Road near Crows Landing). The Orestimba Creek at Newman Gauge has been in operation since 1932 and recorded a peak flow record of 12,000 cubic feet per second (cfs) on March 10, 1995 (Figure 4-3). Over the 75 year period of record, peak flows have exceeded 4,000 cfs 17 times, and peak flows have been less than 1,000 cfs 34 times, including 11 years of no flow. Downstream, the Orestimba Creek at River Road Gauge has only been in operation since 1992. Peak flows at this gauge, for the period of record, have been less than 3,000 cfs including the

1995 flood year. Peak flows in this reach have been less than 1,000 cfs for half of the recorded years and were nearly 0 in 1992, 1994, 2007, and 2009 (Figure 4-4).

Overbank flooding does occur as a result of small, intense flash flood events resulting from summer thunderstorms and longer duration storms typical of winter and spring. The majority of rainfall occurs in the upper watershed with less rainfall over the alluvial fan. As cool, moist air masses descend into the valley, increasing air pressure warms the air and increases its ability to hold moisture. Winter and spring storms are often of low to moderate intensity and may cover the entire drainage basin. Summer thunderstorms are often shorter in duration and isolated to a particular portion of the basin. While flash floods are capable of producing significant amounts of runoff over a short time period, it is the more sustained storms that produce peak runoff rates and volumes.

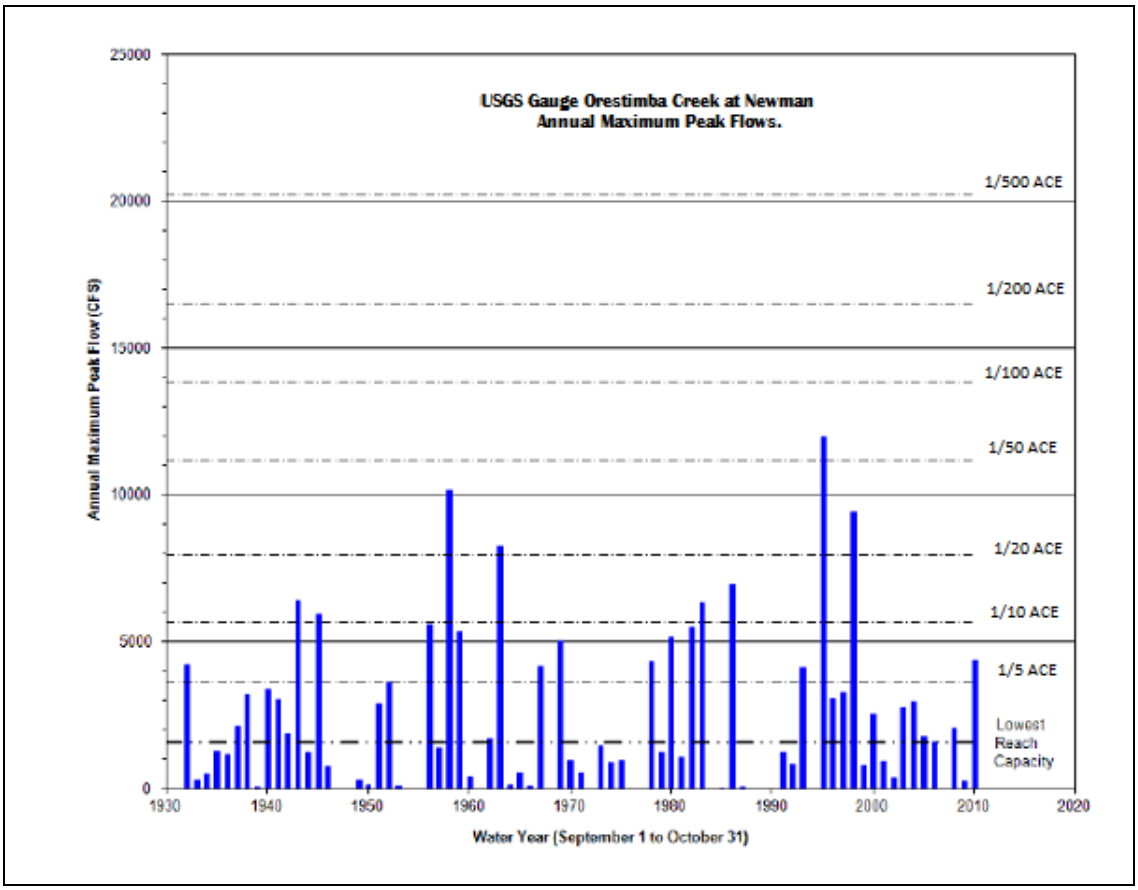

Figure 4-3: Annual Maximum Peak Flows (cfs) - USGS Gauge Orestimba Creek at Newman (1932 to 2007). Source: USGS 2009

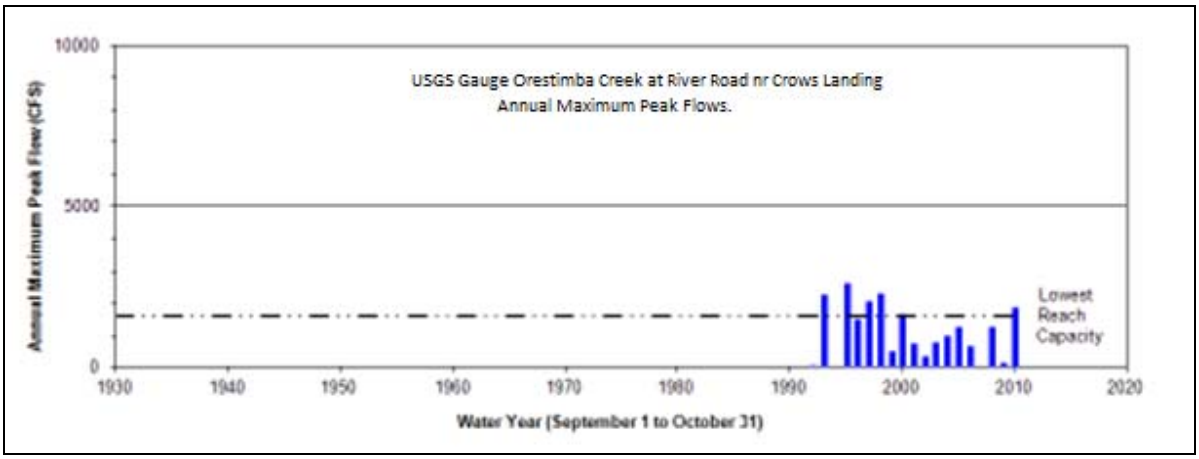

Figure 4-4: Annual Maximum Peak Flows (cfs) - Orestimba Creek at River Road nr Crows Landing (1992 to 2009). Source: USGS 2009

Examination of the stream gauge records confirms that Orestimba Creek is ephemeral in its upper reaches (Table 4-1). Over the 77-year period of record, the average monthly flow at the Orestimba Creek at Newman Gauge is less than 1.0 cfs for the months of June through November. Runoff during the remaining months is sporadic with large volumes (100 to 800 cfs) occurring during winter months of some years and limited to no discharge during most years. In general, runoff begins to appear at this location during mid-November, climbs through December and January, peaks in February and March, and then declines to almost zero in July. August, September, and October are extremely dry months this high on the alluvial fan. Annual stream flow in some years has been zero, with no significant historic trends evident that would indicate a causal relationship.

Table 4-1: Average Monthly Stream Flow

Month	Average Monthly Flow (cfs)	
	Orestimba Creek at Newman Gauge	Orestimba Creek at River Road (Crows Landing)
January	73	89
February	113	122
March	50	70
April	15	53
May	3	42
June	1	25
July	0	24
August	0	19
September	0	12
October	0	29
November	0	30
December	13	22

Source: USGS, 2009

At the Orestimba Creek at River Road Gauge, average monthly flow is consistently higher than the average monthly flow at the Orestimba Creek at Newman Gauge (Table 4-1). Monthly records indicate that peak discharges for several events are lower at the Orestimba Creek at River Road Gauge than at the Orestimba Creek at Newman Gauge. This occurs due to the regulation of flows by channel constriction of the Highway 33 Bridge and the CNRR trestle, which results in a significant portion of flows overtopping the channel between the two gauge sites that does not reenter the channel. The return of irrigation water is the most likely source of flows in the lower reach when nearly no flows are recorded at the Orestimba Creek at

Newman Gauge. A comparison of average annual discharge at each gauge shows similar trends in relative flow volumes (Table 4-2).

Table 4-2: Average Annual Discharge

Year	Average Annual Discharge (cfs)	
	Orestimba Creek at Newman Gauge	Orestimba Creek at River Road (Crows Landing)
1993	45.5	56.8
1994	0.0	15.7
1995	45.0	57.0
1996	33.6	53.9
1997	49.6	94.1
1998	83.4	133.8
1999	4.6	49.5
2000	11.5	35.6
2001	4.5	34.2
2002	33.0	21.7
2003	9.1	15.3
2004	4.9	14.1
2005	26.5	40.4
2006	14.7	53.1
2007	0.0	12.8
2008	14.7	6.95
2009	3.0	19.4

Source: USGS, 2009

Flood Frequency and Floodplain

The Hydrologic Engineering Center (HEC) Flood Frequency Analysis (FFA) computer program was used to compute the annual peak flow frequency curves using 76 years (1932-2007) of peak flow records and 75 years of daily flow records (1933-2007) at the Orestimba Creek at Newman Gauge (Appendix C). The HEC-FFA output is based on a modeled storm event which simulates the volume and duration of flows carried within the creek. Given the 1,800-cfs minimum carrying capacity of Orestimba Creek, each year there is a 20 percent chance (1/5 ACE) that peak flow volumes will result in flooding (Table 4-3). Storm events with a 10 percent chance of occurring each year (1/10 ACE) with a duration of 1 day would also result in flooding.

Table 4-3: Modeled Peak and Average Daily Flows by Flood Frequency

Duration	Flow Volumes (cfs)					
	1/500 ACE	1/200 ACE	1/100 ACE	1/50 ACE	1/10 ACE	1/5 ACE
Peak	20,255	16,533	13,831	11,208	5,679	3,634
1-Day	7,398	6,026	5,035	4,093	2,132	1,405
3-Day	4,825	3,908	3,250	2,627	1,344	876
7-Day	3,039	2,467	2,052	1,657	838	539
15-Day	1,685	1,408	1,196	985	516	334

Source: Appendix C

During flood events that exceed the capacity of the channel, flooding proceeds as shallow to moderate depth sheet flow across the cone-shaped, convex alluvial fan surface, generally following topographic depressions. Floodflow, which is augmented by additional runoff from rainfall on the alluvial fan surface, is then diverted by surface features including roads, highways, canals, and ditches. These features divert flow contrary to the direction it would naturally proceed, most notably toward Newman. Once flow has ponded to the depth of the tops of these features, it overtops the feature and resumes its historical course to the San Joaquin River. Because of its location along Highway 33 and the railroad, Newman is subject to flooding from flow diversion along these features.

Flood damage reduction structures are limited to short segments of earthen levee along the creek bank, drainage ditches, and a recently constructed detention basin and floodwall near Newman. Runoff from agricultural irrigation or excess rainfall flows follows a path of drainage ditches, which have been constructed by local interests to direct flow. These ditches are small earthen features with an extremely small capacity. They serve no significant flood damage reduction function, but do guide small flows along a path of field boundaries, roads, and other man-made features. Because the banks of Orestimba Creek are higher than surrounding fields in the lower reach, most of this flow is carried directly to the San Joaquin River.

Hydraulic conditions were evaluated for delineation of “existing condition” floodplains. The delineation of floodplains involves modeling of the watershed to determine the direction of floodflows and depth of flooding. It indicates ponding and potential “choke point” locations. For instance, the hydraulics of the watershed will determine where flow might break out of the channel and the water’s likely flow path. Modeling of the existing condition involved the creation of a hydraulic model of Orestimba Creek and its environs utilizing both USACE’s HEC-2 model to determine channel capacity and Tetra Tech, Inc.’s FLO-2D model to evaluate flooding within the study area. The HEC-2 model served as the basis for channel geometry in the FLO-2D model. All significant structures that might restrict flow, such as bridges, siphon crossings, and

culverts, were evaluated. Because the entire length of the channel is incapable of conveying peak flows larger than a 1/10 ACE event, the channel of Orestimba Creek does not play a major role in conveying floodflows. Floodflows not carried in the channel run overland through agricultural and residential properties on their way to the San Joaquin River (Figure 4-5).

Topography used in the modeling effort was based on aerial survey data collected by USACE and Stanislaus County expressly for this study. The majority of the data were collected to support 5-foot contour accuracy, with the exception of areas along the stream between the towns of Patterson and Newman where data were collected to support 2-foot contour accuracy.

Orestimba Creek was modeled from just downstream of Oso Creek (upstream of the canyon mouth) to the San Joaquin River. Flows remain relatively confined between Oso Creek and the gravel pits just upstream of Jorgensen Road. Downstream of Jorgensen Road, the channel capacity diminishes. Initial breakout from the channel occurs at Horseshoe Bend between Anderson Road and the CCID Main Canal, which exhibits a channel capacity of approximately 1,800 cfs.

Flow restriction was modeled for all of the existing obstructions along Orestimba Creek (Tetra Tech, Inc. 2001). Structures modeled include Anderson Road, the CCID Main Canal, the CNRR trestle, Highway 33, Morris Road, Kilburn Road, and River Road. Additional obstructions are created by the embankments of the CNRR trestle, the CCID Main Canal, Anderson Road, Clary Road, Crows Landing Road, Morris Road, and JT Crow Road, and these obstructions were included in the modeling.

No soil hydraulic conductivity or soil suction data are available for the Orestimba Creek watershed. Soil parameters used in the hydraulic modeling were derived from detailed studies conducted by DWR on the Arroyo Pasajero watershed. This watershed exhibits similar characteristics and land uses similar to those of Orestimba Creek.

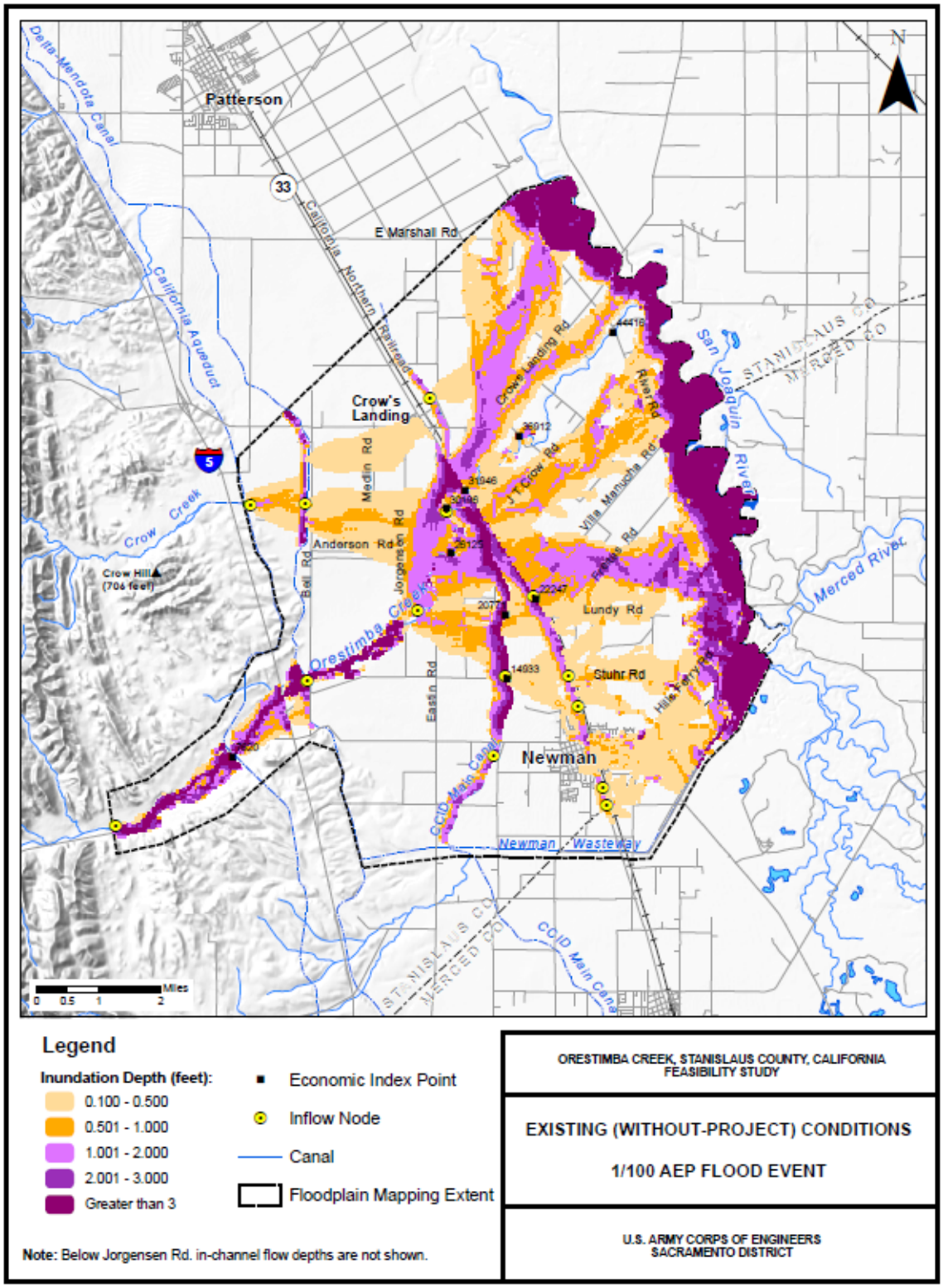

Figure 4-5: 1/100 ACE (100-year) Floodplain of Orestimba Creek

Model calibration was based on the area inundated, as indicated on aerial photographs taken during the flood events of 1995 and 1998. Additional calibration was done using high-water marks generated during these same events. Flood replication, including the area of inundation, was almost exactly the same as those results generated by hydraulic modeling (Tetra Tech, Inc., 2001).

Floodplains were delineated for the 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, and 1/500 ACE events. In all flood scenarios, floodflows exceed channel capacity first at Horseshoe Bend. Downstream flow is somewhat diverted by the CCID Main Canal towards Newman. Eventually, flow diverted by Highway 33 and the CNRR trestle inundates Newman. Flow overtopping Highway 33 and the CNRR continues downslope across fields and farm roads until it reaches the San Joaquin River. Because of the extremely small capacity of the channel, the progression of events during each of these floods is similar; the progressions differ in regards to extent of inundation and depth. All floods between 1/10 and 1/500 ACE events inundate significant areas of agricultural land and residential property.

4.2.5 Water Quality

Surface Waters

Surface waters in the Orestimba Creek watershed include the creek and its tributaries, the California Aqueduct, Delta-Mendota Canal, CCID Main Canal, and secondary canals and irrigation ditches (Figure 4-6). Several tributaries converge with Orestimba Creek in the Diablo Range before it emerges from the foothills, including Red Creek, South Fork Orestimba Creek, North Fork Orestimba Creek, and Oso Creek. The mountainous portion of the watershed catches and delivers the majority of rainfall and runoff evident in the basin. Runoff is substantial after any given amount of rainfall due to the high clay content and shallow depths of soils, which allow for little infiltration of rain water. Most infiltration occurs in the alluvial fan portion of the watershed where soils are sandy and have less clay than those upstream. The California Aqueduct, Delta-Mendota Canal, and CCID Main Canal travel in a general north-to-south direction through the watershed and cross beneath Orestimba Creek via siphons. Although the aqueduct and canals have no direct connection to surface waters, the irrigation water from the canals is indirectly connected to watershed through irrigation return flows. Secondary canals and irrigation ditches generally parallel Orestimba Creek and typically drain into the San Joaquin River.

<u>Surface Water Quality</u>

In the San Joaquin Hydrologic Region, the overarching water quality issues are a result of depleted freshwater flows, municipal and industrial waste water discharges, salt loads in agricultural drainage and runoff, and other pollutants associated with agricultural irrigation and production (such as nutrients, selenium, boron, and organophosphate pesticides) (Central Valley Regional Water Quality Control Board [CVRWQCB], 2007). In urban areas, stormwater

drainage systems may contain heavy metals and chemicals generated from vehicles and yard chemicals from residential and commercial areas.

The Central Valley, which includes Orestimba Creek, has 40 water bodies impaired due to agriculture, including 800 miles of waterways (CVRWQCB, 2007). Relative to other basins, discharges from irrigated lands have their greatest impact in the Central Valley, which covers 40 percent of California's land area, and contains 7 million irrigated acres and at least 25,000 individual agricultural dischargers.

Under Section 303(d) of the Clean Water Act (CWA), the CVRWQCB has developed a Water Quality Control Plan (CVRWQCB, 2007) and maintains a list of impaired waters (CVRWQCB, 2011). The most recent listing cycle ended in 2006. Waters on the 303(d) list do not meet water quality standards, even after point sources of pollution have installed the minimum required levels of pollution control technology. The CWA requires that jurisdictions establish priority rankings for waters on the 303(d) list and develop action plans, incorporating total maximum daily loads (TMDLs), to improve water quality.

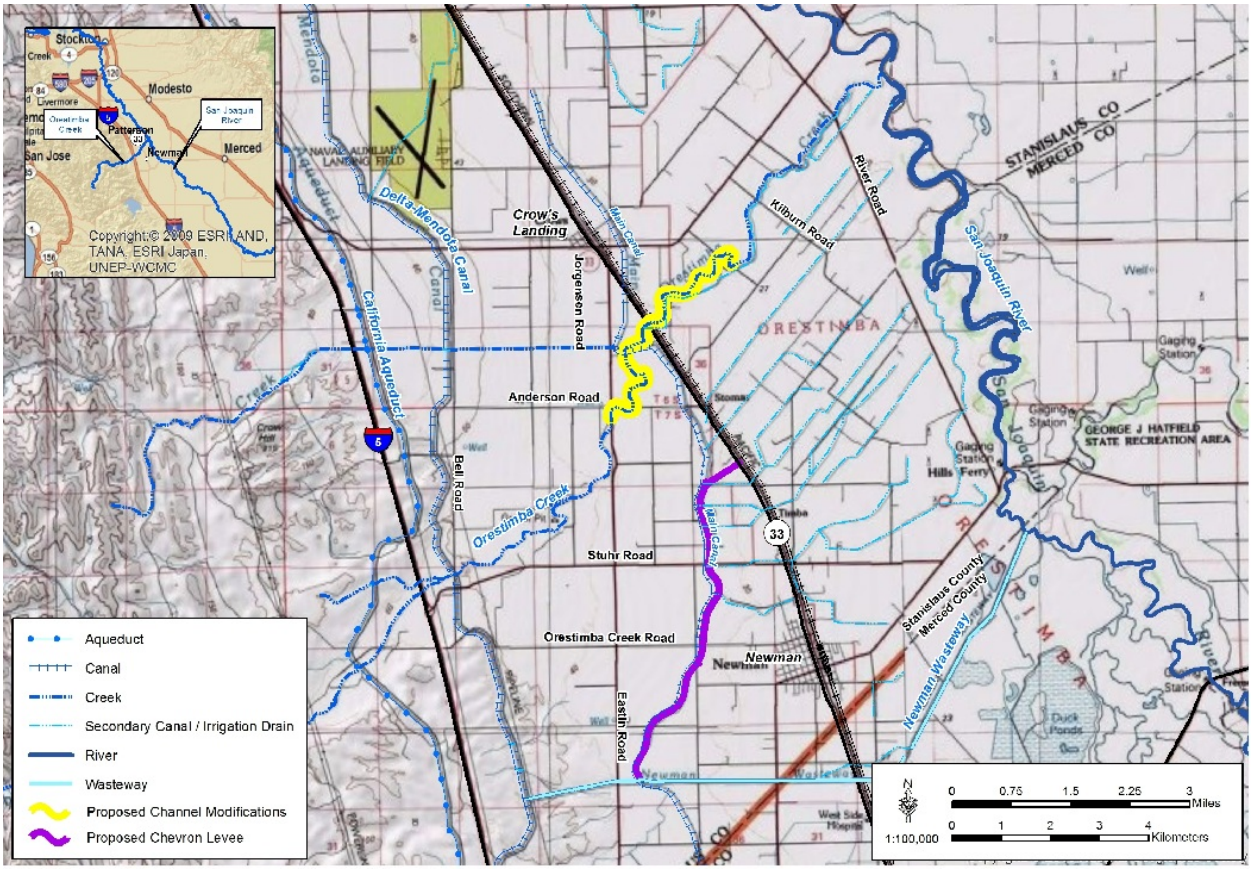

Figure 4-6: Surface Waters in the Orestimba Creek Study Area

The study area is located in the San Joaquin Hydrologic Region. For the purposes of surface water quality monitoring, the CVRWQCB has divided the San Joaquin Hydrologic Region into distinct catchment basins. Orestimba Creek lies within the Greater Orestimba Minor Subarea. The Greater Orestimba Minor Subarea is a 285-square-mile subset of the Northwest Side Subarea located in southwest Stanislaus County and a small portion of western Merced County. It contains the entire Orestimba Creek watershed and the remaining area that drains into the Lower San Joaquin River from the west between the Crows Landing Road Bridge and the confluence of the Merced River, including Little Salad and Crow Creeks. Orestimba Creek is further divided into two segments: one above Kilburn Road and one below Kilburn Road.

The CVRWQCB list of impaired waters includes both monitored segments of Orestimba Creek and the San Joaquin River from the Merced River to the Tuolumne River. Beneficial use of both segments of Orestimba Creek is impaired by high levels of agricultural pollutants including: Azinphos-methyl, Chlorpyrifos, DDE, and Diazinon. The segment below Kilburn Road is also impaired by sediment toxicity of unknown origin and by an unknown toxicity of agricultural origin. Beneficial use of the San Joaquin River is also impaired by high levels of agricultural pollutants including Chlorpyrifos, DDT, and group A pesticides, and is also impaired by high levels of mercury. Designated beneficial uses of the San Joaquin River downstream of the study area include: irrigation; stock watering; industrial processing; canoeing, rafting, and other noncontact recreation; warm freshwater; warm and cold migration; warm spawning; and wildlife habitat. Beneficial use designations of the San Joaquin River are extended to its tributaries, including Orestimba Creek.

CVRWQCB has developed a Water Quality Control Plan for the Sacramento and San Joaquin River Basins and has established the following TMDLs: Central Valley Pesticide TMDL and Basin Plan Amendment; San Joaquin River Organophosphorus Pesticide TMDL; San Joaquin River Dissolved Oxygen TMDL; and the San Joaquin River Upstream Salinity and Boron TMDL. In an effort to address pesticide-related impairments and their effects, CDFG and the California Department of Pesticide Regulation (CDPR) have developed a water monitoring program that encompasses Orestimba and Del Puerto Creeks (Ensminger, 2007). CVRWQCB has initiated a pesticide runoff control program to address Diazanon and Clorpyrifos levels in the region (CVRWQCB, 2007). This program includes load allocations for all National Pollution Discharge Elimination System (NPDES)-permitted discharges and for non-point source discharges. CVRWQCB has also signed a Memorandum of Understanding with the CDPR to ensure that pesticides registered in California are used in a manner that protects water quality and recognizes the need for pest control.

Water quality in Newman is an area of concern because the population is growing quickly and because a large portion of Newman's runoff is discharged into the Newman Wasteway without any water quality treatment. Newman's population reached 10,140 in 2006, and Newman may now become subject to NPDES Phase II Stormwater Program requirements. The Phase II Stormwater Program requirements would require Newman to obtain a permit and develop a stormwater management program designed to prevent harmful pollutants from being carried by stormwater runoff into local water bodies. The program would include public

education, public participation and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control and pollution prevention, and good housekeeping measures.

4.2.6 Groundwater

The San Joaquin River Hydrologic Region is divided into three groundwater basins, which are divided into nine subbasins totaling 9.7 million acres in area (DWR, 2009). The headwaters of Orestimba Creek are located within the Los Banos Creek Valley basin and the alluvial fan is located in the Delta-Mendota subbasin of the San Joaquin Valley basin. The region heavily relies on groundwater, which accounts for about 30 percent of the annual water supply used for agricultural and urban purposes. Groundwater has been used conjunctively with surface water to meet water needs in the area since the beginning of the region's agricultural development. Groundwater is used when and where surface water is unable to fully meet demands.

Few studies have been conducted in the Los Banos Creek Valley basin. The shallow depth to bedrock in this basin generally prevents storage of a significant amount of groundwater in aquifers, and groundwater is rapidly released into streams and aquifers in the Delta-Mendota subbasin. The soils of the Delta-Mendota subbasin are generally well drained, and groundwater barriers do not appear to exist. Natural recharge is estimated to be 8,000 acre-feet, and applied water recharge is approximately 74,000 acre-feet (DWR, 2009). Annual urban and agricultural extractions are estimated to be 17,000 acre-feet and 491,000 acre-feet, respectively. Other extractions are approximately 3,000 acre-feet, and subsurface outflow has not been determined. Thus, total estimated extraction exceeds total estimated recharge by 429,000 acre-feet.

In the Delta-Mendota subbasin, shallow and saline groundwater occurs within about 10 feet of the ground surface (DWR, 2009). There are also localized areas of high iron, fluoride, nitrate, and boron. Total dissolved solids values in the portion of the subbasin underlying the study area range from 400 to 1,600 milligrams per liter. A total of 47 public supply wells were tested for primary and secondary inorganic contaminants, radiological contaminants, nitrates, pesticides, and volatile organic compounds. Except for secondary inorganic compounds, concentrations exceeded U.S. Environmental Protection Agency (USEPA) maximum contaminant levels (MCL) in less than one percent of the wells. Concentrations of secondary inorganic compounds exceeded the USEPA MCL in nearly 40 percent of tested wells.

4.2.7 Waters of the U.S. and Wetlands

The National Wetland Inventory (NWI) indicates several wetlands within and adjacent to the Orestimba Creek riparian zone; however, there are no NWI wetlands identified in the project area as defined by the proposed chevron levee (Figure 4-7). NWI wetlands are typically delineated using USGS soil surveys and aerial photography and should be verified through a

formal wetland delineation to determine their jurisdictional status. Any wetland delineated by an NRCS office will also be included on the NWI maps.

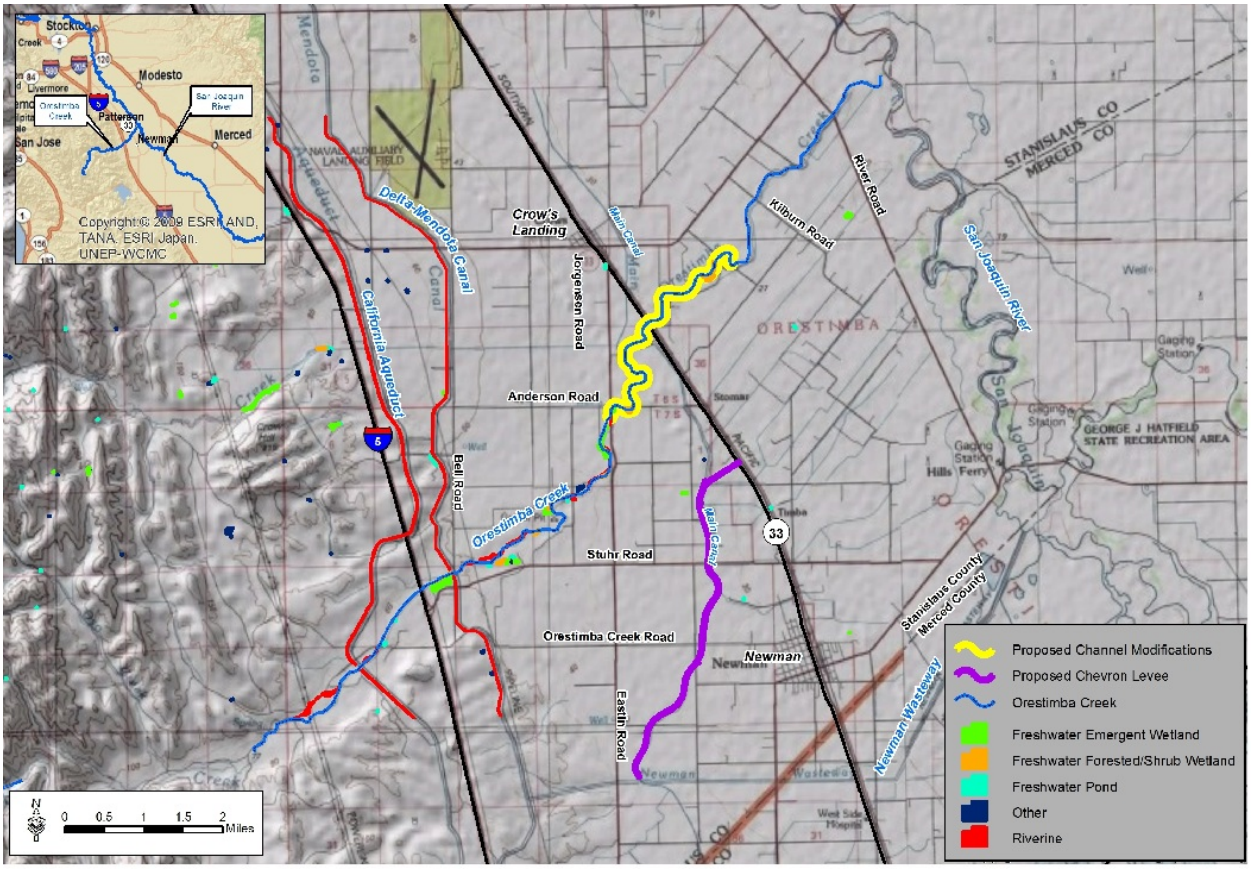

Figure 4-7: NWI Wetlands occurring in the Orestimba Creek Study Area

4.2.8 Air Quality

Orestimba Creek and Newman are located in the San Joaquin Valley Air Pollution Control District (Valley Air District). Air in the Valley Air District does not meet air quality standards for 1-hour and 8-hour ozone (O_3) and particulate matter less than 10 microns in diameter (PM_{10}) and less than 2.5 microns ($PM_{2.5}$) (Table 4-4).

O_3 is formed as a result of complex photochemical reactions in the atmosphere involving volatile organic carbons (VOC), oxides of nitrogen (NO_x), and oxygen. O_3 formulation is enhanced by warm temperatures and sunlight. O_3 is a highly reactive gas that damages lung tissue, reduces lung function, and sensitizes the lung to other irritants. Although stratospheric O_3 shields the earth from damaging ultraviolet radiation, terrestrial O_3 is a highly damaging air pollutant and is the primary source of smog. O_3 is controlled by regulating sources of VOC and

NO_x. NO_x is a brownish, highly reactive gas that can irritate the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory infections. The two primary sources of NO_x are stationary and mobile source fuel combustion.

Table 4-4. Valley Air District Attainment Status

Pollutant	Federal Status	State Status
Ozone - 1 hour	No Federal Standard	Nonattainment/Severe
Ozone - 8 hour	Nonattainment/Extreme	Nonattainment
PM_{10}	Attainment/Maintenance Area	Nonattainment
$PM_{2.5}$	Nonattainment	Nonattainment
Carbon Monoxide	Attainment/Unclassified	Attainment/Unclassified
Nitrogen Dioxide	Attainment/Unclassified	Attainment
Sulfur Dioxide	Attainment/Unclassified	Attainment
Lead (Particulate)	No Federal Standard	Attainment
Hydrogen Sulfide	No Federal Standard	Unclassified
Sulfates	No Federal Standard	Attainment
Visibility Reducing Particles	No Federal Standard	Unclassified
Vinyl Chloride	No Federal Standard	Attainment

Source: Valley Air District, 2011

PM_{10} is composed of dust, ash, soot, smoke, or liquid droplets emitted into the air by industrial sources, fires, construction activities, use of unpaved roads, and by natural sources such as wind-blown dust. The large area of agriculture surrounding Orestimba Creek and Newman is a substantial source of PM_{10}. Small particulates are most likely to cause adverse health effects because they can be inhaled into the thoracic or lower regions of the respiratory tract, where they can cause aggravation of existing respiratory disease and a decline in lung function (USEPA, 2003).

$PM_{2.5}$ can be emitted directly or formed secondarily in the atmosphere (by sulfates from SO_2 emissions and nitrates from NO_x emissions). Health studies have shown a significant association between exposure to $PM_{2.5}$ and premature death from heart or lung disease (USEPA, 2003). Fine particles can aggravate the heart and lungs and have been linked to effects such as cardiovascular symptoms, cardiac arrhythmias, heart attacks, respiratory symptoms, asthma attacks, and bronchitis.

California's State Implementation Plan (SIP) introduces and enforces control measures to reduce emissions of pollutants. Measures to control one criteria pollutant are often utilized to control other non-attainment pollutants. Several control measures in the O_3 SIP are also included in the $PM_{2.5}$ SIP. These measures include controls on fugitive emissions from petroleum and chemical production plants, improvements to school bus fleets, and bans on

burning agricultural wastes. SIPs also include incentive plans to reduce emission from mobile sources such as automobiles, trucks, and construction equipment. These incentive plans apply to both O_3 pollutants and PM pollutants.

Greenhouse Gases and Climate Change

Global climate change refers to a change in the average weather on the earth. Greenhouse Gases (GHGs) are gases that trap heat in the atmosphere. They include water vapor, carbon dioxide (CO_2), methane (CH_4), NO_x, fluorinated gases including chlorofluorocarbons (CFC) and hydrochlorofluorocarbons (HCFC), and halons, as well as ground-level O_3 (California Energy Commission, 2007).

The major GHG-producing sectors in society include transportation, utilities (such as coal and gas power plants), industry/manufacturing, agriculture, and residential. End-use sector sources of GHG emissions include transportation (40.7 percent), electricity generation (22.2 percent), industry (20.5 percent), agriculture and forestry (8.3 percent), and other (8.3 percent) (California Energy Commission, 2007). The main sources of increased concentrations of GHG due to human activity include the combustion of fossil fuels and deforestation (CO_2), livestock and rice farming, land use and wetland depletions, landfill emissions (CH_4), refrigeration system and fire suppression system use and manufacturing (CFC), and agricultural activities, including the use of fertilizers (California Energy Commission, 2007).

<u>Final Mandatory GHG Inventory Rule</u>

In response to the Consolidation Appropriations Act (House Resolution [H.R.] 2764; Public Law 110–161), USEPA has issued the Final Mandatory Reporting of Greenhouse Gases Rule. The rule requires large sources that emit 25,000 metric tons (27,557 U.S. tons) or more per year of GHG emissions to report GHG emissions in the U.S., collect accurate and timely emissions data to inform future policy decisions, and submit annual GHG reports to the USEPA. The final rule was signed by the Administrator on September 22, 2009, published on October 30, 2009, and made effective December 29, 2009.

4.2.9 Vegetation Communities

EDAW conducted field surveys of the study area between April and October 2001 (USACE, 2002). The purpose of these surveys was to characterize general biological resources and to determine if sensitive biological resources occur in the project area. Botanical surveys were conducted in the study area west of the California Aqueduct during the weeks of April 23 and July 2, 2001. These surveys included identifying plants, characterizing native plant communities, and assessing the suitability of habitats for special status plant species. Vegetation communities were first delineated on aerial photography and then verified on the ground. Gulf South Research Corporation (GSRC) also conducted biological reconnaissance in August 2008 within the Orestimba Creek Riparian Zone; the results of this study are included in

Appendix B. Vegetation communities within the project area as defined by the proposed chevron levee are discussed below.

Non-native Annual Grassland

This vegetation community is equivalent to the California annual grassland series of the CNPS system. Dominant plant species observed were limited to a few non-native, herbaceous species such as wild oats (*Avena fatua*), slender wildoat (*A. barbata*), soft chess, foxtail barley (*Hordeum marinum*), Italian ryegrass (*Lolium multiflorum*), foxtail fescue, hare barley, ripgut grass (*Bromus diandra*), redstem filaree (*Erodium cicutarium*), smooth cat's ear (*Hypochoeris glabra*), and shortpod mustard (*Hirschfeldia incana*), as well as many other introduced grasses and forbs.

Agricultural Lands

This vegetation community is intensively managed row crops and tree orchards. Plant species include domesticated crop species such as alfalfa, beans, broccoli, cantaloupe, oats, sugarbeet, tomato, winter wheat, and orchards of walnut, almond, apricot, and cherry trees. Besides these crops, other vegetation found along fence lines, roads, and fallowed fields include mustard, common cocklebur, common sunflower, yellow starthistle, and other ruderal (weedy) species.

Developed Areas

Nonnative communities occur in areas developed for urban use in the project area. Developed areas include sidewalks, roadways, buildings, driveways, parking lots, and recreational trails. This community provides little to no habitat for wildlife, and has little to no vegetation and ground cover.

4.2.10 Wildlife and Fisheries

Wildlife

EDAW (2002) conducted field surveys of the study area between April and October 2001, and GSRC conducted a reconnaissance in August 2008. Additional observational surveys were conducted by USFWS personnel in April 2012. The purpose of these surveys was to characterize general biological resources and to determine if sensitive biological resources occur. Other wildlife species were also noted during these surveys and their occurrence within each vegetation community is provided in the following paragraphs.

Wildlife species commonly observed in the Non-native Annual Grassland in the study area include black-tailed jackrabbit (*Lepus californicus*), California ground squirrel (*Spermophilus beecheyi*), Heermann's kangaroo rat (*Dipodomys heermanni*), lark sparrow (*Chondestes grammacus*), western meadowlark (*Sturnella neglecta*), horned lark (*Eremophila*

alpestris), gopher snake (*Pituophis catenifer*), and western rattlesnake (*Crotalus viridis helleri*). Additional species were also recorded in the field surveys, including badger (*Taxidea taxus*) and coyote (*Canis latrans*). While these species were recorded in other parts of the study area outside of the agricultural areas, they may occasionally forage in nearby agricultural lands. Agricultural lands also provide important foraging habitat for many species of raptors in the study area.

Agricultural land and lands dominated by urban development support many wildlife species, most of which are highly adapted to these disturbed environments. Agricultural land is not generally considered important wildlife habitat, but is used by many species, particularly as foraging habitat. Wildlife found in agricultural areas varies by crop type and time of year. Animals observed in these areas included Audubon's cottontail, California vole (*Microtus californicus*), western scrub-jay (*Aphelocoma coerulescens*), American crow (*Corvus brachyrhynchos*), barn owl (*Tyto alba*), and yellow-billed magpie (*Pica nuttalli*). Wildlife found in urban areas is often dependent upon surrounding land uses and the presence or absence of nearby natural vegetation. In the more urbanized areas, a large percentage of the wildlife can be made up of exotic species such as rock pigeon (*Columba livia*), European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), house mouse (*Mus musculus*), and brown rat (*Rattus norvegicus*).

Fisheries

While the San Joaquin River above and below Orestimba Creek is designated Essential Fish Habitat (EFH) for Pacific salmon under the Magnuson-Stevens Fisheries Conservation and Management Act (Pacific Fishery Management Council, 1999), the project area as defined by the proposed chevron levee is not considered EFH. The CCID canal may contain native fish species, including Sacramento sucker (*Catostomus occidentalis*) and Sacramento pikeminnow (*Ptychochelius grandis*). A variety of introduced species may also be present in the CCID canal, including various species of catfish, carp, mosquitofish, and members of the Centrarchidae family such as green sunfish, black crappie (*Pomoxis annularis*), and largemouth bass (*Micropterus salmoides*). Amphibian species observed include the American bullfrog (*Lithobates catesbeianus*) and the American toad (*Anaxyrus americanus*).

4.2.11 Special Status Species

Certain special status species and their habitats are protected by Federal, State, or local laws and agency regulations. The Federal Endangered Species Act (ESA) of 1973 (50 CFR 17) provides legal protection for plant and animal species in danger of extinction. This act is administered by USFWS and NMFS. The California Endangered Species Act (CESA) of 1977 parallels the Federal ESA and is administered by CDFG. Other special status species lack legal protection, but have been characterized as "sensitive" based on policies and expertise of

agencies or private organizations, or policies adopted by local government. Special-status species are those that meet any of the following criteria:

- Listed or candidate for listing under the Federal ESA (50 CFR 17).
- Listed or candidate for listing under CESA.
- Nesting bird species and active nests of birds listed under the Migratory Bird Treaty Act.
- Species listed in the Bald and Golden Eagle Protection Act.
- Essential Fish Habitat listed under the Magnuson-Stevens Act.
- Fully protected or protected species under stated CDFG code.
- Wildlife species of special concern listed by the CDFG.
- Plant species listed as Rare under the California Native Plant Protection Act.
- Plant species listed by the California Native Plant Society.
- Species protected by other local ordinances, goals, and policies.

Lists of special status species and candidate species that may be found in the United States Geological Survey quad Newman were obtained November 5, 2012 via the USFWS website and the California Natural Diversity Database (CNDDB). The USFWS and CNDDB lists are included in Appendix B, as well as in Table 4-5.

Table 4-5: Special Status Species and Critical Habitats

Species/Critical Habitat	Status	Potential to Occur*
INVERTEBRATES		
Vernal pool fairy shrimp *Branchiecta lynchi*	Threatened	None; primarily occurs in vernal pools, which are located on the east side of the county
Critical Habitat	Final	None
Vernal pool tadpole shrimp *Lepidurus packardi*	Endangered	None; primarily occurs in vernal pools, which are located on the east side of the county
Critical Habitat	Final	None

Species/Critical Habitat	Status	Potential to Occur*
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	Federally Threatened	Low; blue elderberry shrubs have been known to occur in the area but habitat suitability is limited by fragmentation and use of pesticides. No species occurrences identified by Critical Habitat Portal or biological surveys
FISH		
Green sturgeon *Acipenser medirostris*	Federally Threatened	None; spawns in rivers north of the San Francisco Bay
Delta smelt *Hypomesus transpacificus*	Federally Threatened	None; occurs in the San Joaquin River about 50 miles downstream of Orestimba Creek
West Coast Steelhead, California Central Valley Distinct Population Segment (DPS) *Oncorhynchus mykiss*	Federally Threatened	None; this anadromous fish is known to occur in the San Joaquin River above and below its confluence with Orestimba Creek; due to its flashy hydrology, suitability of Orestimba Creek is limited but could provide habitat in some years
Critical Habitat	Final	None; water quality of San Joaquin River above and below Orestimba Creek is a primary constituent element of critical habitat
Central Valley spring-run Chinook salmon *Oncorhynchus tshawytscha*	Federally Threatened	None; this anadromous fish is known to occur in the San Joaquin River above and below its confluence with Orestimba Creek; due to its flashy hydrology, suitability of Orestimba Creek is limited but could provide habitat in some years
Central Valley winter-run Chinook salmon *Oncorhynchus tshawytscha*	Federally Endangered	None; this anadromous fish is known to occur in the San Joaquin River above and below its confluence with Orestimba Creek; due to its flashy hydrology, suitability of Orestimba Creek is limited but could provide habitat in some years
AMPHIBIANS		
California tiger salamander, central population *Ambystoma californiense*	Federally Threatened	None; suitability of habitats is limited by presence of predators such as bullfrogs and fish which were observed in standing pools of water during 2001 and 2008 biological surveys
Critical Habitat	Final	None

Species/Critical Habitat	Status	Potential to Occur*
California red-legged frog *Rana aurora draytonii*	Federally Threatened	None; focused surveys of the upper portion of Orestimba Creek were conducted by EDAW in 2001, and the species was not detected; habitat suitability limited by predators such as bullfrogs and predatory fish observed in standing pools of water during 2008 biological surveys
REPTILES		
Blunt-nosed leopard lizard *Gambelia (=Crotaphytus) sila*	Federally Endangered	None; no longer present in areas that have been significantly altered by agriculture and urban development
Giant garter snake *Thamnophis gigas*	Federally Threatened	None; Orestimba Creek riparian area is somewhat limited in suitability due to a general lack of basking areas and upland refugia, and the species is not known to occur within Orestimba Creek but has been recently sighted in San Joaquin Valley
MAMMALS		
Fresno kangaroo rat *Dipodomys nitratoides exilis*	Federally Endangered	None; there are no known populations in Stanislaus County
San Joaquin kit fox *Vulpes macrotis mutica*	Federally Endangered	Low; the CCID embankment may be used as a migratory pathway between existing populations
BIRDS		
Tricolored blackbird *Agelaius tricolor*	SSC	Low; occurs in marshes above the Delta-Mendota Canal, may utilize agricultural lands
Western burrowing owl *Athene cunicularia*	SSC	Low; occurs in grasslands above Delta-Mendota Canal, may utilize agricultural lands
Swainson's hawk *Buteo swainsoni*	State Threatened	Moderate; occurs in woodlands upstream of Delta-Mendota Canal
Mountain plover *Charadrius montanus*	SSC	Low; could occur in grasslands and plowed fields during winter

Species/Critical Habitat	Status	Potential to Occur*
California horned lark *Eremophila alpestris*	SSC	Low; occurs in grasslands upstream of Delta-Mendota Canal, may utilize agricultural lands
Loggerhead shrike *Lanius ludovicianus*	SSC	Low; occurs in grasslands upstream of Delta-Mendota Canal, may utilize agricultural lands
PLANTS		
Hoover's spurge *Chamaesyce hooveri* Critical Habitat	Threatened Final	None; primarily occurs in vernal pools, which are located on the east side of the county None
Colusa grass *Neostapfia colusana*	Threatened	None; primarily occurs in vernal pools, which are located on the east side of Stanislaus
Hairy Orcutt grass *Orcuttia pilosa* Critical Habitat	Endangered Final	None; primarily occurs in vernal pools, which are located on the east side of the county None
Hartweg's golden sunburst *Pseudobahia bahiifolia*	Endangered	None; remaining populations are concentrated in La Grange east of San Joaquin River
Greene's tuctoria *Tuctoria greenei* Critical Habitat	Endangered Final	None; extirpated from Stanislaus County None
Fleshy owl's-clover *Castilleja campestris ssp. succulenta* Critical Habitat	Threatened Final	None; occurs in beds of vernal pools in valley grasslands in the eastern San Joaquin Valley None

Source: CNDDB, 2012 and USFWS, 2012
* None = no suitable habitat or extirpated; Low = potentially suitable habitat, but no record of occurrence in potentially affected area; Confirmed = suitable habitat with known occurrence in potentially affected area
SSC: State Species of Special Concern

Of the species identified in the study area, only eight have potential to occur in the project area as defined by the area affected by the proposed chevron levee. These species are briefly discussed below.

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle (VELB) is patchily distributed throughout the remaining riparian forests of the Central Valley from Redding to Bakersfield. The VELB appears

to be only locally common (found in population clusters that are not evenly distributed across the Central Valley). Extensive loss of California's Central Valley riparian forests has occurred since 1900, declining by 80 to 96 percent depending on the region (USFWS, 2006). Low density and limited dispersal capability may cause the VELB to be particularly vulnerable to population isolation as a result of habitat fragmentation. Insecticide and herbicide use in agricultural areas and along road rights-of-way may be factors limiting the VELB's distribution. The age and quality of individual elderberry shrubs as a habitat for the VELB may be a factor in its limited distribution. Numerous blue elderberry shrubs were observed within the intact portions of the Orestimba Creek riparian zone. However, the fragmented nature of these habitats and the use of insecticides in adjacent agricultural fields likely limit the suitability of the study area for this species. The California Natural Diversity Database (CNDDB) records several occurrences of this species in Stanislaus County east of the San Joaquin River (CNDBB 2011).

USFWS released a 5-year status review for the VELB on October 2, 2006 (USFWS, 2006). This review reported an observed population increase and the concurrent protection and restoration of several thousand acres of riparian habitat suitable for VELB. The USFWS status review determined that this species is no longer in danger of extinction, and recommended that the species no longer be listed under the Federal ESA. This recommendation is not a guarantee that the species will be delisted, however, because formal changes in the classification of listed species require a separate USFWS rulemaking process distinct from the 5-year review. In August 2011, USFWS initiated a status review to determine if delisting is warranted (USFWS, 2011). On October 2, 2012, USFWS announced a proposed rule to remove the VELB from the Federal List of Endangered and Threatened Wildlife. This proposed rule is currently in public review.

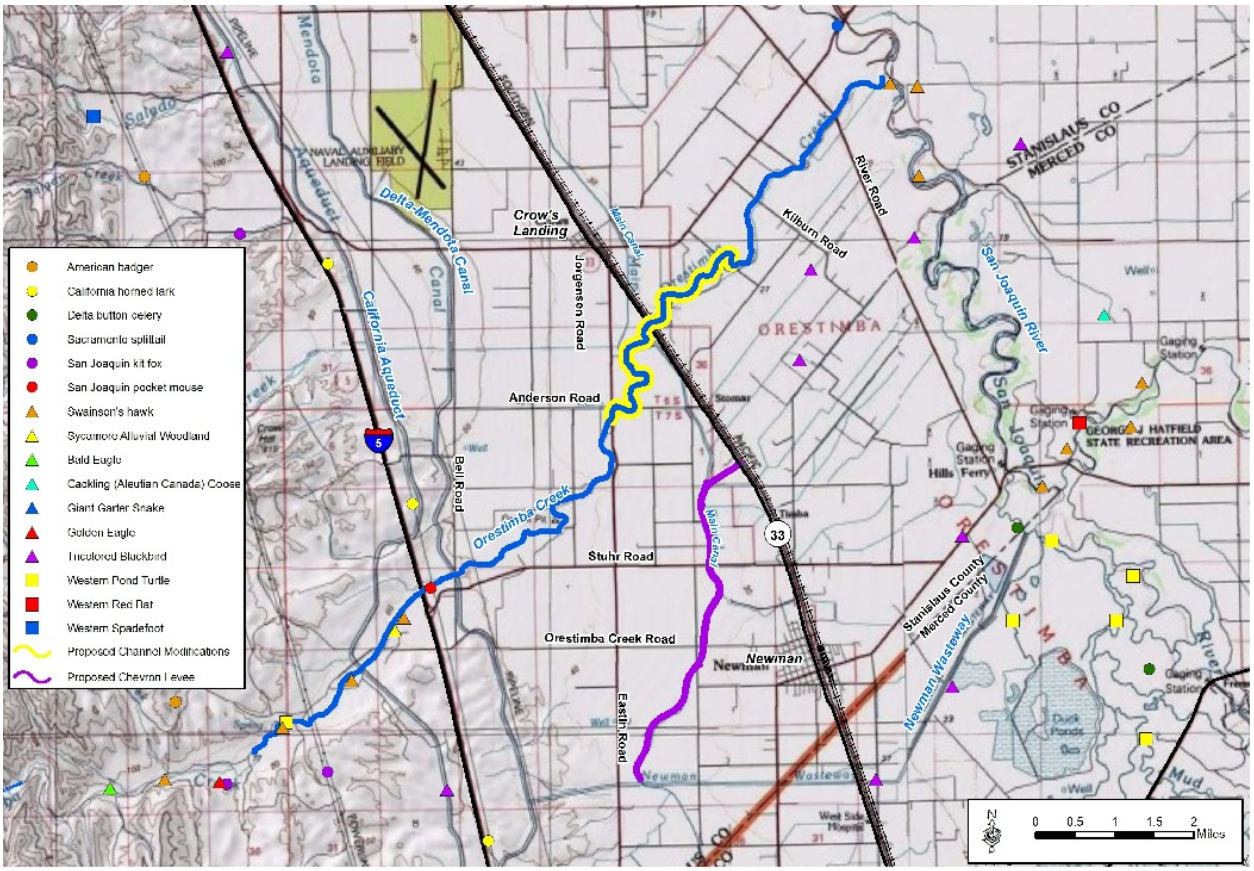

Figure 4-8: CNDDB Occurrences within the Study Area

<u>San Joaquin Kit Fox</u>

The San Joaquin Kit Fox inhabits grasslands, scrub and shrub communities, and agricultural lands. They will use multiple dens in a year, often enlarging holes started by ground squirrels. They will also use man-made structures such as culverts and pipes with small enough entrances to exclude coyotes. While the project area as defined by the proposed chevron levee is unlikely to provide habitat for the San Joaquin Kit Fox, they may use the CCID embankment as a migratory pathway.

<u>Tricolored Blackbird</u>

Tricolored blackbirds nest in dense emergent or riparian vegetation, especially where cattails and bulrush (*Scheonoplectus* spp.) are dominant (Beedy, 2008). This species was occasionally observed during 2001 biological surveys and numerous CNDDB records occur within Stanislaus County, with one record near the California Aqueduct southwest of Newman and three records located within agricultural fields east of Highway 33 (CNDBB, 2011).

Western Burrowing Owl

In California, the western burrowing owl can be found throughout the Central Valley, in the interior portion of the Coast Ranges, and along the coast (Howard, 1996). The population of burrowing owls has declined primarily because native grassland habitats have been converted for agricultural uses. Current threats to remaining populations include urban development and conversion from agricultural crop types that are compatible with burrowing owl occurrence to those that are incompatible. Optimal habitat conditions include open, dry, and nearly level grasslands or prairies. In the Central Valley, burrowing owls often nest along roadsides adjacent to agricultural fields, along field borders, in annual grasslands and dryland pastures, and along levee embankments that are open to adjacent fields. The species was observed above the Delta-Mendota Canal in the 2001 surveys, and CNDDB records also indicate occurrences near Salado Creek and Del Puerto Canyon (CNDBB, 2011). Although not observed near Orestimba Creek below the Delta Mendota Canal, surrounding agricultural fields could provide suitable habitat.

Swainson's Hawk

Swainson's hawks prefer to nest in riparian areas with isolated trees bordered by suitable foraging habitat (grasslands, active agriculture, or fallow fields) (Johnsgard, 1990). Agricultural fields provide important foraging habitat for Swainson's hawks. Alfalfa, fallow fields, dry and irrigated pastures, and other low-growing row crops (including corn after harvest) are preferred foraging habitats for Swainson's hawks. Swainson's hawks are summer residents in the Central Valley, and typically arrive in April to breed. The species was observed upstream of the Delta-Mendota Canal in 2001 and 2008. There are numerous CNDDB occurrences of Swainson's hawk throughout the Orestimba Creek riparian area (CNDBB, 2011) .

Mountain Plover

From September through March, mountain plovers spend the winters in northern California (Knopf and Rupert, 1995). In order of preference, habitats include alkali flats, heavily grazed native grasslands, and recently cultivated croplands. Alkali flats are virtually non-existent and were historically found in the eastern half of the San Joaquin Valley. Mountain plovers remain dependent upon alkali flats, especially in October and November, and the lack of these habitats near Orestimba Creek may limit the suitability of secondary habitats found in agricultural fields. CNDDB records indicate one occurrence near Turlock Lake approximately 10 miles east of the San Joaquin River (CNDBB, 2011).

California Horned Lark and Loggerhead Shrike

The California horned lark and the loggerhead shrike both use grasslands for foraging and nest in shrubs (American Ornithologists Union, 1983). Both species were commonly observed during 2001 biological surveys in grasslands and riparian area surrounding Orestimba

Creek upstream of the Delta-Mendota Canal. CNDDB records indicate a loggerhead shrike occurrence near Patterson and the Delta-Mendota Canal approximately 10 miles north of Orestimba Creek, and California horned lark occurrences in the vicinity of Orestimba Creek near the California Aqueduct and near the Newman Wasteway (CNDBB, 2011).

4.2.12 Invasive Plants and Noxious Weeds

Of the approximately 1,400 non-native plant species occurring in California, the California Invasive Plant Council has identified approximately 200 species of invasive plants that are considered a threat to wildlands based upon their ecological impact and invasive potential (California Invasive Plant Council, 2010). Wildlands are public and private lands that support native ecosystems, including grazed rangeland and active timberland. A total of 22 species considered to be a threat to wildlands were observed within the study area. Giant reed (Figure 4-9), yellow star-thistle, and common fig (*Ficus carica*) are classified as invasive plants having severe impacts. Curly doc, black mustard (*Brassica nigra*), ripgut grass, Italian thistle (*Carduus pycnocephalus*), tocalote (*Centaurea melitensis*), Bermuda grass (*Cynodon dactylon*), Tasmanian blue gum (*Eucalyptus globulus*), Mediterranean barley (*Hordeum marinum* subsp. *gussoneanum*), hare barley, smooth cat's-ear (*Hypochoeris glabra*), tree tobacco, olive (*Olea europa*), and foxtail fescue are classified as having moderate impacts. Depending on the species, tamarisk is classified as either limited or severe in impacts and invasiveness. The remaining invasive species identified in the study are classified as having limited impacts.

Figure 4-9: Giant Reed along Agricultural Margins in the Lower Reach of Orestimba Creek

The California Department of Food and Agriculture lists 171 plants as noxious weeds (3 CCR § 4500). A noxious weed is defined as any plant species that is, or is liable to be, troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate. Any area that is infected with any pest, including noxious weeds, is considered a public nuisance, is unlawful for any persons to maintain, and should be abated (California Food and Agriculture Code Sections 5402-5403).

Within the project area as defined by the proposed chevron levee, at least three noxious weeds occur: yellow-star thistle, Italian thistle, and Bermuda grass. Each of these species is given a rating of C by the California Department of Food and Agriculture, and as such they are not subject to State-enforced action outside of nurseries, except to retard spread.

4.2.13 Socioeconomics and Environmental Justice

The study area is located in the southwestern portion of Stanislaus County, in what is referred to by the U.S. Census Bureau (USCB) as the Newman Division. Orestimba Creek stretches approximately 7.5 miles within the Newman Division after having left the foothills of the Diablo Mountain Range. It is estimated that in the 500-year flood event the floodplain would encompass approximately 20,000 acres, including Newman (Appendix C). Newman is home to the world's first school bus company. It is also home to some of California's most efficient and important agricultural industries, such as tomato and vegetable processing, cheese manufacturing, and turkey hatching. The area is acknowledged for crop diversity and productivity, which can be accredited to a combination of exceptional factors such as soil quality, air quality, climate, and water supply.

Population and Diversity

Over the last decade, Newman grew much faster than Stanislaus County and California, increasing by more than 44 percent from 7,093 in 2000 to 10,224 in 2010 (USCB, 2000 and 2010) (Table 4-6). Stanislaus County experienced a higher population growth rate than California as a whole, and some of this growth is attributable to growth in Newman.

The populations of Newman, Stanislaus County, and California are all predominantly comprised of minority races. Persons reporting in 2010 that they are "white, not Hispanic or Latino" make up approximately 32 percent of the population of Newman, 47 percent of the population of Stanislaus County, and 40 percent of the population of California. Newman is more than 61 percent Hispanic/Latino, while Stanislaus County is approximately 42 percent Hispanic/Latino. Relative to California, a substantial portion of growth experienced in Stanislaus County, and especially Newman, can be accounted for by increases in minority populations, primarily by individuals of Hispanic or Latino origin. Newman's Hispanic/Latino population grew by more than 72 percent from 2000 to 2010, compared to 52 percent in Stanislaus County and 28 percent in California over the same decade.

Table 4-6: California, Stanislaus County, and Newman Population (2000 & 2010)

Population	2000	Percent	2010	Percent	Percent Change
California	**33,871,648**		**37,253,956**		**10.0**
White, not Hispanic or Latino	15,816,790	46.7	14,956,253	40.1	-5.4
Hispanic or Latino	10,966,556	32.4	14,013,719	37.6	27.8
Other Minority*	7,088,302	20.9	8,283,984	22.2	16.9
Stanislaus County	**446,997**		**514,453**		**15.1**
White, not Hispanic or Latino	256,001	57.3	240,423	46.7	-6.1
Hispanic or Latino	141,871	31.7	215,658	41.9	52.0
Other Minority	49,125	11.0	58,372	11.3	18.8
Newman	**7,093**		**10,224**		**44.1**
White, not Hispanic or Latino	2,987	42.1	3,319	32.5	11.1
Hispanic or Latino	3,648	51.4	6,299	61.6	72.7
Other Minority	458	6.5	606	5.9	32.3

Source: USCB, 2000 and 2010.
* "Other Minority" includes the Black or African American, American Indian & Alaska Native, Asian, Native Hawaiian & Other Pacific Islander, Other Race Alone, and Two or More Races categories.

Income and Poverty

California's 2009 per capita personal income ($42,395) was above the national average per capita income of $39,635 by nearly 10 percent (Table 4-7). However, the per capita personal income in Stanislaus County of $31,248 was only 79 percent of the national average. Although the Newman median household income was noticeably below the median household income for California, median household income in Newman and Stanislaus County are very near the U.S. average (American Community Survey [ACS], 2010). As discussed below, California supports a higher proportion of high-salary occupations statewide when compared to the more rural areas of Newman and Stanislaus County. Median household income for Newman is slightly greater than the county. The ACS estimates the 9.9 percent poverty rate for Newman, which is noticeably lower than the 17.0 percent poverty rate for Stanislaus County. California's poverty rate is similar to the U.S. rate, 14.2 and 14.3 percent, respectively.

Table 4-7: Newman, Stanislaus County, California and U.S. Income and Poverty (2009*)

Income and Poverty	Newman	Stanislaus County	California	U.S.
Per capita personal income **		$31,248	$42,395	$39,635
Per capita income as a percent of U.S.		78.8%	107.8%	
Median Household Income (2005-2009)	$49,856	$48,550	$58,925	$50,221
Persons of all ages below poverty level, percent, 2005-2009	9.9%	17.0%	14.2%	14.3%

Source: USCB, 2010; ACS 2010
* Estimates for 2009 reflect county population estimates available as of April 2010.
** Per capita personal income was computed using Census Bureau midyear population estimates.
Personal and per capita state and local area dollar estimates are in current dollars (not adjusted for inflation).
BEA does not calculate personal or per capita income for small communities, so these data are not available for Newman.

Employment

The proportion of individuals employed within each occupational category listed by the USCB is relatively similar for California, Stanislaus County, and Newman (Table 4-8). California employs a greater proportion of individuals in the management, professional, and related occupations relative to Stanislaus County and Newman. The service occupations and sales and office occupations are nearly equally represented among the three geographic areas, with Newman providing the lowest proportion of employment in these two categories. Farming, fishing, and forestry occupations provide a greater proportion of employment in Stanislaus County, and especially Newman, than in California as a whole. In Newman, this occupational group did not grow as fast as other groups over the last decade. Construction, extraction, maintenance, and repair occupations, as well as production, transportation, and material moving occupations, each account for a relatively large proportion of jobs in Stanislaus County and Newman, and the proportion of jobs in each of these categories has increased over the last decade.

USACE estimated that approximately 18,400 acres of agricultural land exist within the 1/500 ACE floodplain (Appendix C). Agricultural use consists primarily of orchards, row crops, and field crops. About 3,400 acres of the affected floodplain is devoted to high-value orchard production with about 8,500 acres planted annually, to crops including tomatoes, broccoli, beans, and other crop types. The remaining acreage is primarily devoted to field crops such as pasture and alfalfa hay. Much of the cropland is plowed and planted annually, with a small percentage left fallow. Through a farm budget analysis, USACE estimated agricultural damages to be approximately $1.2 million as a result of a 1/5 ACE storm event and approximately $7.1 million as a result of a 1/100 ACE storm event (Appendix C). The farm budget analysis included estimates of damages to equipment and crops, loss of net income during reestablishment of lost acreage, removal of trash, and reestablishing the land to pre-flood conditions.

Table 4-8: California, Stanislaus County, and Newman Employment by Occupation

Occupation	2000		2005-2009	
	Individuals	Percent	Individuals	Percent
California				
Management, professional, and related occupations	5,295,069	36.0	5,938,977	35.9
Service occupations	2,173,874	14.8	2,827,174	17.1
Sales and office occupations	3,939,383	26.8	4,221,825	25.5
Farming, fishing, and forestry occupations	196,695	1.3	229,497	1.4
Construction, extraction, and maintenance occupations	1,239,160	8.4	1,478,041	8.9
Production, transportation, and material moving occupations	1,874,747	12.7	1,855,192	11.2
Stanislaus County				
Management, professional, and related occupations	46,182	26.5	55,785	27.1
Service occupations	26,856	15.4	34,131	16.6
Sales and office occupations	44,706	25.6	52,261	25.4
Farming, fishing, and forestry occupations	6,226	3.6	6,512	3.2
Construction, extraction, maintenance, and repair occupations	19,877	11.4	23,601	11.5
Production, transportation, and material moving occupations	30,481	17.5	33,788	16.4
Newman				
Management, professional, and related occupations	548	23.7	954	24.2
Service occupations	306	13.3	473	12.0
Sales and office occupations	486	21.1	827	21.0
Farming, fishing, and forestry occupations	237	10.3	244	6.2
Construction, extraction, and maintenance occupations	280	12.1	611	15.5
Production, transportation, and material moving occupations	451	19.5	826	21.0

Source: USCB, 2010; ACS, 2010

Environmental Justice

EO 12898, Environmental Justice, was issued by President Clinton on February 11, 1994. Objectives of the EO, as it pertains to this assessment, include development of Federal agency implementation strategies, identification of minority and low-income populations where proposed Federal actions have disproportionately high and adverse human health and environmental effects, and participation of minority and low-income populations.

Accompanying EO 12898 was a Presidential Transmittal Memorandum that referenced existing Federal statutes and regulations to be used in conjunction with EO 12898. The memorandum addressed the use of the policies and procedures of NEPA. Specifically, the memorandum indicates that, "Each Federal agency shall analyze the environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by the NEPA 42 U.S.C. section 4321, et.seq."

Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, or Pacific Islander. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population. Low-income populations as of 2010 are those whose income are $22,050 for a family of four and are identified using the Census Bureau's statistical poverty threshold. USCB defines a "poverty area" as a Census tract with 20 percent or more of its residents below the poverty threshold and an "extreme poverty area" as one with 40 percent or more below the poverty level. This is significant because the social and economic welfare of minority and low-income populations may be positively or disproportionately impacted by the proposed action alternatives and because of public concerns about the fair and equitable treatment (fair treatment and meaningful involvement) of all people with respect to environmental and human health consequences of Federal laws, regulations, policies, and actions. A potential disproportionate impact may occur when the percent minority in the study area exceeds 50 percent and/or the percent low-income exceeds 20 percent of the population. Additionally, a disproportionate impact may occur when the percent minority and/or low-income in the study area are meaningfully greater than those in the reference community. The State of California, Stanislaus County, and Newman all had less than 20 percent of the population below the poverty level, while the poverty rate in Newman was a relatively low 9.9 percent (Table 4-9).

Table 4-9. Minority Population and Poverty Data

Location	Minority Population (percent)	All Ages in Poverty (percent)
California	59.9	14.2
Stanislaus County	53.2	17
Newman	67.5	9.9

Source: USCB 2010 and ACS 5-Year Estimates, 2005-2009.

4.2.14 Land Use

Above the study area, the headwaters of the Orestimba Creek watershed are in open space usage, as very little of the mountainous portion is suitable for development. Open space land uses in the headwaters include ranching, recreation, and ecological preservation, with a small portion of the watershed bisected by roads and site development. The Nature Conservancy manages the 33,000-acre Simon-Newman Ranch as an ecological reserve. California State Parks operates Henry Coe State Park, which is located nearly 20 miles above the study area on South Fork Orestimba Creek. CDFG manages portions of Orestimba Creek and the surrounding grasslands upstream of the study area above the Delta-Mendota Canal.

Downstream of the Delta-Mendota Canal, land use within the Orestimba Creek floodplain is characterized by scattered rural-residential development and isolated centers of urban development surrounded by extensive agricultural development. Gravel mining, located just downstream of the Delta-Mendota Canal, is the only in-channel land use activity in the study area. In the lower reach, where overbank flooding is less common, houses and associated structures are located near both banks of the creek.

Newman and Crows Landing

Newman and the Village of Crows Landing include commercial, government, and residential land uses. Newman is a small town with a vibrant historic downtown surrounded predominantly by single-family residential neighborhoods and also by agricultural and ranch lands (Newman, 2008). The downtown is centered along Main Street and consists of one- and two-story commercial buildings, many of which are historic and dating from the early 20th century. The area east of Highway 33, extending from the center of town to Newman's southern boundary, is predominantly in industrial and commercial use.

An inventory of structures identified a total of 2,087 parcels with structures located within the 1/500 ACE floodplain of Orestimba Creek (Appendix C). The results of this inventory are shown in Table 4-10. Crows Landing includes a relatively small area of industrial, commercial, and residential land uses. The shipping yard along the railroad at Crows Landing plays an important role in the import and export of agricultural supplies and commodities.

Table 4-10: Number of Parcels with Structures within the 1/500 ACE Floodplain by Land Use

Economic Impact Area	Single-Family Residence	Multiple-Family Residence	Commercial	Industrial	Public	Total
Rural	146	0	0	0	0	146
Urban	1,657	173	75	26	10	1,941
Total	1,803	173	75	26	10	2,087

Source: Appendix C

Newman has established four increasingly inclusive areas which define the extent of planning efforts relative to anticipated development over time (Figure 4-10). The city limits define the area of lands that are already annexed. The primary SOI defines the area that is anticipated to be annexed and would accommodate urban development for the next 10 years (through 2016). The SOI defines the area expected to be annexed and developed for urban land use over the next 20 years. The Newman General Plan anticipates and plans for a mixture of urban development, including commercial, industrial, residential, and other uses. The Planning Area is an area outside of Newman's jurisdictional boundaries that is included in the General Plan to provide recognition to the county and other nearby local and regional authorities, because development in these areas could have an impact on future land use in Newman.

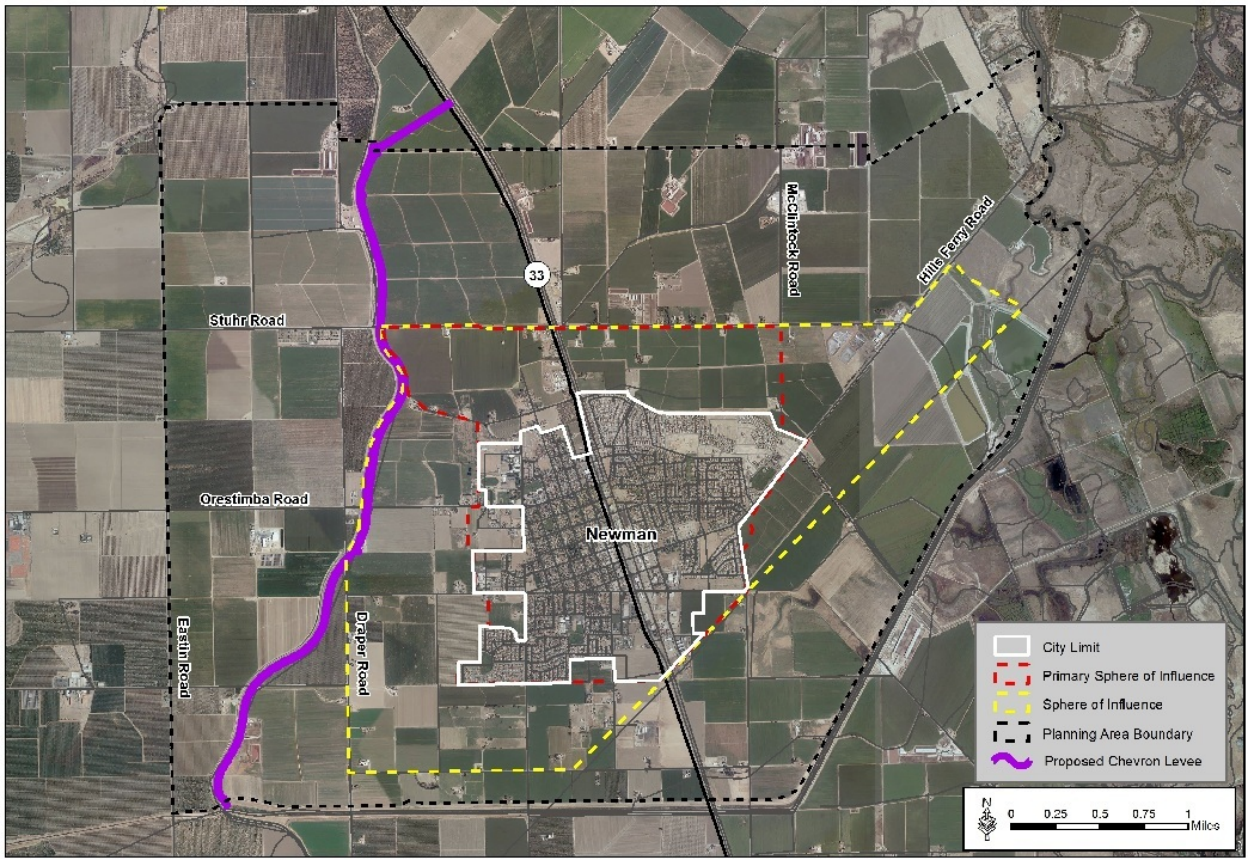

Figure 4-10: Newman Planning Boundaries

Agriculture

The California Land Conservation Act of 1965, commonly referred to as the Williamson Act, enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. In return, landowners receive property tax assessments, which are much lower than normal because they are based upon farming and open space uses as opposed to full market value. Local governments receive an annual subvention of forgone property tax revenues from the state via the Open Space Subvention Act of 1971. State financial support for the Williamson Act was recently eliminated; however, Senate Bill 863 was passed in 2010 as a short-term solution for preserving the program. As of January 1, 2011, counties are allowed to establish new contracts with a reduction in terms from 10 to 9 years and a reduction of tax benefits by 10 percent. Stanislaus County holds Williamson Act Contracts with the land owners of the majority of agricultural parcels in the county (Figure 4-11). There are approximately 480 acres of lands within the Newman SOI currently held under Williamson Act contracts. Non-renewal forms have been filed for nine of these parcels, and these contracts will expire between 2012 and 2014 (Newman, 2007).

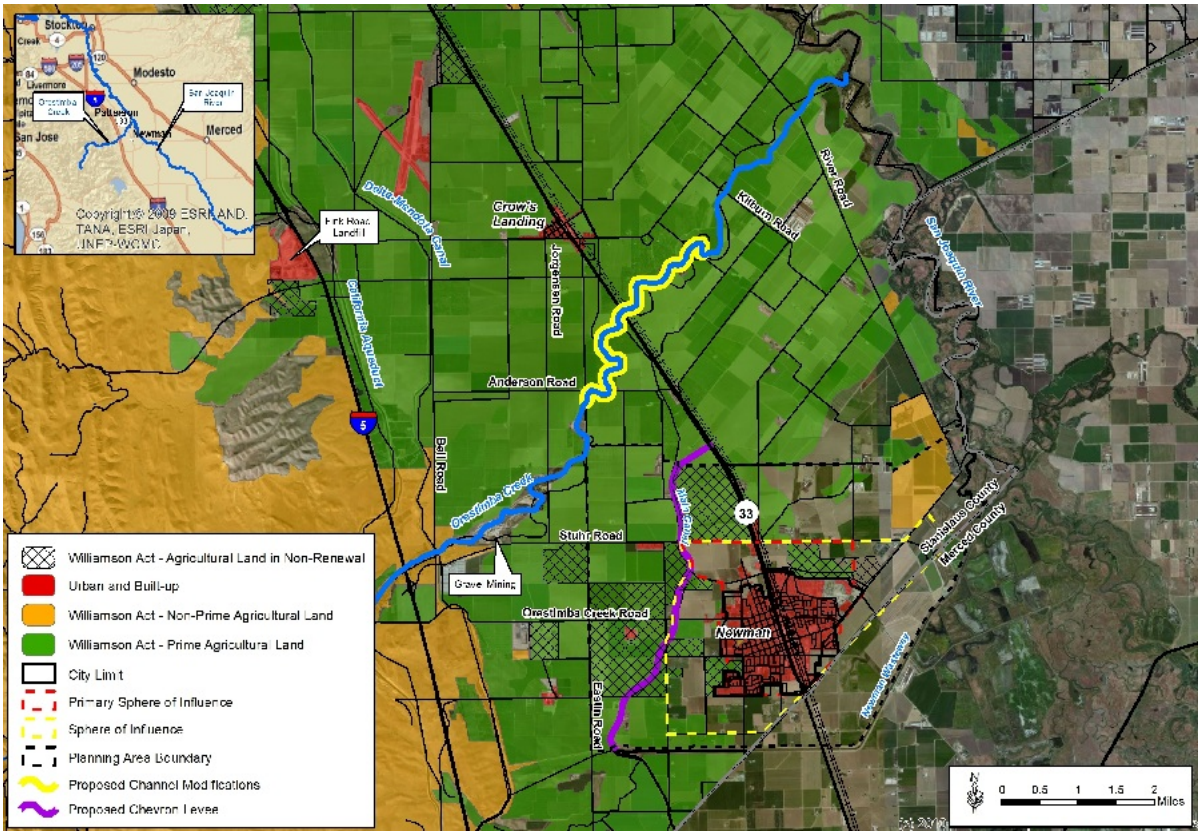

Figure 4-11. Williamson Act Contracts in the Study Area

The Stanislaus County General Plan (1994) designates lands outside of the accepted Newman SOI as agricultural and outlines a number of policies concerning its governance of land use within the county. It is the county's policy, among others, to: (1) restrict the use of lands designated as agricultural to uses that are compatible with agricultural practices, including natural resource management, open space, outdoor recreation, and enjoyment of scenic beauty; (2) protect the riparian habitat along the rivers and natural waterways to the extent possible; (3) deny all uses that intrude into or are located adjacent to an agricultural area if they are detrimental to continued agricultural usage of the surrounding area; (4) promote and protect agriculture as the primary industry of the county; (5) minimize conflict between various land uses resulting from urban expansion; and, (6) promote the diversification and growth of the local economy.

Newman has adopted a right-to-farm ordinance (Municipal Code Section 5.23.140), which recognizes that agricultural operations frequently become the subjects of nuisance complaints and seeks to reduce the premature conversion of farmland by clarifying the circumstances under which an agricultural operation may be considered a nuisance. The ordinance declares it the policy of Newman that commercial agricultural uses in the SOI, or

areas not annexed by Newman, are a priority use, and inconveniences or discomforts arising from such a use shall not be a nuisance. The ordinance also requires discretionary development approvals to require a good faith effort to coordinate with adjacent agricultural operations to reduce potential conflicts.

Newman General Plan

The Newman General Plan is a land use and development plan that is required by state law. It outlines the vision for the future and provides the regulations necessary for the community to manage the growth pressures it now faces. These regulations are designed to allow Newman to manage growth while preserving its small-town atmosphere, high quality of life, and connections to agriculture. While focused on managing growth, the Newman General Plan outlines for growth of Newman that includes the development of farmland within the SOI.

The Newman General Plan proposes land use changes to existing zoning that could result in substantial conversion of farmland to non-agricultural uses. However, existing measures in the Newman General Plan would delay, control, and minimize impacts on farmlands.

The Stanislaus Local Agency Formation Commission (LAFCO) cannot approve Newman's proposed changes to its SOI if the area includes lands under a Williamson Act contract. There are currently three properties within the proposed expansion of the SOI that are under Williamson Act contracts (Figure 4-11). These three properties are located just north of Hallowell Road and abut the southernmost boundary of the proposed SOI. Section 56426.5 of the California Code of Regulations allows LAFCO to approve a change to the SOI when the area includes land under a Williamson Act contract if certain findings can be made. One of the findings that can be made is that "the change would facilitate planned, orderly and efficient patterns of land use or provision of services, and the public interest in the change substantially outweighs the public interest in the current continuation of the contract beyond its current expiration date." Because the Newman General Plan provides for the planned, orderly, and efficient use of land, requiring the development of master plans prior to the development of most of the non-urbanized land within the proposed SOI, and because there is public interest to create a logical, clearly defined southern boundary to Newman that does not create small islands of agricultural land, LAFCO could make the finding necessary to approve the proposed expanded SOI.

The policies and actions of Newman's General Plan would result in the conversion of up to 1,729 acres of Prime Farmland, 710 acres of Unique Farmland, and 196 acres of Farmland of Local Importance to non-agricultural uses and constitute a significant impact on these valuable resources. The majority of farmlands within Newman's SOI are not located within the FEMA 100-year floodplain and development of these lands is not limited by lack of available flood insurance. As discussed below in Section 5.2.14, Williamson Act contracts existing within the proposed Newman SOI are set to expire in 2012 and 2014. Once contracts expire, these lands are likely to be developed for commercial or residential use to compensate for the substantial

increase in property taxes. Stanislaus County has designated most of the undeveloped lands within the proposed Newman SOI as agricultural lands. However, as discussed above, these lands would be zoned for development once annexed by Newman. The General Plan includes the conversion of approximately 0.67, 2.26, and 0.24 percent of the Stanislaus County Prime Farmland, Unique Farmland, and Farmland of Local Importance, respectively. Efforts to mitigate these impacts include designation of an SOI, Newman's Right-to-Farm Ordinance, and requirement of County-approved development plan prior to annexation of lands to Newman.

New development within the Newman SOI would minimize potential incompatibilities between agricultural and urban uses through the careful allocation of land uses, the layout of roads, parks, and public facilities, density controls and transfers, design guidelines for buildings and public and private improvements, and possibly the use of buffers that restrict uses adjacent to agricultural land. Newman would continue to enforce its Right-to-Farm Ordinance (municipal Code Section 5.23.140), that protects owners of agricultural land at the urban fringe from unwarranted nuisance suits brought by surrounding landowners and provides for resolution of urban-agricultural disputes. An Agricultural Mitigation Fee would be implemented as a private, market-based approach to mitigate the loss of agricultural land. The mitigation fee would be used to acquire easement or fee interest in agricultural land that restricts the use to agricultural production in perpetuity. These measures would reduce and partially offset farmland conversion impacts. Nonetheless, even with the mitigation fee, design provisions, agricultural buffer, and Right-to-Farm Ordinance included in the proposed General Plan, a substantial area of Prime Farmland would be converted to urban uses.

The proposed urban land use designations contained in the city limits and proposed SOI would in time lead to the conversion of farmland to urban uses as the Newman General Plan is implemented. The Newman General Plan designates agricultural land within the SOI and on Urban Reserve lands outside the SOI as supporting urban uses in the future. As a result of these urban designations, owners of farmland under Williamson Act contracts may be encouraged to file for non-renewal or early cancellation of their contracts in anticipation of developing their properties.

Agriculture is a significant socioeconomic driver in the study area and surrounding region, and it is important to Newman residents that new development minimizes loss of agricultural land. The Newman General Plan contains a number of policies that provide for the long-term preservation and orderly conversion of farmland within Newman's SOI and planning area.

4.2.15 Transportation

Flow of traffic and safety conditions are typically categorized according to Level of Service (LOS) on a scale from A to F. A roadway categorized as LOS A supports free-flow operations where traffic flows at or above posted speed limits and all motorists have complete mobility between lanes. A roadway categorized as LOS F represents a breakdown in vehicular flow where every vehicle moves in response to the vehicle in front of it and frequent slowing and stopping are required. A roadway functioning at LOS C represents conditions with free-flow operations and few restrictions. Planners typically establish a threshold of LOS C to provide the most efficient flow of traffic without affecting driver comfort and safety. The roadways discussed below are those which cross Orestimba Creek via either low water crossing or bridges and may be impacted by the project (Figure 4-12).

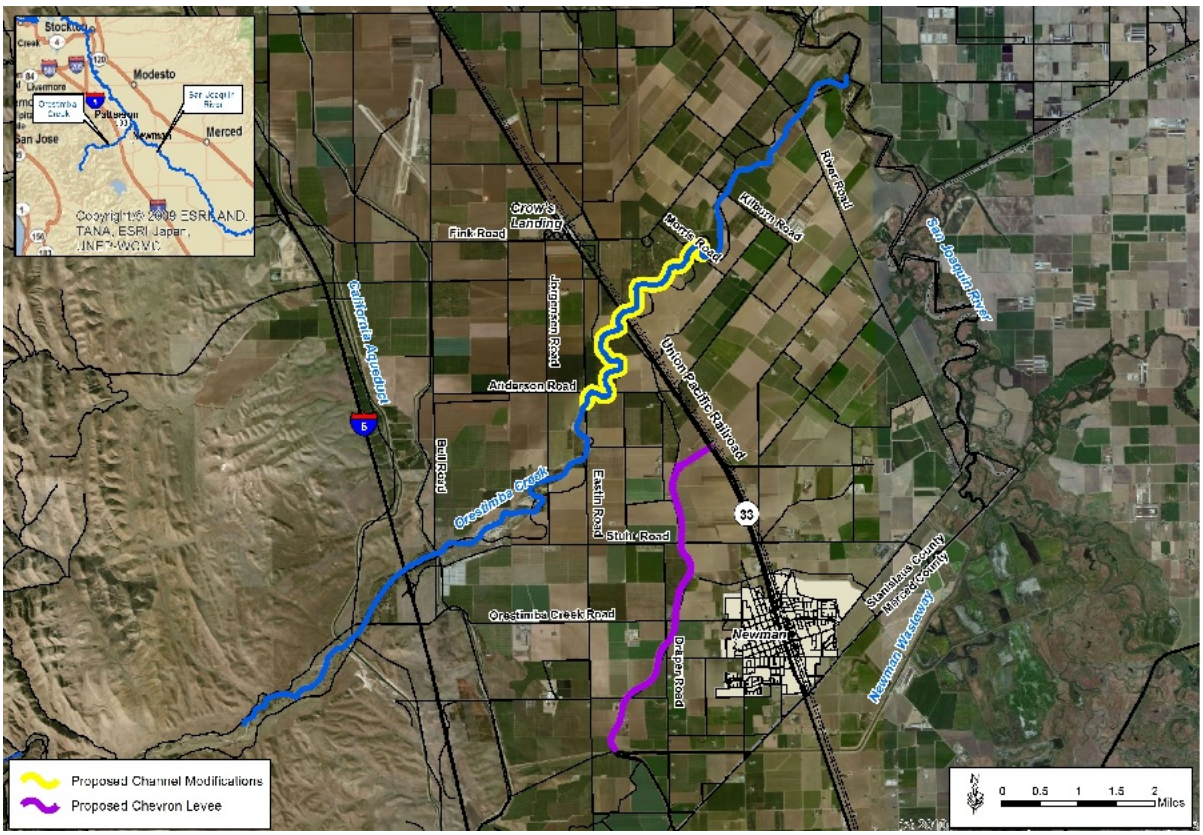

Figure 4-12: Transportation Routes

State-Maintained Highways

There is one interstate highway, I-5, and one state highway, Highway 33, that cross Stanislaus County in or near the study area.

I-5 and Highway 99

I-5 traverses Washington, Oregon, and California from north to south, connecting Vancouver, Canada to Tijuana, Mexico, and is an important corridor for both commuter and freight traffic. As I-5 enters the Central Valley from the south, it splits from Highway 99 and skirts the more remote western extremity of the valley. Highway 99 travels through the Central Valley east of the San Joaquin River and services the larger population centers of the valley, including Bakersfield and Fresno.

Highway 33

Highway 33 has a northwest-southeast alignment and generally parallels I-5 from Patterson to Gustine. Highway 33 can be accessed from I-5 via Stuhr Road. In 2008, the California Department of Transportation (Caltrans) reported average daily traffic (ADT) volumes of 6,900 and 4,600 trips, respectively, for southbound and northbound traffic on Highway 33 at Stuhr Road (Caltrans, 2009). This is somewhat less than ADT volumes in for the same segments reported in 2006 (7,200 and 4,750 trips) and for 2007 (7,300 and 4,800 trips) (Caltrans, 2009). The LOS on Highway 33 is "C or better" according to the Stanislaus County General Plan (Stanislaus County, 1994).

County-Managed Roadways

The different types of Stanislaus County-managed roadways include major, collector, and local roads (Stanislaus County, 2008). The function of a major road is to carry moderate-to-high-volume traffic to and from collectors to other major roads, expressways, and freeways with a secondary function of land access. Collectors generally serve as transition facilities, carrying traffic from lower to higher level roads but also provide access to abutting property. Local roads serve as land access facilities in the agricultural areas of the county. The LOS classifications for Stanislaus County roads that serve the rural portions of the study area are good (LOS C or better with most roads graded LOS A) (Newman, 2007). Potentially affected roads which cross Orestimba Creek or the CCID Main Canal are briefly described below.

Stuhr, Fink, and Draper Roads

Stuhr, Fink, and Draper roads are classified as major roads by Stanislaus County (Stanislaus County, 2008). Stuhr and Draper roads are classified as two-lane arterials by the City of Newman (Newman, 2007). Stuhr Road currently consists of two lanes from I-5 to Highway 33. Stanislaus County has adopted an Official Plan Line for Stuhr Road outside of Newman's Planning Boundary. Adoption of an Official Plan Line indicates possible future improvement of this road. There is no traffic signal at the intersection of Stuhr Road and

Highway 33. The Stanislaus Council of Governments assumes that Stuhr Road will be upgraded to a four-lane road by 2030 to accommodate increased growth. Because Stuhr Road is the most direct access from Newman to I-5 and because the City of Newman anticipates future growth, it is highly likely that this road will require upgrades, including additional lanes and a signal at Highway 33, to maintain its current LOS. Fink Road intersects Highway 33 approximately 6 miles north of Stuhr Road and provides access to I-5 from Crows Landing. Draper Road extends south from Stuhr Road approximately 0.5 mile west of Newman and crosses the CCID Main Canal within the proposed chevron levee alignments.

Orestimba Road

Orestimba Road is classified as a collector road by Stanislaus County (Stanislaus County, 2008) and as a two-lane arterial by Newman (Newman, 2007). Orestimba Road begins in the foothills west of I-5 and continues due east into Newman where it becomes Yolo Street. Orestimba Road crosses Orestimba Creek approximately 0.25 mile west of the California Aqueduct via a two-lane bridge.

Eastin and River Roads

Eastin Road and River Road are classified as collector roads by Stanislaus County (Stanislaus County, 2008) and are outside Newman's Planning Area. Eastin Road extends south from Highway 33 near Crows Landing and crosses Orestimba Creek via a low water crossing south of Anderson Road. River Road generally parallels the San Joaquin River and serves as a loop for Highway 33 from near Patterson to Newman. River Road crosses Orestimba Creek via a two-lane historic bridge.

Bell and Jorgenson Roads

Bell and Jorgenson roads are classified as local roads by Stanislaus County (Stanislaus County, 2008). Both roads extend south from Anderson Road and cross Orestimba Creek via low water crossings. Bell Road connects Stuhr and Fin roads east of the Delta-Mendota Canal and provides access to Anderson Road from the west.

Anderson, Morris, and Kilburn Roads

Anderson, Morris, and Kilburn roads are classified as local roads by Stanislaus County (Stanislaus County, 2008) and are between and generally parallel to Highway 33 and the San Joaquin River. Each of these roads crosses Orestimba Creek via a low water crossing.

City-Managed Roadways

Newman manages roadways within the city limits, including Highway 33. Bicycle paths are planned along Jenson Road and the Sherman Parkway from the CCID Main Canal to McClintock Road, along the CCID Main Canal, and along other roadways within Newman's SOI.

Newman has a number of designated truck routes within the city limits to allow for the safe passage of trucks.

Public Transit

The Newman area is served by Stanislaus County Transit's Westside Runabouts, which combine fixed stops and curb-to-curb service. Westside Runabouts travel along Highway 33 connecting Newman with the communities of Crows Landing and Patterson.

Railroad

CNRR operates freight service in northern California along 250 miles of leased Union Pacific Railroad's (UPRR) rail lines (UPRR, 2008). UPRR provides 54.7 miles of freight service to Stanislaus County, including a stop at Crows Landing, over a line extending from Los Banos to a connection with the UPRR at Tracy. Commodities carried include lumber, wine, beer, food products, steel pipe, agricultural products and construction material.

4.2.16 Utilities

Water Services

Groundwater is Newman's potable water source. All areas of the proposed project are underlain with groundwater, and water levels vary from 30 to 50 feet below ground surface (Newman, 2007). Groundwater wells are typically drilled to a depth of approximately 500 feet. Water quality is an area of concern due to high salinity levels; however, taste of Newman water is generally more of a concern rather than health. Currently, Newman has no treatment measures to reduce the salinity of groundwater, although several have been explored and rejected due to the special requirements for handling and disposal of byproducts that are produced in the treatment process. In order to meet future water supply needs, Newman and CCID are actively exploring the acquisition of surface water from the Delta Mendota Canal (Newman, 2007).

In 1982, most of Newman's water mains were enlarged, gridded, and connected for increased fire flow and improved water supply. New development is required to provide a looped water system to ensure greater water supply and pressure. The new water mains are required to have a minimum diameter of 8 inches for service mains and 10 and 12 inches for all distributing mains. Connection fees and fees for new construction are also levied on new development. A new well is needed for approximately every 600 units (Newman, 2007). In addition, when the water mains were replaced, new steamer-type hydrants with three hose connections replaced 276 old hydrants. The new hydrants now supply water for fire flow that is deemed satisfactory for Newman.

There are currently four wells that serve Newman. The maximum pumping capacity of all four wells combined is 6,000 gallons per minute or 8.6 million gallons per day (Newman, 2007). This capacity is sufficient to serve future expansion of the current city limits, and it is

expected that there will continue to be sufficient groundwater available to serve future growth with new wells.

Waste Water

Newman's Waste Water Treatment and Disposal Facility (WWTDF) is located 1 mile northeast of Newman on 450 acres land along Hills Ferry Road and adjacent to the San Joaquin River. The facilities provide primary and secondary waste water treatment, and the WWTDF are currently in compliance with all applicable waste water discharge and monitoring requirements (Newman, 2007).

Treated water is disposed through overland flow irrigation and flood irrigation. A total of 239 acres of agricultural land is currently irrigated and farmed by a third party contracted by Newman. The irrigation system includes a 29-acre storage reservoir, an irrigation canal, a recovery/circulation ditch, a tailwater collection pond, and a return pump station. The current irrigation acreage and storage capacity are adequate to handle flow from the proposed project. Into the future, however, it is anticipated that Newman would need an additional 406 acre-feet of storage pond in order to meet the projected 2025 waste water flows of 2.22 million gallons per day (mgd) average dry weather flow (Newman, 2007).

The WWTDF have a current operational capacity of 1.37 mgd and a permitted capacity of 1.69 mgd (Newman, 2007). It is anticipated that the projected operational capacity would be slightly exceeded with the building of all currently approved subdivisions within Newman; however, this exceedance would not cause a public health or safety issue since it is within the permitted capacity. Peak flows generally occur in the summer months due to increased inflow and infiltration of agricultural irrigation and are projected to be 1.60 mgd in the near future (Newman, 2007). The capacity of the waste water treatment plant is currently a major factor limiting growth in Newman. The City of Newman is actively working to create and approve a plan for additional waste water facilities.

Stormwater

The City of Newman is responsible for stormwater collection, drainage, and disposal and maintains and services all storm drains within the city limits. In addition to storm drains, some agricultural ditches used for irrigation supply and tailwater runoff are located within the area. These ditches are maintained by the CCID.

Drainage within the area generally flows from west to east. Storm runoff is collected in underground pipes and CCID ditches and then piped to a pump station at Inyo Avenue and Canal School Road. A main pipe along Inyo Avenue collects drainage from Newman pipe system north of Inyo Avenue. This pipe is the primary bottleneck in the current system. Newman has plans to upgrade approximately 750 to 1,000 feet of pipe to 60-inch diameter (Newman, 2007). After this upgrade, the storm drain system would be adequate to serve existing and approved new development. Currently, this pump system is operating below capacity.

The stormwater system also includes an open channel storm drain that runs from the railroad west to Hills Ferry Road along Sherman Parkway and collects runoff from the northeast areas of Newman. In the southwest portion of Newman, the CCID Clery Ditch collects stormwater from the Creekbridge subdivision, and the CCID Miller Ditch runs near Shiells Road and drains the Stephens Ranch and Canyon Creek areas. At this time, a large portion of Newman discharges into the Wasteway without water quality treatment. As the Newman population continues to approach 10,000 residents, Phase II NPDES permitting, which would likely involve the treatment and monitoring of stormwater, would be required.

Solid Waste

The Bertolotti Disposal Company serves as the waste hauler for Newman. They serve approximately 3,000 households and businesses in and around Newman (Newman, 2007). Bertolotti Disposal Company collects recycling once every 2 weeks, as well as normal household waste weekly. In 2000, approximately 49 percent of Newman's waste came from households, and 51 percent came from businesses. Newman disposed of 3,344 tons of household waste, with a residential daily disposal rate of 3 pounds per resident per day. Business waste disposal was approximately 3,480 tons, with an employee daily disposal rate of 12.7 pounds per day in 2000 (Newman, 2007). Of the 6,824 tons of non-recycled waste disposed of by Newman, 2,253 tons were taken to the Fink Road Landfill, and 4,571 tons were burned at the Covanta Stanislaus Transformation Facility (Newman, 2007).

Nearly 70 percent of the total waste received at the Fink Road Landfill is processed at the on-site waste-to-energy cogeneration plant run by Covanta Energy. The waste-to-energy plant generates approximately 30 tons of ash per day. The remaining 30 percent of waste, approximately 300 to 400 tons per day, is deposited in the landfill. The Fink Road Landfill has a permitted capacity until 2022 or 2023, depending on the type of permitted waste (such as ash) generated by the cogeneration versus municipal solid waste. In order to accommodate waste after 2023, the Fink Road Landfill is currently undergoing a permitting process with Stanislaus County to expand its site westward onto adjacent property owned by the county. A recycling center would also be included in this expansion in order to reduce the total amount of landfill waste. The Fink Road Landfill is currently permitted to accept up to 2,400 tons of waste per day (Newman, 2007).

Energy Use and Conservation

In Newman, energy conservation efforts aim to reduce electricity and private automobile use, encourage alternate energy sources, efficiently site buildings for optimal sun exposure, and implement land use and transportation policies that encourage fewer and shorter vehicle trips. Newman enforces the State (Title) 24 Building Codes on energy efficiency for all new development and also standard conditions for incorporation of solar energy conservation. Additional energy efficiency would be achieved by requiring that all new residential development meet the State Energy Star qualifications.

4.2.17 Recreation

Henry W. Coe Park (Coe Park), located 20 miles west of the study area along the headwaters of Orestimba Creek, is the largest state park in northern California, with over 87,000 acres of wild open spaces (Coe Park, 2008). The terrain of the park is rugged, varied, and beautiful, with lofty ridges and steep canyons. Within Coe Park are the headwaters of Coyote Creek, long stretches of Pacheco and Orestimba creeks, and a 23,300-acre wilderness area. The park is open year-round for hikers, mountain bikers, backpackers, equestrians, car campers, picnickers, photographers, and other visitors.

Newman provides three city parks, Harold R. Densmore, Pioneer, and Hurd Barrington parks, within its city limits (Newman, 2007). Other recreational opportunities near the study area include a community swimming pool, a youth center, and a public library. The Newman General Plan proposes to construct a bicycle path west of and parallel to the CCID Main Canal. There are no other existing or planned recreation features in or near the proposed chevron levee footprint. There is no established recreation on Orestimba Creek, and recreational access to the area above the California Aqueduct is restricted by penalty of law.

4.2.18 Aesthetics

An area's visual character is determined by the variety of the visual features present, the quality of those features, and the scope and scale of the scene. The visual components of a particular area consist of such features as landforms, vegetation, man-made structures, and land use patterns. The quality of these features depends on the relationship between them and their scale in the overall scene.

In assessing the aesthetic effects of a project, the visual sensitivity of the site must be considered. Areas of high visual sensitivity are easily visible to the general public. Scenic highways, tourist routes, and recreation areas generate sensory reactions and evaluations by the observer. The evaluations of a particular scene will vary depending on the perceptions and values of the observer. The determination of significance of potential aesthetic effects is based on the change in visual character as determined by the obstruction of a public view, creation of an aesthetically offensive public view, or adverse changes to objects having aesthetic significance.

The study area is a primarily rural environment in the southern portion of the San Joaquin Valley of central California. The area possesses a pleasant atmosphere, oriented around its agricultural heritage. Newman possesses a small town feel, with a quaint, partially rehabilitated central core. Entry corridors are important visual amenities to travelers to and from Newman, and designated gateways can greatly enhance Newman’s small-town image. There are three existing or proposed gateways located on Stuhr Road at the following intersections: CCID Main Canal, Highway 33, and Hills Ferry Road.

The alluvial fan around Newman is dominated by row cropping and orchards. The Diablo Range and its foothills rising above the town provide a pleasing backdrop to the populated portion of the watershed. Both the foothills and the mature stand of Sycamore Alluvial Woodland are easily visible from the I-5 Bridge over Orestimba Creek. The mountainous headwaters are almost completely undeveloped, and provide a stark contrast to the developed portion of the watershed further downstream. The watershed possesses an aesthetic quality that appeals to people not oriented toward an urban lifestyle.

4.2.19 Noise

The area surrounding Orestimba Creek and Newman is extremely rural and the typical noise environment is relatively quiet. Agricultural and gravel mining operations, vehicle traffic on I-5 and Highway 33, and intermittent trains are the primary sources of noise levels greater than ambient conditions. Thresholds for noise exposure are normally expressed using an average daily exposure level over an extended period of time, or average day-night-level (DNL). To account for greater noise sensitivity during evening hours, nighttime noise exposure is more heavily weighted than daytime exposure in the calculation of DNL. Short-term noise levels measured over a brief period are expressed as Leq. Sound intensity is measured in decibels (dB). Because the intensity of noise does not increase linearly with increasing dB, noise levels are often expressed using the A-scale (dBA), so that a doubling of dBA represents a doubling of intensity.

The City of Newman measured ambient noise levels within the study area during development of the 2007 General Plan. To characterize the noise exposure along Highway 33, a noise measurement was taken just north of Crows Landing approximately 50 feet from the centerline of the highway. The measured noise level was approximately 72 dBA DNL. The average hourly noise level ranged from approximately 65 to 70 dBA during the daytime, and dropped to approximately 57 dBA at night. Noise measurements of approximately 70 to 74 dBA were also recorded at a location 75 feet from Stuhr Road and Highway 33 (Newman, 2007).

Currently, one freight train goes southbound through Newman to Volta and then returns back through town northbound each weekday along the UPRR line, during daytime hours. Train movements typically generate maximum noise levels of about 90 dBA at a distance of 100 feet. In locations without horn soundings, train operations generate noise levels of about 54 dBA DNL at a distance of 100 feet from the tracks. Where warning horns are used, the DNL is approximately 60 dBA at a distance of 100 feet. DNL generated by traffic along Highway 33 dominate the noise environment along the tracks at many locations.

4.2.20 Hazardous, Toxic, and Radiological Materials and Waste (HTRW)

Products as diverse as gasoline, paint solvents, film solvents, household cleaning products, refrigerants, and radioactive substances are categorized as hazardous materials. What remains of a hazardous material after use or processing is considered to be a hazardous

waste. Many of the commercial and industrial operations in Newman use hazardous materials and generate hazardous materials as part of their daily operations. Some examples of hazardous material users include gasoline stations, dry cleaners, and automotive repair shops. Additionally, hazardous materials are used by agricultural operations in the form of pesticides, herbicides, and fertilizers; and by residential households, including cleaning supplies and paints. A search of Federal, state, local, and tribal databases was conducted in 2010 (Environmental Data Resources, Inc. [EDR], 2010) for records of historical and existing hazardous material generation, handling, transport, or storage facilities within 1 mile of the construction footprint (Figure 4-13, Table 4-11). A total of 10 underground storage tanks (UST) were identified within the search radius. Each of the USTs was listed on a historic database and their current status is unknown. The contents stored within these USTs were listed as diesel or gasoline. Site #10 was identified as having violated three Federal regulations in 1998, but was in compliance as of 1999.

Table 4-11: Findings of Database Records Search for HTRW within 1 Mile of the Construction Footprint

Measure	Database	Map ID (see Figure 4-13)
Channel Modifications	Historical UST	1,2,3,4
	SWEEPS UST	1,2,4
Chevron Levee	Historical UST	6,7,8,9
	SWEEPS UST	6,9,10
	RCRA Non-Gen	10
	FINDS	10

Source: EDR, 2010

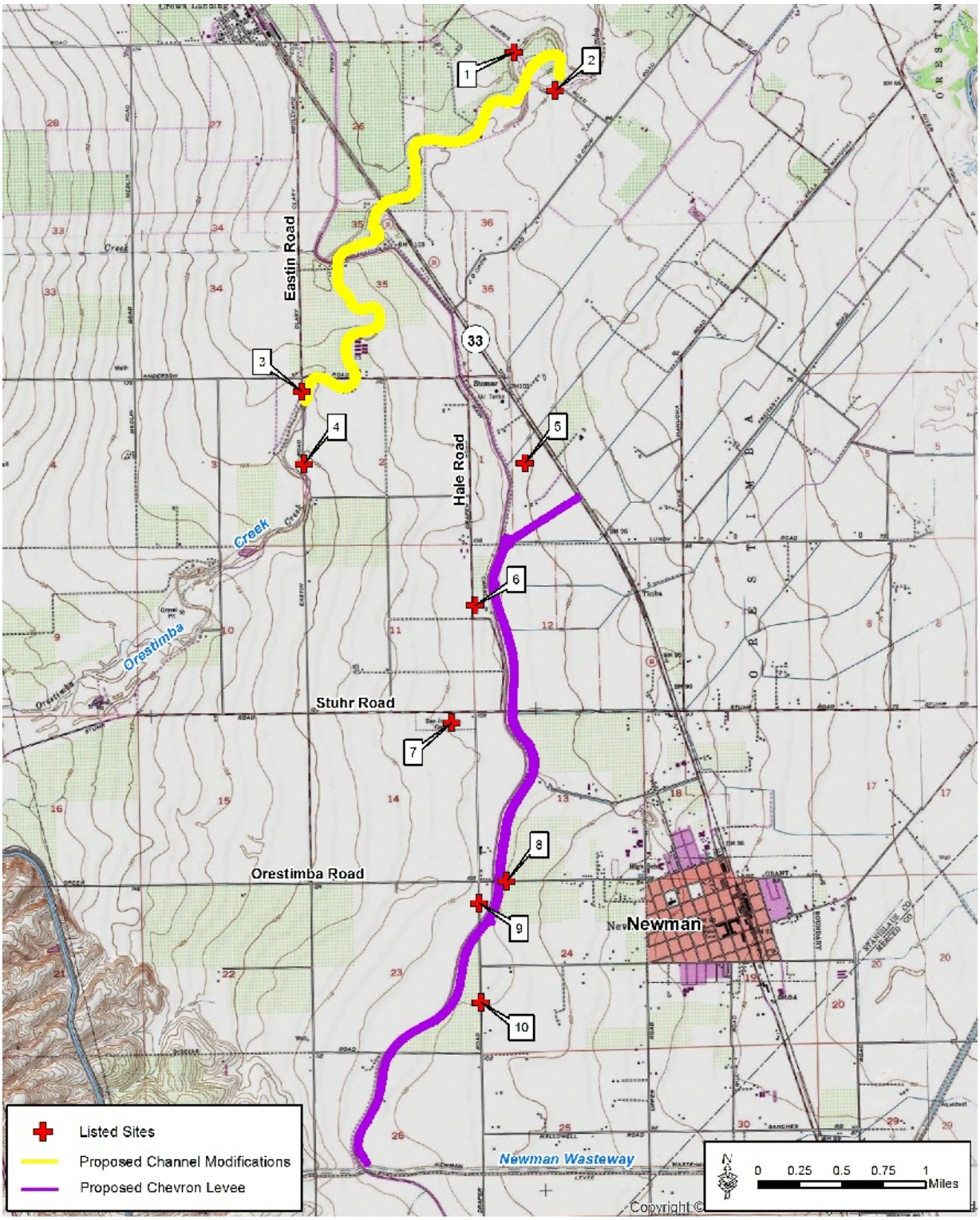

Figure 4-13: Location of Potential USTs within 1,000 feet of Project

4.2.21 Cultural Resources

Regulatory Setting

Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800) requires Federal agencies, or those they fund or permit, to consider the effects of their actions on the properties that may be eligible for listing or are listed in the National Register of Historic Places. To determine whether an undertaking could affect National Register-eligible properties, cultural resources (including archeological, historical, and traditional cultural properties) must be inventoried and evaluated for listing in the National Register prior to implementation of the undertaking.

CEQA also requires that for public or private projects financed or approved by public agencies, the effects of the projects on historical resources and unique archeological resources must be assessed. Historical resources are defined as buildings, sites, structures, objects, or districts that have been determined to be eligible for listing in the California Register of Historical Resources. Properties listed in the National Register are automatically eligible for listing in the California Register.

The Orestimba Creek Project is subject to the stipulations of the 2012 Programmatic Agreement between USACE, the California State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation regarding implementation of the Orestimba Creek Project. The agreement requires that USACE consult with SHPO and signatories of the agreement regarding its determinations of eligibility and findings of effect once an alternative has been selected.

Cultural Setting

The term “cultural resources” is used to describe several different types of properties: prehistoric and historic archeological sites; architectural properties, such as buildings, bridges, and infrastructure; and resources of importance to Native Americans (traditional cultural properties). Artifacts include any objects manufactured or altered by humans.

Prehistoric archeological sites date to the time before recorded history. This area of the U.S. consists primarily of sites associated with Native American use before the arrival of Europeans. Archeological sites dating to the time when these initial Native American-European contacts were occurring are referred to as protohistoric. Historic archeological sites can be associated with Native Americans, Europeans, or any other ethnic group. In the study area, these sites include the remains of historic structures and buildings.

Structures and buildings are considered historic when they are more than 50 years old or when they are exceptionally significant. Exceptional significance can be gained if the properties are integral parts of districts that meet the criteria for eligibility for listing in the National Register or if they meet special criteria considerations.

A traditional cultural property is defined generally as one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history; and (b) are important in maintaining the continuing cultural identity of the community (National Park Service, 1998). Although normally associated with Native Americans, traditional cultural properties can include those that have significance derived from the role the property plays in any cultural groups' or communities' historically rooted beliefs, customs, and practices.

According to 36 CFR 800.16(l)(1), historical property is defined as "…any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria."

Cultural Resources in the Area of Potential Effects (APE)

A records search was conducted at Central California Information Center (CCIC) at California State University, Stanislaus in Turlock on August 15, 2008 to determine whether additional cultural resource investigations have occurred within the study area since the initial records search was conducted by USACE in 2001. It was determined that no additional archaeological investigations have been conducted within the study area since the 2001 records search. The results of the 2001 records search indicated that 10 cultural resource studies have been conducted within the study area (Table 4-12). As a result of these studies, there are 12 recorded prehistoric archaeological sites and eight recorded historic sites within the study area.

Table 4-12: Previous Cultural Resource Studies within the Study Area

CCIC #	Author/Date	USGS Quadrangle
621	Moratto *et al.* 1990	Crows Landing, Newman, Orestimba Peak
2753 a&b	Moratto *et al.* 1995	Crows Landing, Newman, Orestimba Peak
883	Napton 1980	Newman
911	Napton 1990	Newman Orestimba Peak
913	Napton 1991	Crows Landing
1715	Napton 1992	Newman
1846	Canaday, Ostrogorsky, and Hess 1992	Newman
1950	Department of Parks and Recreation 1993	Orestimba Peak
3120	Derr 1997	Newman
3265	Derr 1998	Newman

Source: CCIC records search, 2008

In September 2012, a Programmatic Agreement was agreed upon by USACE and SHPO. The Programmatic Agreement identifies specific stipulations that take into account the effects of the proposed project on cultural and historic properties. In addition to other specific requirements of the Programmatic Agreement, additional records and literature searches would be conducted prior to conducting archaeological surveys of the APE. Consultation with Native American groups and individuals to identify properties of cultural significance would be maintained and complete field surveys would be conducted prior to any construction.

Prehistoric Context

Newman is within the historic territory of the Yokuts people. Prior to European settlement, the Yokuts consisted of numerous separate tribes speaking the same language. Yokut tribes populated the San Joaquin Valley from the Sacramento-San Joaquin Delta to the current location of Bakersfield, including the foothills of the Sierra Nevada range to the east and the foothills of the Coast Range to the west. Historically, much of the study area consisted of marshlands, which supported large numbers of resident and migratory waterfowl. The Yokut likely hunted in the study area, and the potential for prehistoric resources to be scattered throughout the study area is high.

Prehistoric Resources

Existing records and previous studies indicate that 12 prehistoric sites have been identified within the study area. These sites may be determined eligible for listing on the National Register of Historic Places (NRHP) in consultation with the State Historic Preservation Officer (SHPO). Previously identified prehistoric resources include occupation sites, a signal hill or shrine, rock shelters, and several bedrock milling sites. Eligibility for listing in the NHRP has not been determined for each of the identified prehistoric resources. None of these resources occur east of the Delta-Mendota Canal.

Pursuant to the Programmatic Agreement described above, further actions would be conducted to identify and evaluate sites, assess any adverse effects, and mitigate if necessary.

Historic Context

Prior to the construction of irrigation systems, much of the marshland surrounding Orestimba Creek and the San Joaquin River remained intact, and agriculture was primarily limited to cattle ranching on the vast grasslands. Efforts to bring irrigation water to the San Joaquin Valley began in 1866 when Mr. John Bensley became involved in a corporation formed to build a new canal system connecting the Tulare Lake Basin to the San Joaquin River at the southern end of the San Joaquin Valley. From there, the canal system would extend north to Sacramento, San Joaquin Delta, San Francisco Bay, and the Pacific Ocean. At the time, Miller and Lux owned much of the water rights in the area which Bensley proposed to construct his canal system. Under the agreement entered into on May 18, 1871, Miller and Lux subsidized the newly formed canal company in exchange for a discounted price on irrigation and livestock water. This same year, the first permanent dam at the Mendota Pool was finished and impounded waters of the San Joaquin River were diverted into the headworks of the newly

constructed Main Canal. In its early years, Bensley's canal company was largely unsuccessful. Miller and Lux wrestled control away from the original investors and immediately embarked on a rapid fire campaign of canal construction. From the early 1870s through the 1920s, virtually all construction of what is now the CCID occurred. In 1937, the heirs of Miller and Lux exchanged water rights on the San Joaquin River for water to be provided by the Central Valley Project. This accord, "The Exchange Contract," remains the backbone of CCID's water supply to this day. The Central Valley Project resulted in construction of the Delta-Mendota Canal, the Friant Dam, and brought irrigation to the east side of the valley.

The Southern Pacific Westside railroad line was constructed between 1888 and 1913 and provided a rail line west of the San Joaquin River from Tracy south towards Fresno. Completion of the line had a noticeable social impact along its route and played a crucial role in the establishment of Newman. At the close of the Civil War, German-born businessman Simon Newman moved to Hills Ferry where he operated a successful mercantile business. In 1887, Mr. Newman saw an opportunity to expand his business by moving it adjacent to the rail line. He convinced others in Hills Ferry to move their businesses as well, and just one year later, the town of Newman was founded.

Historic Resources

Existing records and previous studies indicate that eight historic sites have been identified within the study area. Four of these sites are located in the Orestimba Peak quadrangle, which is entirely west of I-5, and would not be affected. These historic resources include an early concrete bridge, a sheep dip and refuse site, a historic habitation site, and a water storage site. Potentially affected resources east of I-5 include Yrenero Corona Ranch, Charles A. Hutching's grave, the railroad trestle, and the CCID Main Canal and associated irrigation features.

Yrenero Corona Ranch site CA-STA-172H (P-50-000257), was originally referenced by Latta (1977). The first historic settler on Orestimba Creek, Yrenero Corona, settled the area in 1859. The ranch house is no longer standing. During interviews with local residents, Napton (1980) reports of "…finding bottles and other historic refuse near the former house site." Charles A. Hutching's grave and other unmarked graves site CA-STA-177H (P-50-000257) are located near Corona Ranch. Mr. Hutchings (1790 – 1871) was a clerk of the first school on the west side of the county, a private institution. Mr. Hutchings, his wife, and possibly Yrenero Corona's daughter are buried at the site. There is one standing grave marker at the location with a small white wooden fence enclosing the site (Napton, 1980). During the August 2008 record search at the CCIC, it was noted that no additional investigations have been conducted at these sites, and no NRHP eligibility recommendations have been made.

The CCID Main Canal (P-50-0000065) (also known as the San Joaquin and Kings River Canal) is part of a valley-wide water distribution system constructed in the 1870s. Early irrigation in the San Joaquin Valley encompassed low-lying areas adjoining the San Joaquin River south of Stockton. In the late 1860s, much of this riparian land was controlled by the partnership of Henry Miller & Charles Lux and Bank of California President William Ralston.

Together, these three formed the San Joaquin and Kings River Canal Irrigation Company. In the 1870s, the company proposed a valley-wide system of water distribution; the CCID Main Canal is a product of this system. Construction began on the San Joaquin and Kings River Canal in 1871. The construction date of the section of the CCID Main Canal that is part of the area of potential effects is unknown, although it appears on a 1939 soils map and the 1908 USGS Panoche Quadrangle as the "San Joaquin and Kings River Canal."

Southern Pacific Westside Railroad site CA-STA-350H (P-50-000001) is the UPRR Line now operated by CNRR, but was formerly owned and operated by the San Pablo & Tulare Extension Railway Company (Fickeworth, 1992). The San Pablo & Tulare Railroad line was incorporated by the Southern Pacific Railroad on February 7, 1887. No site records have been reported within the area of potential effects, but this line has been designated the same trinomial as the San Joaquin Valley Main Line (CA-STA-350H [P-50-000001]) elsewhere in Stanislaus County. UPRR has replaced or refurbished most of the bridges and trestles currently in use today, and the trestle within the study area is not likely to be a historic feature. Although the line itself is designated as a historic site, the modern trestle does not contribute to the historic character of the line.

Pursuant to the Programmatic Agreement described above, further actions would be conducted to identify and evaluate sites, assess any adverse effects, and mitigate if necessary.

CHAPTER 5 – EFFECTS ASSESSMENT*

5.1 INTRODUCTION

This chapter assesses the effects of the proposed alternatives on the affected environment described in Chapter 4. This assessment will be used to determine whether the proposed action would result in significant adverse effects on the environment, thus requiring the preparation of an Environmental Impact Statement and/or Environmental Impact Report, or whether the types and significance of effects of the proposed action would support a Finding of No Significant Impact and/or Mitigated Negative Declaration. When necessary, mitigation measures are provided to avoid or reduced potential adverse effects to a less than significant level. This chapter is organized to meet CEQA requirements for an impact-by-impact determination of effect, but will also be used to determine the overall effect of each alternative, as required by NEPA. Significance thresholds used in this assessment are derived from the Newman General Plan of 2007, the Stanislaus County General Plan of 2008, CEQA Guidelines (CERES 2007), and State and Federal regulations and policies.

5.2 EFFECTS DETERMINATION

5.2.1 Seismicity

Implementation of a project alternative would result in a significant seismic impact if it would expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

- Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
- Strong seismic ground shaking; or
- Seismic-related ground failure, including liquefaction, landslides, mudslides, or other similar hazards.

Alternative 1: No Action

Newman and surrounding areas are located in an area of low seismic risk. The nearest Alquist-Priolo Earthquake Fault Zone is located west of the Delta-Mendota Canal near the foothills of the Diablo Range. Development of lands within this zone is limited by Stanislaus County policies and regulations, as well as rugged terrain and lack of infrastructure. The San Joaquin Fault underlies the Orestimba Creek watershed and the southwest corner of Newman's SOI. Newman requires new development and substantial renovations to comply with current seismic standards for construction and requires geotechnical engineering studies for major new buildings or earthworks. The No Action Alternative would not result in development within

areas of high seismic risk or expose people or structures to adverse effects of seismic activity. The No Action Alternative would not result in significant adverse effects due to seismic conditions.

Alternative 2: Chevron Levee (NED)

Alternative 2 could result in significant indirect effects, but these would be mitigated to less than significant through proper levee design and construction. The proposed chevron levee would not be located in the Alquist-Priolo Special Study Zone; however, the San Joaquin Fault underlies the proposed chevron levee alignment and the CCID Main Canal near the Newman Wasteway. Alternative 2 would not directly expose people to adverse effects of seismic activity. No people or structures would be located within the levee footprint, and none would be at risk of damage from seismic-related levee damage.

The location of the proposed chevron levee over a known fault would indirectly expose people and structures to potential adverse effects if seismic-related levee failure occurred during a flood event. When properly designed and constructed, earthen levees are resistant to strong seismic shaking. Seismic damage to earthen levees is typically limited to minimal shifting or settling of earthen materials. Although shifting or settling of the levee materials could result in overtopping of the levee, levee failure is highly unlikely to occur. Thus, seismic damage to the levee could result in increased flood damage on the protected side of the levee. Increased flood damage would be proportional to the seismic damage occurring and would not substantially affect the extent, depth, or duration of flooding occurring under design conditions.

To ensure long-term stability of the levee, a geotechnical study would be completed during the preconstruction engineering and design (PED) phase, and levees would be constructed following State of California and USACE guidelines for levee construction. With a geotechnical study and implementation of appropriate design measures, the potential indirect impacts of seismic activity would be less than significant.

Mitigation

Impacts on seismicity would be less than significant and no mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

Implementation of Alternative 3 would have less than significant impacts similar to Alternative 3.

Mitigation

Impacts on seismicity would be less than significant and no mitigation is required.

5.2.2 Geology

Implementation of a project alternative would have a significant geologic effect if it would:

- Substantially alter natural geologic processes resulting in hazardous conditions;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in an on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse; or
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the State.

Alternative 1: No Action

Under the No Action Alternative, the geologic processes associated with flooding of Orestimba Creek would be minimally impacted. Gravel mining and the construction of levees, berms, and bridges have altered the patterns of sediment deposition on the alluvial fan and in the channel. Additionally, these factors have affected the patterns of channel scouring. These actions have largely had local effects on geologic processes. Flooding and the associated depositional process still occur throughout much of the historic alluvial fan. Flood waters upstream of the trestle overtop both the CCID Main Canal berms and the railroad track berm at multiple locations where flood flows typically follow east-west roads to the San Joaquin River. The metering of flows past the UPRR trestle has scoured the main channel of Orestimba Creek, which is expected to maintain its current capacity. Hazardous conditions arise during flood events; however, these conditions are largely the result of natural patterns of flooding, and geologic process would remain minimally impacted.

Because the study area is generally flat, the potentials for landslides, lateral spreading, and collapse of geologic features are low. The groundwater table can be near the surface throughout the study area, and these areas are subject to liquefaction. Due to the high expansion potential of most soils, local subsidence is common. To minimize the potential for hazardous conditions, Newman requires new development and substantial renovations to comply with current seismic standards for construction and requires geotechnical engineering studies for major new buildings or earthworks. Construction grade aggregate deposits occur throughout the study area and are currently being mined on Orestimba Creek. Mineral resources would remain available for mining. The No Action alternative would result in less than significant effects on geologic processes and resources of the study area.

Alternative 2: Chevron Levee (NED)

Implementation of Alternative 2 would alter the pattern of geologic processes, but would not substantially affect hazardous conditions occurring as a result of deposition and erosion. Under Alternative 2, deposition on the floodplain would be located upstream of the chevron levee and would be reduced in frequency. It is anticipated that channel capacity would continue to be maintained through the natural processes of deposition and scouring. The potential for in-stream deposition or scouring of the channel to cause substantial hazardous conditions would remain minimal.

The chevron levees would be located on expansive soils and could be located in areas where the groundwater table is high. Subsidence or liquefaction of soils underlying the chevron levee could result in hazardous conditions and would be a significant geological impact, but would be mitigated to less than significant as described below.

High quality aggregate is found in the subsurface materials throughout the Orestimba Creek basin. Construction of chevron levees would not remove or affect the availability of these mineral resources.

Mitigation

To ensure long-term stability of the levee, a geotechnical study would be completed during the PED phase, and levees would be constructed following State of California and USACE guidelines for levee construction. With a geotechnical study and implementation of appropriate design measures, based on the study results, the potentially significant impacts resulting from underlying geologic conditions would be less than significant.

Alternative 3: Chevron Levee with Freeboard (LPP)

Alternative 3 would affect geologic processes similar to Alternative 2. Subsidence or liquefaction of soils underlying the chevron levee could result in hazardous conditions and would be a significant geological impact, but would be mitigated to less than significant as described below. High quality aggregates found in the basin would not be affected.

Mitigation

A geotechnical study and implementation of State and USACE construction guidelines would be required to reduce impacts to less than significant.

5.2.3 Soils

Implementation of a project alternative would have a significant impact on soils if it would result in substantial soil erosion or the loss of topsoil.

Alternative 1: No Action

Due to the limited topography and depth of flooding on the alluvial plain, erosion processes are minimal. City and County regulations control soil erosion resulting from development, and the long-term potential for loss of top soil is discountable. The impact would be less than significant.

Alternative 2: Chevron Levee (NED)

The study area is generally flat, and the long-term potential for substantial erosion of soils to occur is minimal. The construction footprint of the NED levee, including the levee footprint, staging areas, haul routes, and a 20-foot buffer within the construction right-of-way would total less than 152 acres. Due to the large area of soils that would be temporarily exposed during construction, the short-term potential for erosion to occur would be significant but would be mitigated to less than significant as described below. Long-term soil erosion would be avoided through appropriate design measures as described below.

Mitigation

A Storm Water Pollution Prevention Plan (SWPPP) incorporating site-specific measures to reduce erosion would be developed by the contractor prior to construction, and erosion protection measures would be monitored to ensure that soil loss is less than significant. Compliance with the conditions of an encroachment permit from the San Joaquin Valley Flood Control District would further reduce the potential for substantial erosion to occur. The potential for substantial erosion to occur as a result of chevron levee construction would be less than significant.

Alternative 3: Chevron Levee with Freeboard (LPP)

Construction of the chevron levee would disturb approximately 152 acres of soils. Due to the large area of soils that would be temporarily exposed during construction, the short-term potential for erosion to occur would be a significant impact, but would be mitigated to less than significant as described below.

Mitigation

A SWPPP would be developed prior to construction to ensure that soil erosion is less than significant, and compliance with the conditions of an SJVFCD encroachment permit would further reduce the potential for substantial erosion to occur.

5.2.4 Hydrology

Implementation of a project alternative would have a significant hydrologic impact if it would expose people or structures to a substantial risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam, or if it would

substantially alter the existing drainage pattern of the site or area in a manner which would result in substantial erosion, siltation, or increased flooding on- or off-site.

Alternative 1: No Action

Under the No Action Alternative, the significant risk of property loss, injury, and death involving flooding would continue. Flood frequency and the extent of flooding across the alluvial plain are primarily the result of natural processes and the general lack of control structures on Orestimba Creek. Limited channel capacity and channel restrictions in the middle reach contribute to flooding in Newman and can result in property loss, injury, and potentially death. Under Newman's General Plan, development within the next 10 years would primarily occur south of Stuhr Road within Newman's proposed primary SOI. This area is affected by the 1/100 ACE; however, Newman regulations require measures to reduce the impacts of flooding to less than significant. Small-scale flood risk reduction measures could be implemented by local interests in the middle reach to reduce flood risk within the primary SOI; however, these measures are likely to have very local effects. The overall risk of property loss, injury, or death involving flooding would remain significant.

Alternative 2: Chevron Levee (NED)

Alternative 2 would have beneficial effects on hydrology. Alternative 2 would reduce the risk of property loss, injury, and death involving flooding. The potential for levee failure would be discountable. Through project design, adverse erosion and siltation would be avoided.

The proposed chevron levee would substantially reduce flood risks on developed lands along the Highway 33 corridor, on undeveloped lands north and south of Stuhr Road, and on lands east of the railroad tracks. Currently, flooding in these areas is generally between 0.1 and 0.5 feet in depth and results in substantial risk of property loss, injury, and death. Approximately 40 percent of the land within Newman's SOI is currently subject to shallow flooding. With construction of the proposed chevron levee, flood flows overtopping the CCID Main Canal berm would be intercepted and directed away from developed areas.

Alternative 2 would likely result in short-term increased depths in some areas east of the railroad tracks that are already subject to flooding. The depth of the potential increases during peak flows, which are projected to recede within 24 hours, would vary under each flood event scenario based on the existing topography. The range of depths under each frequency scenario is generally similar under both existing and with project conditions. The main difference would likely be during the 1/10 AEP, where depths in some places could increase by 0.5 feet.

Agriculture (row crops) is the primary land use within the area with the potential for increased flooding. Four residences are also located in the area. A windshield survey determined that each residence is on a raised foundation with several steps required to reach

the first floor elevation. In addition, the structures are located on raised building sites, putting the first floor elevation well above the modeled potential depths.

Implementation of the project would involve tying the new levee into the bed of the railroad to prevent the existing channeling of low flows into Newman. As a result, flood flows may top the railroad during more frequent events than under existing conditions. The tie-in would be designed to prevent through seepage and provide erosion protection for the railroad bed.

The overall impact of the Alternative 2 would be beneficial.

Mitigation

Impacts on hydrology would be beneficial and no mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

The impacts of Alternative 3 would be similar to those occurring as a result of Alternative 2. The increased height of the chevron levee proposed under Alternative 3 would result in a greater reduction of flood damage risk in developed areas of Newman and a greater overall beneficial impact.

Mitigation

Impacts on hydrology would be beneficial and no mitigation is required.

5.2.5 Water Quality

Implementation of a project alternative would have a significant impact on water quality if it would violate any water quality standards or waste discharge requirements or otherwise substantially degrade water quality; or create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of non-point source polluted runoff.

Alternative 1: No Action

Flooding of agricultural and urban lands results in pollution of both Orestimba Creek and the San Joaquin River and contributes to water quality which is not in attainment of designated uses. Flood flows which inundate agricultural fields are exposed to agricultural pesticides and nutrients, and flood flows in urban areas are exposed to petroleum products, solvents, pesticides, nutrients, and other pollutants. Polluted flood flows either return to Orestimba Creek via overland flow or are collected by agricultural and stormwater drainage systems and discharged to the San Joaquin River. Irrigation return waters, which can also contain pollutants, are collected by agricultural drains managed by the CCID or by Orestimba Creek and are

discharged into the San Joaquin River. Measures to reuse irrigation waters reduce these impacts; however, they remain significant.

In addition to Newman-maintained storm drains within the city limits, CCID-maintained agricultural ditches that supply and collect water runoff are located within Newman's SOI. Some city storm drains collect CCID water. Stormwater runoff is collected in underground pipes and CCID ditches and flows to a pump station at Inyo Avenue and Canal School Road. There are five lift stations to pump stormwater which currently operate below capacity. Under current conditions, large storm events result in the collection of overland flood flows by the Newman Wasteway. Water quality is an issue because the population of Newman is growing quickly and because a large portion of Newman discharges runoff into the Newman Wasteway without water quality treatment. Additional development and related construction activities allowed by the proposed General Plan could affect the drainage system in the Newman area with increased runoff, resulting in the need for more drainage capacity and additional permitting requirements. Increased capacity and treatment measures would reduce the existing significant impacts.

Alternative 2: Chevron Levee (NED)

During the construction of the proposed chevron levee, approximately 152 acres of bare soil would be exposed until construction is completed. In addition, inadvertent spills of oil or fuels from construction equipment could be a source of contamination at work or staging areas. These short-term effects would be mitigated as described below.

Once the construction is completed and the levee slopes and staging areas are reseeded, the long term effects of a chevron levee would be primarily beneficial. The chevron levee would restrict flood flows from entering urban areas. The potential for contamination of flood flows by both agricultural pollutants and pollutants associated with developed areas would be substantially reduced. Reduction in frequency and volume of polluted discharge and reduction in exposure to pollutants would result in a net improvement to water quality in both Orestimba Creek and the San Joaquin River, and long-term water quality would be beneficially affected.

Flood flows would ultimately be discharged to the San Joaquin River via Orestimba Creek, agricultural drains, or the Newman Wasteway. During smaller events, most overland flood flows would return to Orestimba Creek prior to discharge into the San Joaquin River. During moderate events, flood flows could overtop the UPRR embankment and be collected by agricultural drains prior to discharge into the San Joaquin River. The capacity of agricultural drains is not likely to be sufficient to contain these flows, and these flows would be exposed to agricultural pollutants; however, flows would be reduced in comparison to existing conditions. With the implementation of Alternative 2, the volume and frequency of flood flows entering the Newman Wasteway would be substantially reduced. Alternative 2 would substantially reduce flood flows within Newman's proposed SOI and would have a beneficial effect on existing stormwater drainage systems.

Mitigation

Mitigation measures would include obtaining an NPDES general construction permit from CVRWQCB and the development of a SWPPP. The SWPPP would identify best management practices that would avoid or minimize any adverse effects during construction. Once construction is completed, the levee slopes and staging areas would be reseeded in a timely manner to control erosion.

The implementation of these mitigation measures would reduce impacts to water quality to less than significant.

Alternative 3: Chevron Levee with Freeboard (LPP)

The impacts of Alternative 3 would be similar to those occurring as a result of Alternative 2. Mitigation measures would reduce impacts to less than significant. Similar to Alternative 2, Alternative 3 would increase the area of flood risk reduction, thereby reducing the exposure of overland flood flows to agricultural pollutants and beneficially impacting water quality.

Mitigation

The implementation of a SWPPP as described in Alternative 2 would reduce impacts to water quality to less than significant.

5.2.6 Groundwater

A project alternative would significantly impact groundwater if it would substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (if the production rate of preexisting nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted).

Alternative 1: No Action

Development within Newman and surrounding areas could reduce recharge rates as the area of impervious surfaces increases and a larger volume of surface flows are collected by surface drains. According to Newman, there is sufficient groundwater within the proposed SOI and the surrounding area to meet both the needs of the existing population, as well as growth anticipated in the Newman General Plan, without depleting the groundwater aquifer. The No Action Alternative would have a less than significant impact on groundwater availability.

Alternative 2: Chevron Levee (NED)

Construction of chevron levees would minimize the area of flooding and reduce the area over which recharge occurs on the floodplain; however, as illustrated by the high water table in the Newman SOI and Newman's need to reduce water levels by providing and maintaining agricultural irrigation drainage systems, the future growth anticipated by the proposed General Plan would not substantially deplete groundwater supplies even if Newman continues to rely on groundwater as its primary source of water in the future. Alternative 2 would have a less than significant impact on groundwater recharge.

Mitigation

Impacts on groundwater would be less than significant, and no mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

The impacts of Alternative 3 on flooding would be similar to those occurring under Alternative 2.

Mitigation

Impacts on groundwater would be less than significant, and no mitigation is required.

5.2.7 Waters of the U.S. and Wetlands

A project alternative would have a significant impact on waters of the U.S., including wetlands, if it would have a substantial adverse effect on Federally protected waters of the U.S. through direct removal, filling, hydrological interruption, or other means.

Alternative 1: No Action

As discussed in Section 4.2.7, a delineation of wetlands and Waters of the U.S. identified four potential jurisdictional wetlands in the upper reach of the study area. These areas would not likely be impacted as a result of anticipated growth in Newman and surrounding areas. The No Action Alternative would result in less than significant impacts on these wetlands.

Alternative 2: Chevron Levees (NED)

As discussed in Section 4.2.7, a delineation of wetlands and Waters of the U.S. did not identify jurisdictional wetlands within the project footprint as defined by the proposed chevron levee. Formal wetland delineation conducted prior to construction would determine if there are jurisdictional wetlands not identified by the NWI maps.

Mitigation

Impacts on Waters of the U.S. and wetlands would be less than significant, and no mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

Alternative 3 would impact the same areas as described under Alternative 2. Impacts would be mitigated to less than significant as described under Alternative 2.

Mitigation

Impacts on Waters of the U.S. and wetlands would be less than significant, and no mitigation is required.

5.2.8 Air Quality

Implementation of a project alternative would have a significant air quality impact if it would:

- Directly or indirectly result in a substantial increase of air pollutants in areas in non-attainment of State or Federal air standards;
- Conflict with or obstruct implementation of the Valley Air District Air Quality Control Plan;
- Conflict with the Newman or Stanislaus County General Plan guidelines for control of air pollution;
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation; or
- Expose sensitive receptors to substantial pollutant concentrations.

Alternative 1: No Action

The San Joaquin Valley Airshed is currently in non-attainment of State and Federal air quality standards for 8-hour O_3 and $PM_{2.5}$. The Valley Air District has developed air pollution control measures under three California Air Resources Board (CARB)-approved Air Quality Control Plans: the Extreme Ozone Attainment Demonstration Plan, the Carbon Monoxide Maintenance Plan, and a PM_{10} Maintenance Plan. Ozone control measures focus on eliminating precursors and placing restrictions on a wide range of emission sources. These emission sources include oil and gas producers and refineries, school bus fleets, residential development projects generating increased traffic, commercial fuel combustion, wineries, agricultural dryers, and numerous other sources. The control measures for carbon monoxide (CO) are based on reformulation of gasoline, exhaust emission standards, and use of low-emission vehicles.

Control measures for PM_{10} are similar to those implemented for carbon monoxide, and extend emission standards to larger vehicles such as trucks and buses. A $PM_{2.5}$ Plan was submitted to CARB in 2008 and is still under development. The $PM_{2.5}$ Plan demonstrates the effectiveness of control measures adopted under previous plans, and anticipates attainment of $PM_{2.5}$ air quality standards by 2012. Newman and Stanislaus County have adopted policies and regulations to improve air quality conditions in the San Joaquin Valley Airshed. These policies and regulations:

- Endorse implementation of mixed-use land uses that promote alternative modes of transportation;
- Call for a reduction of air pollution associated with energy usage;
- Encourage compliance with Federal and State air quality standards;
- Enact expansion of employment opportunities to reduce commuting times and increase ridesharing and transit use;
- Require installation of cleaner, gas-burning fireplaces in new developments;
- Encourage construction of bicycle, pedestrian and transit facilities;
- Require features in new developments to reduce reliance of gas-powered landscape equipment;
- Regulate emissions from residential fireplaces and wood-burning heaters and provide educational information to reduce wood smoke emissions; and
- Enact measures to reduce ambient concentrations of PM_{10} by requiring actions to prevent, reduce, or mitigate anthropogenic fugitive dust emissions.

Despite these measures, the Newman General Plan would exceed transportation assumptions required to meet attainment under the current plans. Due to increases in vehicle use beyond those anticipated in the Air Quality Control Plan, the No Action Alternative would have a significant impact on air quality.

Alternative 2: Chevron Levees (NED)

The material required for construction of the levee would be obtained from the Fink Road Landfill, an existing regional landfill operated by Stanislaus County. The Fink Road landfill is located about 12 miles from the proposed construction site. This borrow source for the material has been the assumed location for calculating air quality emissions. Emissions resulting from implementation of Alternative 2 would be less than those occurring under Alternative 3 due to the smaller size of the NED levee. As discussed below, the effects of Alternative 3 would be less than significant; thus, the effects of Alternative 2 would also be less than significant.

Mitigation

In compliance with Valley Air District control measures, all construction equipment would meet current exhaust emission standards. In compliance with City of Newman and Stanislaus County guidelines, measures to reduce anthropogenic emissions of PM_{10} would include minimization of the construction footprint and wetting of soils when beneficial for the suppression of windborne dust. To further reduce air emissions resulting from the transport of materials, suitable excavated materials would be used in the construction of levees or would be spread on adjacent agricultural fields. With these and other Best Management Practices in place, effects on Air Quality would be mitigated to less than significant.

Alternative 3: Chevron Levee with Freeboard (LPP)

Emissions resulting from implementation of Alternative 3 would not exceed Federal and State *de minimis* thresholds, and a conformity determination would not be required (Table 5-1 and Appendix D). Due to the greater number of dump truck trips required for construction of the larger chevron levee, this alternative would have the greatest annual impact on air quality. Impacts to air quality would be short-term and limited to the construction period. The use of dump trucks with a minimum load capacity of 16 cubic yards for transport of levee construction materials is necessary to meet conformity requirements. Direct and indirect impacts on air quality would be less than significant. All applicable Valley Air District control measures and local guidelines for controlling emissions would be implemented. There are no sensitive receptors, such as schools, near the construction footprint and construction activities would not result in high concentrations of pollutants. Alternative 3 would result in less than significant impacts on air quality.

Table 5-1: Construction Emissions for Alternative 3

Construction Activity	Construction Emissions for Criteria Pollutants and GHG (tons per year)						
	VOC	CO	NO_x	PM-10	PM-2.5	SO_2	CO_2
Levee Construction	3.45	15.99	38.86	42.95	5.89	2.78	15,101
de minimis Thresholds	50.00	NA	50.00	50.00	100.00	NA	27,557

Mitigation

In compliance with Valley Air District control measures, all construction equipment would meet current exhaust emission standards. In compliance with City of Newman and Stanislaus County guidelines, measures to reduce anthropogenic emissions of PM_{10} would include minimization of the construction footprint and wetting of soils when beneficial for the suppression of windborne dust. To further reduce air emissions resulting from the transport of materials, suitable excavated materials would be used in the construction of levees or would be

spread on adjacent agricultural fields. With these and other best management practices in place, effects on air quality would be mitigated to less than significant.

5.2.9 Vegetation

Implementation of a project alternative would result in significant impacts on vegetation if it would have a substantial adverse effect on any riparian habitat or other sensitive natural community type identified by CDFG.

Alternative 1: No Action

Growth of Newman and surrounding areas could result in impacts on agricultural fields and riparian areas of Orestimba Creek and the San Joaquin River. Although grazing lands are dominated by non-native annual grasses, some native species are likely to occur in these areas. Other agricultural fields support native and non-native species around their margins. The loss of common native plants would not be substantial due to the prevalence of similar communities throughout the Central Valley. Much of the riparian habitat within the study area has been removed or substantially degraded by past agricultural and urban development. The removal or degradation of remaining patches of riparian habitat could occur as a result of local efforts to control the hydrology of Orestimba Creek. Due to the limited area of remaining riparian habitat, even a modest loss or degradation as a result of future growth would be a significant impact on this sensitive natural community. However, local agencies would be required to receive a Streambed Alteration Agreement from CDFG for any work to the Orestimba Creek bed and banks, and implement mitigation measures for loss of riparian habitat as part of the permit activity. The impact would be less than significant.

Alternative 2: Chevron Levee (NED)

The construction footprint of the NED levee, including the levee footprint, staging areas, haul routes, and a 20-foot buffer within the construction right-of-way would total less than 152 acres. During construction, approximately 152 acres of agricultural land would be temporarily or permanently impacted. None of these lands are used for grazing and none would be considered a natural community. There would therefore not be any adverse effect on any riparian habitat or other sensitive natural community type. The Coordination Act Report provided by the USFWS recommends implementation of the project as proposed without any need for compensatory mitigation (USFWS, 2012). The impact would be less than significant.

<u>Mitigation</u>

No mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

The construction of a chevron levee would result in impacts similar to those described under Alternative 2. The impact would be less than significant.

Mitigation

No mitigation is required.

5.2.10 Wildlife and Fisheries

Implementation of a project alternative would have a significant impact on wildlife and fisheries if it would result in a substantial loss of habitat such that displacement of individuals threatens the long-term persistence of local populations; or have a substantial interference with the movement of any native resident or migratory fish or wildlife species, their wildlife corridors, or nursery sites.

Alternative 1: No Action

Wildlife habitats would be impacted by the No Action Alternative. Anticipated growth under the General Plan would result in loss of alfalfa fields and grazing lands, which provide habitat for insects and small mammals. These areas also provide foraging habitat for raptors nesting in woodland habitat along Orestimba Creek and the San Joaquin River. However, the area of similar habitat within foraging distance of suitable nesting habitats is extensive, and the number of raptors that forage in agricultural fields surrounding Orestimba Creek is likely limited by nesting habitat availability rather than forage. Newman policies would serve to adequately protect existing trees and other important vegetation resources in Newman's SOI, as well as provide additional plantings as part of new development and public improvements. With measures to avoid, minimize, and mitigate for potential impacts, future development would have a less than significant impact on wildlife and wildlife habitats.

As described under water quality, flooding would continue under the No Action Alternative. Under current conditions, flooding contributes to the discharge of agricultural and urban pollutants into Orestimba Creek and the San Joaquin River. This source of pollution is minimal in relation to stormwater run-off discharged through agricultural drains during storm events of lower intensity and as a result of irrigation returns. Measures to improve existing drainage facilities and measures included in NPDES permit requirements would reduce impacts on water quality, and subsequently fishes and other aquatic organisms, to less than significant.

Alternative 2: Chevron Levee (NED)

Construction of the chevron levee would result in the temporary loss and degradation of less than 152 acres of wildlife habitat associated with agricultural margins. Following construction, the grass-covered levee and relocated agricultural margins would provide habitats of similar quality. The temporary loss of these habitats would have minimal impact on

wildlife populations due to the prevalence of equally suitable habitats nearby. Due to the proximity of the proposed chevron levee to urbanized areas and its distance from the foothills, construction-related disturbance is not likely to affect wildlife migration patterns. Potential for displacement of burrowing owls is discussed below in section 5.2.11, Special Status Species. Construction-related impacts on water quality would have short-term and less than significant impacts on local fish populations.

Mitigation

Upon completion of construction, the levee slopes would be hydroseeded with native grasses. All water quality impacts would be mitigated as described in Section 5.2.5, Water Quality. Mitigation measures would include an NPDES general construction permit from CVRWQCB and the development of a SWPPP.

Alternative 3: Chevron Levee with Freeboard (LPP)

Impacts on wildlife and fisheries would be minimal and similar to those resulting from Alternative 2. Alternative 3 would result in the temporary loss or degradation of approximately 152 acres of habitats associated with agricultural margins during construction. Similar to Alternative 2, these impacts would be minimal, and the chevron levee would provide long-term replacement habitat of similar quality.

Mitigation

Through avoidance of riparian plant communities, as described under Alternative 2, impacts would be mitigated to less than significant.

5.2.11 Special-Status Species

Implementation of a project alternative would significantly impact special-status species if it would:

- Harm or harass a special-status plant or animal;
- Directly or indirectly affect essential habitat of special-status species; or
- Prevent the migration of a special-status species between potentially occupied habitats.

Alternative 1: No Action

Potential habitat for eight special-status species occurs within Newman's SOI: the Valley Elderberry Longhorn Beetle (*Desmoceros californicus* dimorphus) (VELB), the San Joaquin Kit Fox (*Vulpes macroitis mutica*), Tricolored blackbird (*Agelaius tricolor*), Western burrowing owl (*Athene cunicularia*), Swainson's hawk (*Buteo swainsonii*), Mountain plover (*Charadrius montanus*), California Horned Lark (*Eremophila alpestris*), and Loggerhead shrike (*Lanius*

ludovicianus). Newman and Stanislaus County regulations and policies require pre-construction surveys of projects located in potentially suitable habitats for special-status species, and mitigation of any habitat loss. With mitigation, impacts from future growth and development to special-status species would be less than significant.

Alternative 2: Chevron Levee (NED)

Construction of the levee improvements could result in direct and indirect effects to the VELB, San Joaquin kit fox, tricolored blackbird, Western burrowing owl, Swainson's hawk, mountain plover, California horned lark and loggerhead shrike.

There would be no direct effects to the VELB due to removal or damage to elderberry shrubs during site preparation and construction activities. Indirect effects could include physical vibration and an increase in dust during operation of equipment and trucks during construction activities.

Direct effects to the San Joaquin Kit Fox could involve the destruction of existing dens or direct mortality due to construction traffic in agricultural areas. Indirect effects would include physical vibration, presence of construction vehicles and workers, and bright lights if night construction were to occur.

Direct effects to the Western burrowing owl could involve the destruction of existing burrows or direct mortality due to construction traffic in agricultural areas. Indirect effects would include physical vibration, presence of construction vehicles and workers, and destruction or degradation of foraging habitat adjacent to occupied burrows. Construction activities in the vicinity of an active nest have the potential to result in forced fledging or nest abandonment.

Construction of the levee improvements would not directly affect Swainson's hawks. Indirect affects would include physical vibration and presence of construction vehicles and workers. Construction activities in the vicinity of a nest have the potential to result in forced fledging or nest abandonment.

Construction of the levee improvements could potentially result in direct and/or indirect affects to tricolored blackbirds, mountain plovers, California horned larks or loggerhead shrikes if these species begins nesting in or adjacent to the project area prior to construction. Construction activities in the vicinity of nesting areas may cause destruction of nesting habitat.

<u>Mitigation</u>

Potential impacts on VELB would be reduced to less than significant through avoidance, and if necessary, through mitigation. A pedestrian survey of the construction footprint for blue elderberry shrubs would be conducted prior to any ground-disturbing activities. If any

elderberry shrubs are observed, USACE would reenter Section 7 consultation with USFWS. If possible, the area would be avoided through design. Unavoidable impacts on blue elderberry shrubs would be mitigated per USFWS mitigation requirements. Although no VELB populations are known to occur in the vicinity, their range is poorly described and improving habitat conditions could reduce the impacts of habitat fragmentation and benefit the species.

Potential impacts on the San Joaquin Kit Fox would be reduced to less than significant through avoidance and, if necessary, through mitigation. A kit fox survey would be conducted prior to any construction activities. Avoidance would be achieved by restricting construction activities within 50 feet of potential dens and within 100 feet of known dens. Additional avoidance or mitigation measures would be coordinated with USFWS.

Potential impacts on Swainson's hawks would be reduced to less than significant through avoidance. A qualified biologist would survey the project area and all areas within one-half mile of the project prior to construction. If the survey determines that a nesting pair is present, USACE would coordinate with CDFG and the proper avoidance and minimization measures would be implemented. To avoid potential effects on nesting Swainson's hawks, CDFG typically requires the avoidance of nesting sites during construction activities. These measures include avoiding construction during the breeding season and monitoring of any discovered nest site by a qualified biologist.

Potential impacts on burrowing owls would be reduced to less than significant through avoidance and, if necessary, through mitigation. A burrowing owl survey would be conducted prior to any construction activities. Avoidance would be achieved by restricting construction activities within 160 feet of occupied burrows during the non-breeding season and within 250 feet of occupied burrows during the breeding season. Avoidance also requires that a minimum of 6.5 acres of foraging habitat be permanently preserved contiguous with occupied burrows for each pair of breeding burrowing owls. If destruction of active burrows is unavoidable, burrowing owls would be passively relocated from active burrows during the non-breeding season, existing unsuitable burrows would be enhanced, and new burrows created at a ratio of 2:1. All burrowing owl mitigation measures would be conducted in coordination with CDFG.

Potential impacts on Tricolored blackbirds, Mountain plovers, California Horned Larks, and Loggerhead shrikes would be reduced to less than significant through avoidance. A qualified biologist would conduct a nesting survey prior to any construction activities. If the survey determines that a nesting pair is present, USACE would coordinate with CDFG and the proper avoidance and minimization measures would be implemented. To avoid potential effects on nesting birds, CDFG typically requires the avoidance of nesting sites during construction activities. These measures include avoiding construction during the breeding season and monitoring of any discovered nest site by a qualified biologist.

Potentially significant impacts on water quality would be avoided through implementation of mitigation measures described in Section 5.2.5, and potential adverse effects on critical habitat would be minimal.

Alternative 3: Chevron Levee with Freeboard (LPP)

Impacts of Alternative 3 would be similar to those occurring under Alternative 2 and would be mitigated to less than significant.

Mitigation

Mitigation of impacts on less than significant would be achieved through the implementation of measures described above for Alternative 2.

5.2.12 Invasive Plants and Noxious Weeds

Implementation of a project alternative would result in significant invasive plant or noxious weed impacts if it would promote the establishment of invasive plants or noxious weeds in native plant communities or agricultural fields.

Alternative 1: No Action

Several invasive plants and noxious weeds were observed along Orestimba Creek and in association with field margins and ditches. These populations are likely to remain established, and the seeds and propagules of these plants are likely to colonize areas where soil disturbance occurs. Soil disturbance is likely to continue to occur as a result of agricultural practices and land development including road improvements and other linear projects. Because invasive plants and noxious weeds are currently present along agricultural margins throughout the study area, continued soil disturbance would not promote further establishment of these plants. The impact of invasive plants and noxious weeds on native plant communities and agricultural fields would be less than significant.

Alternative 2: Chevron Levee (NED)

During construction, the project area would be scraped and grubbed to remove weedy vegetation from the project footprint. This layer of vegetation is likely to contain roots and seeds of invasive plants and/or noxious weeds; this material would be disposed of at the Fink Landfill or other designated disposal area. During construction, only clean, weed-free borrow material would be used. When leaving the borrow site, the disposal site, and construction site all construction vehicles would be brushed off to remove dust and any attached vegetation, thus reducing the spreading of weed parts or seeds. Upon the completion of construction, all barren areas (levee slopes, seepage berms, and staging areas) would be hydroseeded with native grasses in order to encourage growth of native vegetation and reduce the growth of invasive plants or noxious weeds. Vegetation maintenance along the chevron levee would be required to maintain levee integrity and would substantially limit the establishment of many invasive plants and noxious weeds. The maintained levee provides less suitable habitat for invasive plants and noxious weeds than field margins and would not substantially promote

establishment of these plants. The impact of invasive plants and noxious weeds on native plant communities and agricultural fields would be less than significant.

Mitigation

Impacts associated with invasive plants and noxious weeds would be less than significant and no mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

The effects of levee construction under Alternative 3 would be similar to those resulting from Alternative 2 and would be less than significant.

Mitigation

Impacts associated with invasive plants and noxious weeds would be less than significant and no mitigation is required.

5.2.13 Socioeconomics

Implementation of a project alternative would have a significant impact with regard to population, housing, and employment if it would induce substantial unplanned population growth in an area, either directly or indirectly, or if it would physically divide an established community.

Implementation of a project alternative would have a significant impact with regard to environmental justice if it would have substantial and disproportionate adverse effects on the social and economic welfare of minority or low-income populations.

Alternative 1: No Action

The No Action Alternative would not result in unplanned growth, either directly or indirectly. The Newman General Plan anticipates continued growth within Newman's SOI and planning area (see Figure 4-10) and establishes guidelines and regulations to minimize the impacts of growth on human and environmental resources. Flooding would continue to result in short-term and minor restrictions of connectivity between rural and urban areas; however, the limited duration and depth of flooding does not substantially isolate or divide communities. The Newman General Plan would encourage development of a mixture of commercial, residential, and public spaces suitable for local residents through planned zoning and extension of services.

Flooding occurring under the No Action Alternative would continue to result in substantial damage to private and public property, loss of personal income, and loss of public tax revenue. Because Newman is primarily populated by minorities, adverse effects on the economic welfare of the community essentially affect a minority population. Thus, the No

Action Alternative would continue to have significant adverse impacts on the economic welfare of a minority population.

Alternative 2: Chevron Levee (NED)

Alternative 2 would not result in unplanned growth and would reduce the adverse effects of flooding on economic welfare to a less than significant level. The NED levee would not remove any properties from FEMA-designated flood zones and, therefore, would not induce growth substantially. The alignment of the levee would substantially reduce flood damage risk within Newman's SOI, especially in the most densely developed areas within the city limits. The area of flood risk reduction is generally contiguous with Newman's SOI and includes most of Newman's Planning Area. The levee would not substantially increase the area of flooding within the Newman Planning Area west of the CCID Main Canal. Flood waters would be captured between the CCID Main Canal and the proposed levee and directed back towards Orestimba Creek. East-west roadways crossing the alignment would be temporarily closed during flooding; however, there are existing north-south roadways which provide alternative routes around the affected areas. These east-west roads generally provide access to I-5 and do not connect communities; therefore, Alternative 2 would not divide communities. Some increased flood depths may occur outside of Newman's Planning Area in rural areas. This flooding, which would occur without implementation of Alternative 2, could temporarily restrict access to rural residences or agricultural fields, but would not divide communities. The overall reduction in duration, depth, and extent of flooding would result in beneficial effects on overall connectivity during flood conditions.

The reduction of flood damage risk would have beneficial effects on the economic welfare of low income and minority individuals and the community. Furthermore, Alternative 2 could temporarily increase job availability resulting in short-term beneficial effects on local income as a result of construction-related jobs and investment, but it would not substantially affect population size, diversity, household size, or housing availability. Up to four residential properties and three agricultural structures are within the preliminary footprint of the proposed chevron levee. Relocation or demolition of these structures would be avoided through design measures where possible. If avoidance is not possible, owners would be compensated for the relocation or demolition of the structures.

<u>Mitigation</u>

Socioeconomic impacts would be less than significant and no mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

Socioeconomic effects resulting from Alternative 3 would be similar to those occurring under Alternative 2. The increased height of the LPP levee would further reduce the risk of flood damage, resulting in proportionally greater benefits to the economic welfare of Newman.

Mitigation

Socioeconomic impacts would be less than significant and no mitigation is required.

5.2.14 Land Use

A project alternative would create a significant land use impact if it would:

- Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project and adopted for the purpose of avoiding or mitigating an environmental effect; or
- Result in unnecessary and unavoidable conversion of substantial areas of Prime Farmland, Unique Farmland, or Farmland of Local Importance to nonagricultural use.

Alternative 1: No Action

The No Action Alternative would have no effect on land use. Lands outside of Newman's city limits are under the jurisdiction of Stanislaus County, which designates these lands as agricultural. Newman's General Plan, which designates lands outside of its city limits as non-agricultural, is in conflict with the Stanislaus County Plan. However, as plans for development are proposed within the County, these projects would be evaluated for compliance with existing City and County regulations and guidelines, and the County would support incorporation by Newman of lands for approved developments. The vast majority of these lands are designated Prime Farmlands under the Farmland Protection Policy Act and would be converted to non-agricultural use. Any growth beyond existing development would result in impacts on Prime Farmland; however, Newman and Stanislaus County implement numerous measures to limit the effects of growth on farmland conversion and on the daily operation of farmland. The No Action Alternative would have a less than significant impact.

Alternative 2: Chevron Levee (NED)

The chevron levee would be located on lands under the jurisdiction of Stanislaus County, and the Stanislaus General Plan designates these lands as agricultural. The County, which is the local sponsor, intends to revise its zoning designation upon approval of this project, and no conflicts would occur. The alignment of the chevron levee generally coincides with the western boundary of Newman's SOI and would reduce flood damage within the areas proposed for development over the next 20 years. A small area of land outside of Newman's Planning Area would receive flood risk reduction, while a substantial area of land within the western portion of Newman's Planning Area would experience induced flooding. Growth within the Planning Area is not anticipated to occur until after 2030, and Newman would have adequate time and space to redirect future plans towards development of equally suitable lands within and adjacent to unaffected portions of its Planning Area. Thus, the proposed levee would not conflict with any land use plans or zoning.

The chevron levee would be located on Prime Farmlands. The Farmland Protection Policy Act ensures that Federal actions do not cause farmland to be irreversibly converted to nonagricultural uses in cases in which other national interests do not override the importance of the protection of farmland or otherwise outweigh the benefits of maintaining farmland resources. Impacts on Prime Farmland were evaluated using the California Land Evaluation and Site Assessment (LESA) model. LESA has been approved as an alternative to the FPPA model for quantifying impacts on Prime Farmlands and other important soils (7 C.F.R. § 658.4 (f)). Scoring thresholds are based upon both the total LESA score as well as the component LE and SA scores (Table 5-2). A total LESA score of 80 to 100 points is considered significant (Table 5-3). The footprint of the LPP levee was modeled using LESA and, as discussed below, the impacts on Prime Farmland would be considered significant. Although Alternative 2 would occupy a smaller footprint than Alternative 3, a LESA evaluation would result in a similar score due to the overall size of the project and the high value of surrounding farmlands. Section 1548 of the FPPA states that the FPPA does not provide a basis for challenging a Federal project that may affect farmland, but allows for a challenge of the action when a state policy or program exists to protect farmland (7 C.F.R. § 658.3 (d).

Table 5-2: LESA Score for LPP Levee

Factor	Score	Weight	Weighted Factor Score
Land Evaluation (LE)			
Land Capability Classification	99	0.25	24.71
Storie Index	80	0.25	20.00
LE Subtotal		**0.50**	**44.71**
Site Assessment (SA)			
Project Size	100	0.15	15.00
Water Resource Availability	100	0.15	15.00
Surrounding Agricultural Land	100	0.15	15.00
Protected Resource Land	60	0.05	3.00
SA Subtotal		**0.50**	**48.00**
Final Score			**92.71**

In California, farmlands are protected under the California Farmland Conservancy Program (CFCP). The CFCP seeks to encourage the long-term, private stewardship of agricultural lands through the voluntary use of agricultural conservation easements. There are no CFCP conservation easements on potentially affected lands. Additionally, the California Land Conservation Act, commonly referred to as the Williamson Act, enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural use. In return, landowners receive property tax assessments which are

much lower than normal because they are based on farming and open space uses as opposed to full market value. Within Newman's Planning Area and outside the SOI, lands held under Williamson Act Contracts occur on the flood side of the levee and would not be affected by the proposed project. The majority of lands within the area of flood damage risk reduction, especially within the Primary SOI and SOI, are not held under Williamson Act contracts or are held under Williamson Act contracts set to expire by 2014. Lands directly converted to non-agricultural use as a result of constructing the chevron levee are currently planned for development as residential areas within the next 20 years. The levee would not remove any lands from FEMA-designated flood zones; and therefore would not induce development or result in indirect conversion of Prime Farmlands.

Although the direct impacts of levee construction would remove an area of Prime Farmlands from agricultural production, Alternative 2 would not induce growth, conflict with a CFCP conservation easement, directly remove lands from Williamson Act contracts, or induce removal of lands from Williamson Act contracts. The area of the impacts has been minimized to the maximum extent practicable through engineering design, and other locations assessed for the placement of the levee would result in substantial impacts on other resources including endangered species, traffic, and the ability to conduct flood fighting efforts. The policies and ordinances of the City of Newman and Stanislaus County work together to ensure that conflicts between land uses is minimized when lands are developed for non-agricultural use. By ensuring consistency with State and local polices and avoiding the unnecessary and unavoidable conversion of Prime Farmland, implementation of Alternative 2 would result in a less than significant impact.

Mitigation

Impacts on land use would be less than significant and no mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

Alternative 3 would result in impacts on land use that are similar in quality and quantity to those occurring under Alternative 2. Because the Alternative 3 footprint is slightly larger than the Alternative 2 footprint, a LESA was conducted using quantities for the LPP levee. The quantity of impacted Prime Farmland was delineated as the area of the levee footprint plus the area of maintenance roads minus the area of existing maintenance road along the east side of the CCID. The LESA results (Table 5-2) would be considered significant under the LESA scoring thresholds. However, as described above, these impacts would occur on lands within Newman's SOI and would be developed over the next 20 years. Thus, the action would not conflict with State or local policies or programs to protect farmland. By ensuring consistency with State and local polices and avoiding the unnecessary and unavoidable conversion of Prime Farmland, implementation of Alternative 3 would result in a less than significant impact.

Table 5-3: California LESA Model Scoring Thresholds

Total LESA Score	Scoring Decision
0 to 39	Not Considered Significant
40 to 59	Considered Significant only if LE and SA subscores are each greater than or equal to 20
60 to 79	Considered Significant unless either LE or SA subscore is less than 20 points
80 to 100	Considered Significant

Mitigation

Impacts on land use would be less than significant and no mitigation is required.

5.2.15 Transportation

A project alternative would have a significant impact on traffic or transportation if it would:

- Degrade traffic flow and safety to conditions below thresholds established on Newman roadways, or to an LOS of C, except for Merced Street downtown and Highway 33 where Newman has established less stringent thresholds due to existing constraints and the desire to maintain the community character;
- Substantially increase hazards due to a design feature (such as sharp curves or dangerous intersections) or incompatible uses (such as farm equipment);
- Result in inadequate emergency access; or
- Conflict with adopted policies, plans, or programs supporting alternative transportation.

Alternative 1: No Action

Current transportation infrastructure is sufficient to provide a LOS of C or better for Newman and Stanislaus County managed roadways and intersections in the study area. Continuing growth within and around Newman would increase traffic volumes on roadways in the study area. Existing development limits improvement of many roads within the city limits, and LOS on these road segments is anticipated to be unacceptable as a result of continued growth. The LOS of intersections within Newman's city limits would be similarly affected but can be improved to a LOS lower than C with installation of traffic signals. Newman has implemented plans and policies to minimize the impact of projected growth on traffic within the city limits.

Flooding can result in temporary road and railway closures; however, access to lands on either side of Highway 33 is provided by arterial roadways, and emergency access would not be

significantly impacted. Impacts on transportation resulting from the No Action Alternative would be less than significant.

Alternative 2: Chevron Levee (NED)

Alternative 2 would result in minimal, short-term impacts on traffic, but would not substantially increase hazards due to design features, would not substantially restrict emergency access, and would not conflict with alternative transportation policies, plans, or programs. Construction activities would require moving large quantities of soil, construction materials, and heavy equipment into and out of the study area. The number of trips to and from construction activities would likely be less than 100 per day, including commute of workers and movement of materials. This volume is less than 10 percent of the total anticipated volume for any given road managed by Newman. Worker commutes, approximately half of the resulting increase, would likely occur during peak traffic hours. However, LOS is currently A on most city- and county-managed roads, and these roads are capable of accommodating a moderate, temporary increase in traffic without substantial change to LOS. During construction of chevron levees, truck traffic is likely to increase on Stuhr, Eastin, and Orestimba roads. However, even with the increased truck traffic, the LOS of these roadways is not anticipated to be lower than C with implementation of Newman's General Plan. Alternative 2 would not substantially affect LOS of impacted roadways, and impacts on traffic would be less than significant.

Detours would be required on Stuhr, Orestimba, Draper, and Shiells roads for up to two weeks each during levee construction. Stuhr Road is the major access route near Newman between I-5 and State Highway 33. A detour around Stuhr Road from Newman to I-5 would route traffic through Newman and could temporarily reduce LOS on these streets. Alternatively, access to I-5 is available within 10 miles of Newman through either Crows Landing and Fink roads to the north or through Gustine and Sullivan roads to the south. Orestimba, Shiells, and Draper roads are connected to Stuhr Road on the west side of the proposed levee and would provide local access to rural residences and agricultural fields. Detour routes are available that would result in minimal delays to commuters and minimal impacts on LOS, and detours would be in place for a minimal duration; thus, impacts on traffic would be less than significant.

Increased depth of flooding is expected to be minimal; however, inundated roadways would result in hazardous conditions and would significantly impact transportation safety. Impacts would be mitigated to less than significant. During flood events, roadways north of the chevron levee could be temporarily inaccessible. Alternative southbound and northbound routes to I-5 would remain accessible from Highway 33. Emergency access to areas within the city limits would not be affected. Eastin Road would remain accessible for emergency response in rural areas and would not substantially add to response times.

The Newman General Plan denotes a proposed bicycle route along the CCID within Newman's SOI. This bicycle path would either cross over the proposed chevron levee at Jenson

Road, or the bicycle path could be built on the levee. Either way, the levee would not preclude development of this alternative-transportation route.

Mitigation

Where increased depth of flooding results in hazardous conditions, installation of temporary barriers and signage to prevent motorists from entering inundated roadways would mitigate transportation safety impacts to less than significant.

Alternative 3: Chevron Levee with Freeboard (LPP)

Impacts on traffic would be similar to those occurring as a result of Alternative 2. Because existing roadways are capable of supporting a minimal increase in traffic without substantial reductions of LOS, and because detour routes would only be required for a brief period, Alternative 3 would have less than significant impacts on traffic in the study area. Inundated roadways could result in hazardous conditions and would significantly impact transportation safety, but would be mitigated to less than significant as described below.

Mitigation

Installation of temporary barriers and signage to prevent motorists from entering inundated roadways would mitigate transportation safety impacts to less than significant.

5.2.16 Utilities and Public Services

A project alternative would have a significant impact related to utilities and public services if it would:

- Result in substantial adverse physical impacts associated with the need for of new or physically altered public service or facilities, including police service, fire protection, school, library, drinking water, wastewater, and stormwater collection facilities;
- Substantially increase need for new or physically altered public service or facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objective;
- Require or result in the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects; or
- Be served by a landfill with insufficient permitted capacity to accommodate the buildout of Newman's General Plan solid waste disposal needs.

Alternative 1: No Action

With implementation of Newman's General Plan, future growth would not exceed the capabilities or capacity of Newman to provide utilities and public services, including police service, fire protection, schools, libraries, or drinking water, wastewater, and stormwater collection facilities. Although anticipated growth would require improvement of public services and facilities, the impacts of induced development resulting from improved utilities and services would be mitigated to less than significant through implementation of City of Newman policies and regulations.

Alternative 2: Chevron Levee (NED)

Flood risk reduction measures would not require the expansion of utilities or public services. The farm road alignment would not extend flood damage risk reduction to substantial areas outside of Newman's proposed SOI. The chevron levee would alter existing drainage patterns, resulting in a reduced demand on City facilities during flood events, and no new stormwater drainage systems would be required as a result of Alternative 2. The integrity of the CCID Main Canal, its capacity to deliver irrigation water, and the quality of irrigation waters in the canal would not be affected. Overhead electric power distribution lines along Stuhr Road would be temporarily relocated within the construction right-of-way, but service would be continuous during and after chevron levee construction.

Soils unsuitable for levee construction but suitable for agricultural use may be disposed of in adjacent agricultural fields, as approved in writing by USACE and the affected landowner. Any material unsuitable for levee construction or for disposal on agricultural fields would be disposed of in the Fink Road Landfill. The Fink Road Landfill has a permitted capacity until 2022 or 2023, depending on the type of permitted waste generated by the cogeneration versus municipal solid waste. In order to accommodate waste after 2023, the Fink Road Landfill has applied for a permit with Stanislaus County to expand its site westward onto adjacent property owned by the county. A recycling center would also be included in this expansion in order to reduce the total amount of landfill waste. The Fink Road Landfill is currently permitted to accept up to 2,400 tons of waste per day. Impacts on utilities and public services from the implementation of Alternative 2 would be less than significant.

<u>Mitigation</u>

Impacts on utilities and public services would be less than significant and no mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

Impacts on utilities and public services would be similar to those described under Alternative 2 and would be less than significant.

Mitigation

Impacts to utilities and public services would be less than significant and no mitigation is required.

5.2.17 Recreation

The proposed project would have a significant impact on recreational resources if it would:

- Increase the use of existing neighborhood and regional parks or other recreational facilities, such that substantial physical deterioration of the facility would occur or be accelerated; or
- Would result in substantial adverse physical impacts associated with the need for new or physically altered parks or recreational facilities.

Alternative 1: No Action

Newman offers sufficient recreational opportunities through public parks and would be able to maintain sufficient recreational area to population ratios meeting future needs for recreational opportunities without adversely impacting other resources. Following the Newman General Plan, a bicycle path north of the CCID Main Canal would be developed over the next 10 years. Therefore, the No Action Alternative would have a less than significant impact on recreation.

Alternative 2: Chevron Levee (NED)

With the implementation of Alternative 2, no adverse effects would occur to recreation resources in the area. Construction of the chevron levee east of the CCID Main Canal would not prohibit development of the proposed bicycle path and would not restrict access to or impede views from the proposed path, and recreation would not be impacted. Alternative 2 would not impact existing and future recreation opportunities.

Mitigation

As a result of Alternative 2, adverse effects to recreation would not occur and no mitigation is required. Relocation of the proposed bicycle route onto the proposed chevron levee could reduce costs of the path, enhance the recreational experience, and minimize cumulative impacts on surrounding land use by allowing multiple uses of land within the same footprint.

Alternative 3: Chevron Levee with Freeboard (LPP)

Similar to Alternative 2, Alternative 3 would not have an impact on recreational resources.

Mitigation

Recreational impacts would not occur, and no mitigation is required.

5.2.18 Aesthetics

The implementation of the proposed project would have a significant impact on visual and aesthetic quality if it would:

- Substantially or demonstrably result in a negative aesthetic alteration to the existing character of the area. A substantial alteration is characterized by a negative "sense of loss" of character or unique resources;
- Have a substantial adverse effect on a scenic vista; or
- Create a new source of substantial light or glare which would adversely affect daytime or nighttime views in the area.

Alternative 1: No Action

Features that define the character of the area identified by the Newman General Plan (2007) include its distinct neighborhoods and areas, gateways, its primary corridor Highway 33, and its trees and landscaping. As Newman grows, development is likely to impact some of these features. The General Plan contains policies that work in conjunction with current City design and development regulations to ensure that new development complements the existing aesthetic fabric of City of Newman and its surrounding environment, and does not threaten scenic corridors or exacerbate issues of light and glare. Because each of the characteristic features is susceptible to flood damage, the No Action Alternative would have a significant effect on the character of the area**.**

Future flooding would not degrade the physical appearance of features which contribute to scenic vistas, including farmlands, the Diablo Range, and riparian habitats along Orestimba Creek and the San Joaquin River. Although farmlands are functionally impacted following flooding, they remain open spaces and continue to contribute to the rural quality of views. Similarly, riparian habitats may be damaged but would retain the undeveloped appearance which contributes to the scenic views. Flooding does not affect light or glare.

Alternative 2: Chevron Levee (NED)

Although construction would temporarily detract from aesthetic values, the Stuhr Road levee alignment would not have a long-term adverse effect on the aesthetic and visual resources of the area. The height of the proposed levee along the CCID Main Canal would not be significantly higher than the existing canal berm. The CCID Main Canal is an existing

component of the agricultural setting which contributes to the area's viewshed. If construction occurs at night, the use of lighting would have a significant short-term impact; however, the chevron levee would not have a long-term impact on light or glare. If construction activities affect the Newman Gateway at Stuhr Road, aesthetics would be significantly impacted, but would be mitigated to less than significant as described below.

Mitigation

Nighttime construction would be avoided to the extent practicable. If nighttime construction is unavoidable, shielding would be used to direct light away from residential areas and onto the construction area. The Newman Gateway at the CCID Main Canal and Stuhr Road would be avoided or relocated if necessary and the aesthetic quality of the gateway would be unaffected or improved. These mitigation measures would reduce potential aesthetic impacts to less than significant.

Alternative 3: Chevron Levee with Freeboard (LPP)

The impact of Alternative 3 would be similar to those resulting from implementation of Alternative 2. Construction activities could result in significant short-term impacts, but would be mitigated to less than significant. Although the LPP levee would be taller than the NED levee, it would not be significantly higher than the CCID Main Canal and thus would not impact views.

Mitigation

Short-term impacts would be mitigated to less than significant through implementation of measures described under Alternative 2.

5.2.19 Noise

Implementation of a project alternative would result in a significant noise impact if it would:

- Expose people to or generate noise levels in excess of standards established in the local general plan, noise ordinance, or applicable standards of other agencies;
- Expose people to or generate excessive groundborne vibration or groundborne noise levels;
- Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
- Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project; or

- Result in the encroachment of incompatible land uses near known noise producing industries, railroads, airports, and other sources.

Alternative 1: No Action

Development occurring as a result of implementing the Newman General Plan would result in an increase of traffic on city-, county-, and state-maintained roadways. Of these roadways, Highway 33, Upper Road, Prince Street, Barrington Avenue, Merced Street, Hills Ferry Road, Canyon Creek Drive, Kern Street, Driskell Avenue, and Inyo Avenue are adjacent to existing residences within Newman, and would experience a substantial permanent increase in ambient noise levels. Residences located adjacent to roadways with low existing traffic volumes would also experience a substantial permanent increase in ambient noise levels, including Fig Lane, Main Street, Balsam Drive, Eucalyptus Avenue, Orestimba Road, and Hoyer Road. Although the proposed General Plan includes policies and actions that would serve to reduce the identified noise increases in Newman, it does not eliminate the significant unavoidable impact with regard to noise.

Newman and Stanislaus County regulations would reduce any construction-related groundborne vibrations to less than significant. Periodic increases in ambient noise levels resulting from construction associated with new development or infrastructure maintenance would be similarly mitigated. City and County policy and regulation would prevent encroachment of incompatible land uses. However, as a result of increased traffic near residential areas, the No Action Alternative would have a significant impact on noise.

Alternative 2: Chevron Levee (NED)

Stanislaus County (2008) has established land use compatibility guidelines, which promote the development of new land uses within areas of compatible exterior noise exposure (Table 5-4).

Table 5-4: Stanislaus County Land Use Compatibility Guidelines

Land Use Category	Exterior Noise Exposure (DNL, dBA)		
	Acceptable	Conditional	Unacceptable
Residential – Low-Density-Single Family, Duplex, and Mobile Homes	50 - 60	60 - 70	> 70
Industrial, Manufacturing, Utilities, and Agriculture	50 - 75		> 75

Source: Stanislaus County, 2008

The State of California General Plan guidelines require the following noise-sensitive areas be considered in the development of each community's General Plan: schools, hospitals, convalescent homes, churches, sensitive wildlife habitats, and use deemed noise-sensitive by the local jurisdiction. Neither Stanislaus County nor Newman identifies locally specific noise-sensitive receptors. Stanislaus County requires the evaluation of mitigation measures for construction projects that would cause the DNL at sensitive uses to increase by 3 dBA or more and exceed the "normally acceptable" level, or cause the DNL at noise-sensitive uses to increase 5 dBA or more and remain "normally acceptable." Newman further requires evaluation of mitigation for construction activities lasting more than one construction season that cause noise levels to exceed an hourly average of 60 dBA and exceed existing ambient noise levels by 5 dBA or more at a sensitive receiver.

Earth compaction and earthmoving equipment such as dump trucks and bulldozers would be the loudest source of noise during construction. Operation of typical earth-moving equipment produces noise emissions up to 81 dBA at the source and is typically attenuated to less than 60 dBA within approximately 700 feet. Noise receptors within 700 feet of the construction footprint include: rural residences on agricultural. DNL at any given location near construction would be less than 60 dBA for several reasons. Because the project is linear, construction activities are not expected to occur at one location for more than several weeks. Because DNL averages noise over an entire year, intermittent peaks of 81 dBA for short periods would not substantially affect DNL values. The impact of construction activities on long-term ambient noise levels would be less than significant.

Noise levels could exceed an hourly average of 60 dBA at noise receptors within 700 feet of construction. Rural residences are typically located within or near clusters of agricultural facilities and ambient noise levels are likely to be affected by intermittent noise caused by equipment maintenance and by seasonal harvesting and field operations. Ambient noise levels at residences and commercial operations along Stuhr Road are affected by traffic along Stuhr Road, Highway 33, and the UPRR. Because existing sources of intermittent and long-term noise affects ambient noise levels near residences potentially affected by construction, construction activities are not likely to increase DNL by more than 5 dBA. The impact of construction activities on intermittent ambient noise levels near residences would be less than significant.

<u>Mitigation</u>

Measures to further minimize noise emissions would include restriction of nighttime construction near residences, location of staging areas at least 700 feet from residential areas, design of construction and detour routes that avoid noise-sensitive receptors to the extent practicable, and proper maintenance of equipment.

Alternative 3: Chevron Levee with Freeboard (LPP)

The impacts of Alternative 3 on the noise environment would be similar to those occurring under Alternative 2. Residences within 700 feet of the proposed chevron levee would be further impacted due to the additional time required to increase the levee height. However, due to the linear nature of the project, construction noise would not substantially affect long-term ambient noise levels at any one location. Because these residences are located within the vicinity of agricultural land use, temporary increases of noise would not substantially affect ambient noise levels and would also be less than significant. Intermittent increases in noise levels near sensitive wildlife habitats would be significant, but would be mitigated to less than significant.

Mitigation

Mitigation measures described under Alternative 2 would reduce noise impacts and avoid any significant impacts on sensitive receptors.

5.2.20 Hazardous, Toxic, and Radiological Materials and Wastes

A project alternative would have an impact related to hazards or hazardous materials if it would:

- Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials;
- Emit hazardous emissions or handle hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school;
- Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment; or
- Be located on a site that is included on a list of hazardous material sites compiled pursuant to Government Code Section 65962.5 and, as a result, create a significant hazard to the public or the environment (Health & Safety Code § 65962.5).

Alternative 1: No Action

Many of the commercial and industrial operations in Newman utilize and generate hazardous materials as part of their daily operations, including gasoline stations, dry cleaners, and automotive repair shops. Additionally, hazardous materials are utilized by agricultural operations in the form of pesticides, herbicides, and fertilizers, and by residential households, including cleaning supplies and paints. The potential increase in development permitted under the Newman General Plan could result in more hazardous materials being used, stored, or transported through and discarded within Newman, which would increase the potential risk

associated with hazardous materials and waste. To address these issues, the Newman General Plan includes policies and actions that are intended to limit the impact hazardous materials could have on the population and environment, and the potential impacts would be less than significant.

Alternative 2: Chevron Levee (NED)

The operation of construction equipment during levee construction could potentially result in the release of hazardous materials as a result of leaks or spills. If a large spill were to occur, impacts on water quality and agricultural resources may be significant, but would be mitigated to less than significant as described below. There are no sensitive receptors within 0.25 mile of the construction footprint. The extension of flood risk reduction measures to developed areas within Newman would reduce the risk of flooding in commercial and industrial facilities utilizing hazardous materials, thereby reducing potential negative impacts associated with flood waters.

As discussed in Section 4.2.20, a search of Federal, state, local, and tribal databases was conducted in 2010 (EDR, 2010) for records of historical and existing hazardous material generation, handling, transport, or storage facilities within 1 mile of the construction footprint (Figure 4-13, Table 4-11). A total of six USTs were identified in the vicinity of the proposed levee. Only one appears close to the footprint of the proposed alignment. Since the UST was listed on a historic database, its current status is unknown. Implementation of the mitigation measures would result in a less than significant impact.

Mitigation

Mitigation measures to avoid or minimize impacts as a result of spills or leaks would be included in a SWPPP, as described in Section 5.2.3, and SPCCP to be developed prior to construction. An SPCCP would include best management practices, such as the use of drip pans and containment berms, to limit the potential release of hazardous materials and toxic substances.

A Phase I Environmental Site Assessment to identify potential hazardous materials and wastes within the project area would be conducted during the PED phase. Subsequent assessments would be conducted to analytically quantify any potential contaminants detected and to delineate the range of contamination, if necessary.

Alternative 3: Chevron Levee with Freeboard (LPP)

Hazardous materials and wastes would be handled and disposed of similar to Alternative 2 and could potentially result in significant impacts, but would be mitigated to less than significant.

Mitigation

Measures to avoid the uncontrolled release of hazardous materials and toxic substances, as described under Alternative 2, would mitigate the potential for impacts to less than significant.

5.2.21 Cultural Resources

Effects to cultural resources would be from four types of construction-related actions: (1) impacts to the integrity of the visual and physical setting of historic properties, (2) impacts to the structural integrity of historic buildings and structures from demolition, (3) impacts from earth moving activities, and (4) impacts from clearing and grubbing and follow-on planting.

Effects are considered to be adverse if they:

- Alter, directly or indirectly, any of the characteristics of a cultural resource that qualify that resource for the NRHP so that the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association is diminished; or
- Disturb any human remains, including those interred outside of formal cemeteries.

Alternative 1: No Action

Newman contains numerous buildings that are over 50 years of age and may be historically significant. Although the majority of new development under the proposed General Plan would take place on land without existing structures, redevelopment within the historic downtown or in-fill development in older residential areas could result in the demolition, destruction, relocation, or alteration of buildings that are historically significant and eligible for listing in the NRHP. In addition, there are a number of rural buildings that are located outside Newman but within the proposed SOI that may be adversely affected by new development as allowed by the proposed General Plan. Development allowed under the proposed General Plan would also involve construction activities that could result in the disturbance of undiscovered archaeological and paleontological resources during grading or other on-site excavation activities. City policy includes measures to mitigate adverse affects to cultural resources.

Flooding currently effects historic downtown Newman, and potentially effects historical buildings in residential and rural areas. Remediation of flood damage could result in adverse effects on these buildings if repairs are not compatible with the historic building in design, materials, details, and character-defining features of historic buildings. Extensive flood damage could result in the reduction of the historical importance of affected buildings, resulting in significant impacts.

There are no known archaeological resources or human remains identified within the floodplain. Due to the generally shallow depth of flooding, such resources would likely remain undiscovered and are not likely to be adversely affected.

Alternative 2: Chevron Levee (NED)

The CCID Main Canal is potentially eligible under Criterion A for the NRHP based on its association with the San Joaquin and Kings River canals, a valley-wide system for water distribution. The CCID Main Canal is located west of the proposed chevron levee and would not be directly impacted.

Because the entire construction footprint has not been surveyed, there may be potential for unidentified and subsurface NRHP eligible cultural resources within the construction footprint. Any loss of such resources would be significant, but would be mitigated to less than significant as described below.

There are no known historic resources that would be adversely affected by induced flooding, and due to the generally shallow depth of flooding resources that remain undiscovered are not likely to be adversely affected by induced flooding.

The implementation of flood risk reduction measures would benefit historic homes and other structures in the developed areas of Newman. Newman's regulations and policies would prevent any adverse effects to existing structures resulting from renovation or nearby development.

USACE and the California SHPO have entered into a Programmatic Agreement (PA) to avoid and minimize effects to potentially NRHP-eligible cultural resources within the area of potential effects. The PA includes requirements for the identification of NRHP eligible historic properties in the area of potential effects (APE) and the assessment of adverse effects to such properties; in consultation with the SHPO, Native American Tribes, the public, and any other interested parties.

Any cultural resources discovered in the APE during a survey would be evaluated for NRHP eligibility and any potential adverse effects to such properties would be resolved. If previously unidentified cultural resources are discovered during ground disturbing activities, all construction in the vicinity of the find would be halted immediately. Construction would not continue until USACE, in consultation with the SHPO, has assessed the NRHP eligibility of the resources, and mitigated any adverse effects, as stipulated in the PA. The PA would ensure less than significant impacts to cultural resources.

<u>Mitigation</u>

Impacts to cultural resources would be less than significant and no mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

Direct and indirect effects on historic properties would be similar to those occurring under Alternative 2 and would be less than significant.

Mitigation

Impacts to cultural resources would be less than significant and no mitigation is required.

5.2.22 Cumulative Effects

Cumulative effects are evaluated by first identifying other past, present, or reasonably foreseeable future actions that could have direct or indirect environmental effects in the cumulative study area. The following regional programs, potential projects, and planning efforts have been identified for the cumulative study area, which varies depending on the environmental issue under consideration.

Regional planning programs with measures being planned or implemented in the study area include those listed in Section 1.6 of this Feasibility Report/EA/IS. These include three programs aimed at improving the biological environment: the California Bay-Delta Program (CALFED) to restore ecological health and improve water management of the Bay-Delta; the CVPIA, which amends previous authorizations of the Central Valley Project to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with power generation; and the NRCS Wetland Reserve Program, which focuses on the restoration of a variety of wetland types and has been used to restore flood-damaged wetlands along the San Joaquin River. Projects identified in Section 1.6 include the Nature Conservancy Mount Hamilton project, which seeks to ensure permanent conservation management of nearly 500,000 acres within the Diablo Range west of Newman, and the Nature Conservancy Simon Newman Ranch project, which would prevent future subdivision and development of 33,000 acres in the upper watershed of Orestimba Creek.

A review of the Caltrans District 10 homepage identified several projects planned within the County, most of which would occur along Highway 99 and east of the San Joaquin River in the vicinity of Turlock and Modesto. Two currently programmed projects were identified in the Newman area. The Newman Downtown Plaza Improvement project is in the planning phase and includes the replacement of sidewalks, curbs, gutters, and addition of parking spaces along Highway 33 from Fresno Street to Tulare Street. Rehabilitation of Highway 33 from Jenson Road in Newman to near Patterson is in the construction phase.

The Stanislaus County Planning Department maintains a database of current projects being planned within the county. An online search of the database identified one project planned in the Newman area. California Transplants proposes to expand their greenhouse facility at the west end of Stuhr Road, adjacent to the Delta-Mendota Canal. The expansion project would be extended over a 3-year period and the company would employ 14 people during the planting season each year (January to June).

Newman has two specific plans within its proposed SOI, the Downtown Development Plan and the Highway 33 Plan, each of which promotes controlled development and renewal of

lands according to Newman's Adopted Vision Statement through preserving the historic fabric of downtown and surrounding neighborhoods, creating a walkable community providing a range of activities connected by pedestrian trails and bike paths, providing a range of housing types and a variety of employment options, and maintaining a sufficient level of infrastructure.

Alternative 1: No Action

Under the Alternative 1, it is assumed that local growth would occur as provided for in the Newman General Plan (Newman, 2007). The General Plan identifies several cumulative effects resulting from implementation of the general plan. As a result of anticipated growth and development forecast in the General Plan, the following cumulative impacts were determined by the City to be less than significant with implementation of mitigation measures:

- Degradation of the rural and agricultural setting of Newman and Stanislaus County;
- Loss or degradation of cultural resources as a result of grading and other construction activities;
- Increase in runoff affecting water quality;
- Location of additional population and structures within areas subject to flooding;
- Exposure of people to risk as a result of seismic activity;
- Loss of mineral resources;
- Exposure of people to hazardous materials and wastes; and
- Potential conflicts with other applicable plans, policies and regulations, including the County's General Plan.

As a result of anticipated growth and development, the following cumulative impacts would be significant even with implementation of mitigation measures:

- Loss of agricultural resources;
- General reduction in habitat values for existing resident and migratory species and cumulative loss of habitat for common and possible special-status species; and
- Exceedance of Valley Air District's regional clean air planning assumptions.

Under the No Action Alternative, cumulative impacts as described under Newman's General Plan would likely occur in the future. All of these impacts are associated with growth and development and would likely occur without the implementation of any risk reduction measures. Based on the findings in the General Plan Environmental Impact Report, USACE has independently determined that the cumulative impact of the Alternative 1 would be less than significant.

Alternative 2: Chevron Levee (NED)

Some of the direct and indirect effects identified in Sections 5.2.1 through 5.2.21 may result in incremental impacts on the environment when considered in light of other past, present, and reasonably foreseeable future actions. The following analysis of potential cumulative effects corresponds with the findings presented in Section 5.2.

Seismicity

As discussed in Section 5.2.1, the San Joaquin Fault underlies the proposed chevron levee. Although development of Alternative 2 would not directly expose people to adverse effects of seismic activity, it would expose them indirectly if a seismic-related levee failure were to occur. This would have an incremental cumulative effect when added to other past, present, and reasonably foreseeable future actions that could increase development within the study area. However, the potential for cumulative effects would be mitigated by the design of the levee in accordance with the State of California and USACE guidelines.

Geology

As discussed in Section 5.2.2, subsidence and/or liquefaction underlying the chevron levee under Alternative 2 could result in levee failure that would indirectly expose people to adverse effects. This would have an incremental cumulative effect when added to other past, present, and reasonably foreseeable future actions that could increase development within the study area. However, the potential for cumulative effects would be mitigated by the design of the levee in accordance with the State of California and USACE guidelines.

Soils

As discussed in Section 5.2.3, development of Alternative 2 has the potential for short-term erosion. This would have an incremental cumulative effect when added to the potential for soil erosion from similar past, present, and reasonably foreseeable future action in the study area. The potential for an incremental contribution to an adverse cumulative effect would be minimized through the use of best management practices and implementation of the SWPPP. Similar measures would be required of related present and reasonably foreseeable future projects in the study area to comply with the CWA.

Hydrology

As discussed in Section 5.2.4, the implementation of Alternative 2 would have a beneficial effect on hydrology by reducing the risk of property loss, injury, and death involving flooding. This feasibility study is the only known past, present, or reasonably foreseeable future project to consider flood protection for the study area. As a result, there is not a potential for an incremental cumulative impact.

Water Quality

As discussed in Section 5.2.5, the implementation of Alternative 2 would reduce flooding of agricultural and urban areas, thereby reducing the volume of polluted waters discharged to the San Joaquin River via Orestimba Creek, agricultural drains, or the Newman Wasteway. This feasibility study is the only know past, present, or reasonably foreseeable future project to consider the reduction of flooding in agricultural and urban areas in the study. There are, however, likely ongoing regulatory efforts to reduce the discharge of polluted water from agricultural and urban land uses. Implementation of Alternative 2 would make a significant beneficial contribution to cumulative efforts to improve water quality within the study area.

Groundwater

As discussed in Section 5.2.6, implementation of Alternative 2 would not have an impact on groundwater recharge in the planning area. It would not make a cumulative contribution to other past, present, or reasonably foreseeable projects dealing with groundwater recharge within the study area.

Waters of the U.S. and Wetlands

As discussed in Section 5.2.7, implementation of Alternative 2 would no have any effects on delineated wetlands or Waters of the U.S. It would therefore not make a cumulative contribution to a net loss of wetlands or degradation of Waters of the U.S.

Air Quality

As discussed in Section 5.2.8, the temporary emissions resulting from implementation of Alternative 2 would not exceed Federal and State *de minimis* thresholds, and therefore do not constitute a regionally significant contribution to air quality. Other present and reasonably foreseeable projects in the study area would be required to comply with regional air quality standards, which have been implemented to reduce adverse cumulative impacts. Therefore, the cumulative impact to air quality as a result of the proposed action would be less than significant.

Vegetation

As discussed in Section 5.2.9, implementation of Alternative 2 would result in approximately 152 acres of agricultural land being temporarily or permanently impacted. None of these lands are considered a natural community so there would not be any incremental contribution to cumulative impacts.

Wildlife and Fisheries

As discussed in Section 5.2.10, implementation of Alternative 2 would result in the temporary loss and degradation of approximately 152 acres of wildlife habitat associated with agricultural margins. The temporary loss of marginal habitat would have a minimal impact on wildlife populations due to the prevalence of equally suitable habitats nearby. There are no other reasonably foreseeable future projects that would result in a similar temporary degradation of agricultural margins. Therefore, the implementation of Alternative 2 would have a less than significant cumulative impact on wildlife and fisheries.

Special Status Species

As discussed in Section 5.2.11, there is a potential for habitats associated with special status species to be impacted by the implementation of Alternative 2. Other past, present, and reasonably foreseeable projects could also impact habitats associated with special status species. Avoidance is the primary mitigation measure identified for potential impacts associated with the implementation of Alternative 2. Avoidance of impacts would eliminate the possibility of an incremental contribution to cumulative impacts. It is assumed other projects would also be required to avoid impacts, thereby further reducing the potential for cumulative impacts.

Invasive Plants and Noxious Weeds

As discussed in Section 5.2.12, implementation of Alternative 2 could allow the establishment of invasive plants and noxious weeds along agricultural margins. Establishment of invasive plants and noxious weeds as a result of Alternative 2 would make an incremental cumulative contribution to the establishment of invasive plants and noxious weeds by other past, present, and reasonably foreseeable future projects in the study area. The levees proposed under Alternative 2 would provide a less suitable habitat for invasive plants and noxious weeds and would substantially limit the establishment of them along existing agricultural margins. The cumulative effect would therefore be beneficial.

Socioeconomics

As discussed in Section 5.2.13, implementation of Alternative 2 would not divide the community and would have beneficial effects on low income or minority communities in the planning area. These beneficial effects would make an incremental contribution to the cumulative socioeconomic effects resulting from other past, present, or reasonably foreseeable future projects.

Land Use

As discussed in Section 5.2.14, implementation of Alternative 2 would remove an area of Prime Farmlands from agricultural production. This conversion of farmland could make an incremental contribution to the cumulative effect of farmland conversions associated with

other past, present, and reasonably foreseeable future projects. As discussed under the No Action Alternative, however, the County's General Plan already anticipates the build out of the agricultural area that would be converted to non agricultural use under Alternative 2. The County determined that loss of agricultural resources is a significant and unavoidable cumulative effect. Implementation of Alternative 2 would not introduce a cumulative effect not previously anticipated or disclosed by the County.

Transportation

As discussed in Section 5.2.15, implementation of Alternative 2 would result in minimal, short-term impacts on traffic that could have an incremental impact when added to other past, present, and reasonably foreseeable actions within the study area. The transportation network within the study area currently has levels of service high enough to accommodate the temporary increase in truck traffic that would result from the implementation of Alternative 2. Any road closures or detours resulting from the implementation of Alternative 2 would be coordinated with local transportation and public works agencies to avoid adverse cumulative effects. The cumulative impact would be less than significant.

Utilities and Public Services

As discussed in Section 5.2.16, implementation of Alternative 2 would not require the expansion of utilities or public services. Short-term and localized, minor impacts to utilities to accommodate the construction of the levee would not be cumulative in nature. Alternative 2 would make a cumulative contribution to the production of solid waste. The Fink Road Landfill has existing or planned capacity sufficient to accommodate forecasted volumes for present and reasonably foreseeable projects in the study area. The proposed action would have a less than significant cumulative effect.

Recreation

As discussed in Section 5.2.17, implementation of Alternative 2 would not have any adverse effects on recreation in the study area. It would therefore not make any incremental contribution when added to the recreation effects of other past, present, or reasonably foreseeable projects within the study area.

Aesthetics

As discussed in Section 5.2.18, implementation of Alternative 2 would not degrade the physical appearance of features which contribute to scenic vistas in the study area. It would therefore not make any incremental contribution when added to the aesthetic effects of other past, present, or reasonably foreseeable projects within the study area.

Noise

As discussed in Section 5.2.19, implementation of Alternative 2 would result in short-term and localized increases in ambient noise levels. Construction activities related to one or more past, present, or reasonably foreseeable future projects would likely have similar impacts. Since they would not occur in the same location as the levee construction, implementation of Alternative 2 would not make an incremental contribution to an adverse cumulative effect.

Hazardous, Toxic, and Radiological Waste

As discussed in Section 5.2.20, implementation of Alternative 2 there is a potential for impacts associated with spills and leaks. Spills and leaks associated with Alternative 2 could have an incremental impact when added to similar impacts from other past, present, and reasonable foreseeable future actions in the study area. The potential for adverse cumulative impacts is minimized by the CWA's requirement of a SWPPP. The proposed action would have a less than significant cumulative effect.

Cultural Resources

As discussed in Section 5.2.21, no adverse impacts to cultural resources are anticipated to occur with implementation of Alternative 2. There is always the possibility of an unanticipated discovery during ground disturbing activities. Depending on the nature of the resource, unanticipated impacts may have an incremental impacts when added to similar impacts from other past, present, or reasonably foreseeable future action in the study area. Impacts would be mitigated to a less than significant level through the implementation of measures outlined in a memorandum of agreement with the SHPO, as required by the National Historic Preservation Act.

Mitigation

Mitigation for cumulative impacts would be the same as identified for direct and indirect effects under each environmental issue area presented above.

Alternative 3: Chevron Levee with Freeboard (LPP)

The cumulative impacts of Alternative 3 would be similar to those occurring under Alternative 2 and would be less than significant.

Mitigation

Alternative 3 would not result in significant cumulative impacts, and no mitigation, other than measures to mitigate direct and indirect impacts previously described, would be required.

5.2.23 Unavoidable Significant Effects

Alternative 1: No Action

As a result of anticipated growth and development proposed under the Newman General Plan and other actions in the region, Newman anticipates unavoidable significant cumulative impacts on agriculture, air quality, transportation, noise, and wildlife habitat.

Alternative 2: Chevron Levee (NED)

With the implementation of measures to mitigate direct and indirect impacts of the action itself, as described under each resource assessment, all significant or potentially significant impacts would be avoided.

Alternative 3: Chevron Levee with Freeboard (LPP)

With the implementation of measures to mitigate direct and indirect impacts, as described under each resource assessment, all significant or potentially significant impacts would be avoided.

5.2.25 Irreversible and Irretrievable Commitment of Resources

Section 15126.2(c) of the CEQA Guidelines requires a discussion of the extent to which a proposed project would commit nonrenewable resources to uses those future generations would probably be unable to reverse. A project alternative would generally result in a significant irreversible impact if the irreversible commitment of resources, including direct and indirect commitments, is not justified.

Alternative 1: No Action

Development under the Newman General Plan would result in the conversion of agricultural lands to commercial, residential uses, and public uses. This development would constitute a long-term commitment 226 acres of land that were not previously designated for development to urban uses.

Development allowed under the Newman General Plan would also irretrievably commit nonrenewable resources to the construction and maintenance of buildings, infrastructure, and roadways. These include mining resources such as sand, gravel, steel, lead, copper, and other metals. Development also represents a long-term commitment to the consumption of fossil fuels, natural gas, and gasoline. Increased energy demands would be used for construction, lighting, heating, and cooling of new buildings, and transportation of people within, to, and from the planning area. The Newman General Plan policies and actions promoting energy conservation would result in some savings in nonrenewable energy supplies. Implementation

of the Newman General Plan would also result in an irreversible commitment of limited, renewable resources such as lumber and water. Policies and actions contained in the Newman General Plan that promote resource and water conservation and green building would result in some savings of renewable resources.

Irreversible changes to the physical environment could occur from accidental release of hazardous materials associated with development activities. However, compliance with State and Federal hazardous materials regulations and Newman General Plan policies is expected to maintain this potential impact at a less than significant level.

The irreversible commitment of resources occurring under the Newman General Plan would provide beneficial impacts to the socioeconomic conditions of Newman and Stanislaus County. Commitment of resources associated with all new development would be regulated by both Newman and Stanislaus County; thereby, ensuring the efficient and productive use of limited lands and resources and that these commitments are justified.

Alternative 2: Chevron Levee (NED)

Approximately 152 of Prime Farmland occurring within the Newman SOI would be converted to levee and access roads. Although future generations would be committed to maintaining the chevron levee as a flood risk reduction measure, this irreversible commitment of resources would be beneficial to both urban areas within Newman and surrounding agricultural land. Future development would occur primarily as a result of implementing Newman's General Plan, and Alternative 2 would not substantially influence future growth or contribute to the irretrievable commitment of resources occurring under the No Action Alternative. The irreversible and irretrievable commitment of resources would be less than significant and no mitigation is required.

Alternative 3: Chevron Levee with Freeboard (LPP)

The irretrievable and irreversible commitment of resources of Alternative 3 would be similar to those occurring under Alternative 2 and also would be less than significant and not require mitigation.

CHAPTER 6 – PUBLIC INVOLVEMENT

6.1 PUBLIC INVOLVEMENT PROGRAM

On March 4, 1999, a public meeting was held on the West Stanislaus Flood Reduction Project for Salado Creek and Orestimba Creek. At the time of this public meeting, Salado Creek was part of the study but has since been eliminated for purposes of expediency. Approximately 70 individuals attended. The sign-in sheet indicated that residents of the towns of Newman, Patterson, Crows Landing, Modesto, and outlying areas were represented. Following a presentation on the USACE planning process, comments were fielded from the public and agency representatives. No written statements were provided.

The local sponsor stated that the entire community was supportive of the project, except for one person, who later responded by letter. This individual represents the Indian Creek Land Trust, property owners in the watershed. Their concerns are summarized below:

"We are concerned with the Corps of Engineers proposal of widening and deepening the creek channel to a flow capacity of 20,000 cfs. We believe that in order to accomplish this capacity the channel would need to be widened by more than 50% and deepened by an additional 50%. We have a private bridge that crosses Orestimba Creek and we would require that it be upgraded so as to accommodate the proposed 20,000 cfs channel. There is at least one other private bridge that crosses the Orestimba between Kilburn Road and River Road, along with County bridges at both Kilburn and River Roads, respectively, that would all have to be mitigated as well. The CCID weir, the railroad trestle, straightening the 'horseshoe' bend and restoring the plant and wildlife habitat are not the only reconstruction projects involving the '20,000 cfs proposal'.

"We favor the construction of a retention reservoir west of Interstate 5 of sufficient capacity to meter 7,000 cfs until storm flows have been disbursed to below the 7,000 cfs flow rate, couple with some minor streamlining of the creek channel to provide 8,000 cfs capacity. Much of the creek currently has 8,000 cfs capacity. We favor this plan as being less invasive to the creek habitat, more acceptable to the community and possibly more cost effective. Such a proposal would eliminate the straightening of the horseshoe bend, reconstructing the railroad trestle and all the public and private bridges, and minimize the channel dredging and plant and wildlife restoration."

The only other letter received as a result of this meeting was from the Nature Conservancy, a landholder in the canyon. Their comments are summarized as follows:

"The Conservancy recognizes and appreciates the need to protect downstream communities from damage associated with peak flooding. We also wish to ensure that the alternatives developed, include the full range of measures for reducing flood damage, and that

alternatives are designed to minimize their impacts on the environment and on our investment."

"Finally we encourage the Corps to investigate a broad array of measures both upstream and downstream that individually or in combination would reduce the threats of flood damage while avoiding or minimizing adverse effects of detention on the natural features of the Simon-Newman Ranch or Orestimba Creek. In particular, we would recommend that the COE initiate a water conveyance study of Orestimba Creek to analyze in a comprehensive manner the drivers of flood-related damage and assess the feasibility of making conveyance improvements. The Conservancy stands ready to contribute to this overall effort by investigating non-structural measures such as increased stream vegetation and we encourage you to consider measures such as this in your analysis."

Figure 6-1: Public Meeting in Newman

A second public meeting was held on November 26, 2007 in Newman, California. The focus of the meeting was to present the remaining alternatives and lay out the process to evaluate and identify the NED plan. The study team presented the Civil Works Planning Process

and explained how the process requires the examination of a full array of alternatives. The process for identifying the NED plan was outlined. NED establishes the basis for cost sharing between the Federal government and the non-Federal sponsor.

Several alternatives were eliminated and the presentation explained why this was done. Smaller elements of those alternatives were combined with other alternatives to develop hybrid solutions, such as a short setback levee in one area, a removal of a constriction at a bridge, or the use of an existing agricultural ditch to drain excess floodwaters, for example.

The upstream dry dam site is owned by DWR. The property was purchased to use as a mitigation site for other DWR projects. It was discussed that the resource agencies oppose this alternative because of the presence of a Sycamore Alluvial Woodland stand both upstream and downstream from the proposed dam site. Mitigation for effects to the Sycamores would be required. The State has concerns regarding the proximity of the proposed dam to the California Aqueduct – a dam failure could have serious implications for the drinking water supply for Southern California.

The Mayor introduced the idea of a benefits assessment district where the beneficiaries of the project would be assessed to pay for the project. There are about 3,000 parcels in the floodplain – and these landowners currently pay flood insurance. With the construction of a flood management project, the flood insurance would be reduced for those parcels protected by the project and that reduction could then be used for the assessment instead.

The draft Feasibility Report/EA/IS will undergo public review to present the findings of the feasibility study and to provide the public an opportunity to express their views on the results and recommendations of the Orestimba Creek Feasibility Study. Floodplain maps describing the residual risk of flooding with the project are included Comments received during the 30-day comment period, as well as responses, will be presented in Appendix F, Comments and Responses.

6.2 INSTITUTIONAL INVOLVEMENT

6.2.1 Agency Participation

The study team hosts routine meetings to facilitate agency coordination by engaging other agencies that may be affected by the potential project and its implementation. DWR regularly attends the PDT Meetings to ensure continued coordination.

During the feasibility study, coordination with USFWS has been conducted in accordance with the Fish and Wildlife Coordination Act. The USFWS has provided USACE with a draft Coordination Act Report that includes their views on the tentatively selected plan. All USFWS recommendations will be given full consideration. The USFWS will coordinate their report with NMFS and CDFG.

6.2.2 Local and Regional Interests

In addition to the public workshops, a series of stakeholder meetings have been held since 2005 to discuss the problems, opportunities, significant resources, and potential measures and alternatives and the residual risk of flooding associated with each alternative. The meetings included study team members, representatives from the local community, and interested agencies and organizations. Information provided by the local and regional stakeholders guided the identification of resources problems and helped formulate the alternative plans to address the problems and identification of the tentatively selected plan. Participants in the meetings included:

- Local Landowners and Residents
- Stanislaus County
- U.S. Fish and Wildlife Service
- The Nature Conservancy
- California Department of Fish and Game
- Central California Irrigation District (CCID)
- Orestimba Creek Flood Control District
- City of Newman
- Congressman Dennis Cardoza's Office

6.2.3 California Northern Railroad (CNRR) and Union Pacific Railroad (UPRR)

The railroad line in the Study Area is operated by the CNRR, a regional line which transports mostly agricultural produce along the western side of the San Joaquin Valley. The rail line is owned by the UPRR and leased to CNRR.

A coordination meeting with representatives from the CNRR was held in the Sacramento District office on November 12, 2009 to discuss the levee interface with the railroad berm. The CNRR representatives provided information on construction standards and templates for work on the railroad berm. This information was used by the Civil Designers and Cost Engineer for developing quantities and costs for the study.

The current design includes a closure structure across the railroad tracks to prevent floodwater from overtopping the levee at this point. UPRR, which owns the tracks, has stated that the preferred method of dealing with the floodwater would be to raise the railroad berm rather than include a closure structure. Due to the high potential cost of raising the railroad berm and the associated changes to the depth and extent of the floodplain impounded on the west side of the railroad, the closure structure is recommended as the most cost effective and efficient element to address the overtopping issue.

CHAPTER 7 – LIST OF PREPARERS*

The individuals listed below were primarily responsible for the preparation of this report.

Table 7-1: List of Preparers

Name	Role in the Study
Integrated Feasibility Study	
Michelle Williams Project Manager USACE	Report Review, Schedule and Budget
Gary Butler Budget Analyst USACE	Budgeting and programming
Scott Miner Regional Technical Specialist USACE	Plan Formulation and Ecosystem Restoration
Sara Schultz Water Resources Planner USACE	Plan Formulation and evaluation. Report Preparation. Graphic Preparation
Doug Edwards Environmental Manager USACE	Report Preparation and Impact Assessment
Robin Rosenau Environmental Manager USACE	Report Preparation and Impact Assessment
Joe Griffin Cultural Resources Specialist USACE	Cultural Resources
Ajala Ali Project Manager DWR	State Coordination
Nick Applegate Economist USACE	Economic Analysis
Gary Bedker Agricultural Economist USACE	Agriculture Economic Damage Assessment
Peter Blodgett Hydraulic Engineer USACE	Hydraulic Design

Bob Collins Hydrologist USACE	Hydrology
Bob Vrchoticky Cost Engineering USACE	Cost Engineering
Glen Johnson Geotechnical Engineer USACE	Geotechnical Analysis and Report Preparation
Paul Hsia Civil Engineer USACE	Civil Design
Benson Liang Civil Design USACE	Civil Design
Martha Cole Real Estate Appraiser USACE	Real Estate Valuation
Todd Wixom Real Estate Specialist USACE	Real Estate
Anne Burman Attorney USACE	Legal Review
Ricky Okikawa Attorney USACE	Real Estate
Alarice Hansberry Attorney USACE	Legal Review
NEPA/CEQA Compliance Documentation	
Michael Hodson Project Manager Gulf South Research Corp. (GSRC)	EA/IS Project Manager; Soils and Water Quality
Steve Kolian Natural Resources Specialist GSRC	Air Quality and Noise
Ann Guissinger Planner GSRC	Land Use, Socioeconomics, Environmental Justice
Lucinda Freeman Archaeologist GSRC	Cultural Resources

Carey Perry Natural Resources Specialist GSRC	Vegetation, Wildlife, and Sensitive Species
Agency Technical Review (ATR)	
Roger Dale Setters, PE Engineer USACE	ATR Chairperson and Planning Review
Michael Hallisy Economist USACE	ATR Economics
Robert Browning Economist USACE	ATR Agricultural Economics
Stephen Scissons Hydraulic Design USACE	ATR Hydraulic Design
Matthew McPherson Chief, Water Resources Division USACE	Risk Analysis
Bryan C. Miner Engineer USACE	ATR Civil Design
Patty Smith Real Estate Specialist USACE	ATR Real Estate
Eugene Lenhardt Engineer Buffalo District	ATR Geotechnical
Glen Matlock Cost Estimator USACE	ATR Cost Estimating
Hannah Hadley Environmental Manager USACE	ATR Environmental

CHAPTER 8 – COMPLIANCE WITH APPLICABLE LAWS, POLICIES, AND PLANS

The regulatory requirements discussed below must be met before any of the project alternatives are implemented.

8.1 FEDERAL REQUIREMENTS

8.1.1 National Environmental Policy Act (NEPA)

NEPA (42 U.S.C. § 4321 *et seq.*; 40 CFR 1500.1) applies to any action that requires permits, entitlement, or funding from a Federal agency; is jointly undertaken with a Federal agency; or is proposed on Federal land. NEPA requires every Federal agency to disclose the environmental effects of its actions for public review purposes. NEPA also assists the Federal agency to assess alternatives to and the consequences of the proposed action. NEPA requires that an environmental document be prepared that considers, discloses, and discusses all major points of view on the environmental impacts of the tentatively recommended plan and alternatives.

This portion of the Integrated Feasibility Report/EA/IS is in support of a proposed chevron levee project that would be built by USACE. This document provides the information required by NEPA for the decision-makers to consider the environmental consequences of the no-action and action alternatives. USACE is the lead Federal agency for NEPA for this project.

The draft Feasibility Report/EA/IS will be made available for publication and distribution for a 30-day public review. Full compliance will be achieved when the final Feasibility Report/EA/IS is prepared and a Finding of No Significant Impact (FONSI) is signed.

8.1.2 Federal Endangered Species Act of 1973, as Amended

The Federal Endangered Species Act of 1973 (16 U.S.C. § 1531 *et seq.*, 50 CFR 402.03) requires any Federal agency to consult with the U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS) before taking any action that may affect a listed species or designated critical habitat. The Federal agency must first avoid an action that may adversely affect a listed species or designated critical habitat. If the Federal action cannot avoid an adverse effect on listed species or designated critical habitat, then the Federal agency must enter into formal Section 7 consultation with USFWS and/or NMFS to identify appropriate measures to avoid, minimize, and compensate for the effect (USFWS 1996).

As part of the Orestimba Creek Feasibility Study, the lead agencies have begun informal consultation in accordance with Section 7 of the Federal Endangered Species Act. USACE determined that the recommended plan and alternatives are not likely to result in adverse impacts to Federally listed species or result in the adverse modification or destruction of critical

habitat. Informal consultation will be initiated following public review of the draft document. Pre-construction surveys would be required to determine the presence or absence of Federally listed species or critical habitat within the construction footprint. If Federally listed species or critical habitat are observed, it is likely that USFWS would require formal consultation through submittal of a Biological Opinion. If Federally listed species or critical habitats are not present, no further consultation would be required.

8.1.3 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act was authorized on March 19 (16 U.S.C. § 661 *et seq*., 50 CFR 402.06), 1934, to allow State and Federal agencies to work together to protect, rear, stock, and increase the populations of game and fur-bearing species. The Coordination Act was amended in 1946, adding the requirement to consult with USFWS and State fish and wildlife agencies when a Federal project would affect a body of water. The consultation was to prevent the loss or damage to wildlife habitat and resources. The 1958 amendments recognized the importance of wildlife resources to the U.S. and required coordination with other water resource agencies for the purpose of protecting wildlife resources. The amendments expanded the types of water projects that were required to consult with USFWS.

USACE has coordinated with USFWS to develop strategies to minimize temporary construction related impacts and to provide for the long-term enhancement of fish and wildlife habitats. USFWS provided a draft Fish and Wildlife Coordination Act Report in which it recommend implementation of the proposed action. This document is located in Appendix B.

8.1.4 Section 106 of the National Historic Preservation Act

Section 106 of the National Historic Preservation Act (16 U.S.C. § 470 *et seq*., 36 CFR 800.3) requires a Federal agency to consider the effects of Federal undertakings on historical and archeological resources. Under these requirements, the area of potential effect (APE) of the selected project shall be inventoried and evaluated to identify historical or archeological properties that have been placed on the NRHP and those that the agency and the SHPO agree are eligible for listing on the NRHP. If the project is determined to have an effect on such properties, the agency must consult with the SHPO and the ACHP to develop alternatives or mitigation measures and afford the ACHP an opportunity to comment with regard to undertakings that may affect historic properties. The implementing regulation for Section 106 is 36 CFR Part 800 (revised 2001), "Protection of Historic Properties" which requires Federal agencies to initiate Section 106 consultations with the SHPO.

Although pedestrian surveys of the project area were conducted from road crossings, the entire project area has not been systematically surveyed due to a lack of rights-of-entry to potentially affected areas. USACE would enter into a Programmatic Agreement with the SHPO which would require pre-construction surveys, as well as avoidance, minimization and mitigation measures for potential impacts to resources discovered during construction. The PA

would establish guidelines for the mitigation of potentially adverse impacts to cultural resources identified prior to construction.

8.1.5 Farmland Protection Policy Act

The Farmland Protection Policy Act (7 U.S.C. § 4201 *et seq*., 7 CFR 658) was authorized to minimize the unnecessary and irreversible conversion of farmland to nonagricultural use due to Federal projects. This Act protects Prime and Unique farmland, and land of statewide or local importance. The Farmland Protection Policy Act protects forestland, pastureland, cropland, or other land that is not water or urban developed land.

The Farmland Protection Policy Act requires a Federal agency to consider the effects of its action and programs on the Nation's farmlands. This Act is regulated by NRCS. The NRCS is authorized to review Federal projects to see if the project is regulated by the Farmland Protection Policy Act and establish what the farmland conversion impact rating is for a Federal project. USACE is required to provide the NRCS with project maps and descriptions to assess impacts on Prime and Unique farmlands.

In California, NRCS uses a land evaluation and site assessment system (LESA) to establish a farmland conversion impact rating score on proposed sites of Federally funded and assisted projects. This score is used as an indicator for the project sponsor to consider alternative sites if the potential adverse impacts on the farmland exceed the recommended allowable level. As evaluated using LESA, the permanent impacts on Prime Farmlands resulting from construction of the LPP levee would be considered significant. However, there is no land available for construction of the levee that would avoid impacts on Prime Farmlands, and the levee is necessary for reduction of flood damage risks. Furthermore, the project size has been minimized to the maximum extent possible through project design, and the area of impacts is within Newman's SOI and would be developed within the next 20 years with or without the project. Because the impacts on farmlands are unavoidable and necessary, have been minimized to the maximum extent practicable, and would occur as part of the No Action Alternative, impacts on Prime Farmlands are considered less than significant.

8.1.6 Clean Water Act

Federal and State laws regulate the physical, chemical, and biological characteristics of the Nation's water systems. The Federal Water Pollution Control Act, which is more commonly known as the Clean Water Act (CWA) (33 U.S.C. § 1251 *et seq*., 40 CFR 112), is the Federal law that establishes the baseline that all other State and local water quality laws must meet. The CWA's objectives are to regulate water pollution and water quality so that the Nation's waterways can be restored and maintained. The USEPA is the agency that enforces the CWA. The CWA's first goal is to eliminate all pollution discharge into the Nation's waterways. The second goal is to make all the Nation's waterways safe for all animal and human use. The CWA regulates oceans, lakes, rivers, and any other water systems, water or chemical discharges, and

the action of any Federal agency which could affect these resources. The CWA establishes standards; enforces procedures; and develops regulatory programs, permits, grants, and procedures on other water quality related issues. All State and local laws must meet the standards and regulations established by the CWA.

Section 404 of the CWA regulates the discharge of dredged or fill material into wetlands and waters of the U.S. USACE and USEPA both have responsibilities in administering this program and typically issue permits for these regulated activities after notice and opportunity for public hearings. Individual permits and general permits are issued for activities that may affect wetlands and waters of the U.S. The General permit program, which includes Nationwide permits, is for activities that are similar in nature or that would likely cause minimal environmental effects. Although USACE does not issue itself permits for its own Civil Works projects, USACE regulations state that USACE does have to comply with the intent of the Regulatory permitting process and must apply the guidelines and substantive requirements of Section 404 to its activities. As discussed in Section 4.2.8, a delineation of wetlands and Waters of the U.S. identified four potential jurisdictional wetlands in the upper reach of the study area outside of the footprint for the chevron levee. Alternative 2 would not have any effects on delineated wetlands or Waters of the U.S.

Under the Section 402 of the CWA, it is unlawful to discharge any pollutant into navigable waters, unless a permit is obtained. The California Water Quality Control Board is responsible for administering discharge permits through USEPA-approved NPDES Permit Program, which is also approved for the regulation of Federal facilities (see Section 8.2.3 below). USACE would apply for a NPDES General Construction Permit during the PED phase. Compliance would require development of a SWPPP.

8.1.7 Clean Air Act

The Federal Clean Air Act (16 USC § 470 *et seq*., 40 CFR 51) (Public Law 88-206) was enacted in 1963 to protect public health by regulating the amount of pollutants in the air. The act established primary and secondary National Ambient Air Quality Standards that all states must regulate and maintain. The National Ambient Air Quality Standards include the amount of pollutants allowed in the air based on the sensitivity level of the public. Primary pollution levels are pollution levels safe for sensitive receptors such as children, elderly, and asthmatics. Secondary pollution levels are levels of pollutants safe for the general public.

The Federal Clean Air Act also delegated primary enforcement to the states. In California, CARB has been designated as the responsible agency for all air quality regulation. The State must promulgate rules and regulations that promote the goals of the Federal Clean Air Act and assist in their attainment. The State's rules and regulations must be at least as stringent as the mandated Federal requirements. In states where one or more of the criteria pollutants exceed the National Ambient Air Quality Standards, the state is required to prepare a SIP, which determines how the state intends to meet the standards in a timely manner as

detailed in the Federal Clean Air Act (USACE, 1996). In California, CARB develops and implements the SIP.

In 1990, the Federal Clean Air Act was amended. New criteria were established for non-attainment classifications, emission control requirements, and compliance dates for geographic areas that are in non-attainment for one or more pollutants. In addition, the amended act requires that any Federally-funded project must comply with the air quality standards and regulations that have been established by SIPs.

The USEPA developed the General Conformity Rule, which became effective on January 31, 1994, to implement Section 176c of the Federal Clean Air Act. The underlying principle of the General Conformity Rule is that Federal actions must not cause or contribute to any violation of a National Ambient Air Quality Standards. A conformity determination is required for each pollutant where the total of direct and indirect emissions caused by a Federal action in a non-attainment area exceeds *de minimis* threshold levels listed in the General Conformity Rule (40 CFR 93.153).

Preliminary modeling of air quality impacts resulting from the action alternatives indicates that the project would not violate any standards, increase violations, exceed the *de minimis* thresholds, or hinder the attainment of air quality objectives in the local air basin. USACE would require construction contractors to follow best management practices to reduce the emission of air pollutants. Best management practices would include wetting of disturbed soils, proper maintenance of construction equipment and any further mitigation measure developed through coordination with the Valley Air District (Section 8.2.4 and 8.3.1). Since the proposed alternatives would not exceed *de minimis* thresholds, a Federal conformity determination is not required.

8.1.8 Executive Order 11988, Floodplain Management

To comply with this EO, the policy of USACE is to formulate projects that, to the extent possible, avoid or minimize adverse effects associated with use of the floodplain and avoid inducing development in the floodplain unless there is no practicable alternative. As a flood damage risk reduction project, modification of the floodplain cannot be avoided while achieving project objectives. A number of non-structural measures were evaluated during the Feasibility Phase, which would have reduced flood damages; however, these measures either did not satisfactorily meet planning criteria or were cost prohibitive. The historical floodplain of Orestimba Creek has been substantially altered below the California Aqueduct and no longer provides the natural and beneficial values served by a natural undeveloped floodplain. Existing infrastructure within the floodplain, such as transportation routes, housing, agricultural improvements, levees and drains, limits the potential for restoration of Orestimba Creek's natural hydrology and ecosystem functions. Ecosystem restoration opportunities have been considered throughout the planning stages of the project; however, the project features that involved altering the riparian zones within Orestimba Creek also cost prohibitive. The project

would extend flood damage risk reduction to developed areas within Newman and to agricultural fields in the study area. Newman's General Plan identifies the undeveloped area east of the CCID Main Canal as the location where future growth would be directed. This area is not within the existing 1/100 ACE floodplain. Flood damage risk reduction measures would reduce flooding of agricultural lands east of the Highway 33 and CNRR embankments; however, these areas are protected from development by Williamson Act contracts with the state.

Through implementation of the NEPA process, consideration of measures which would avoid adverse impacts to floodplains, minimization of impacts on the human environment resulting from flooding, and restoration of floodplain functions where possible, the Proposed Action is in compliance with EO 11988, Protection of Floodplains.

8.1.9 Executive Order 11990, Protection of Wetlands

EO 11990, Protection of Wetlands, directs USACE to provide leadership and take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands when implementing Civil Works projects.

As part of the Feasibility Study, a full range of measures and alternatives to achieve flood damage risk reduction were developed and assessed. An alternative involving modifications to the Orestimba Creek channel was determined to be cost prohibitive due in part to the effects to the existing wetlands associated with the creek. As discussed in Section 4.2.8, a delineation of wetlands and Waters of the U.S. identified four potential jurisdictional wetlands in the upper reach of the study area outside of the footprint for the chevron levee. Alternative 2 would not have any effects on delineated wetlands or Waters of the U.S. Therefore, the proposed action is in compliance with EO 11990, Protection of Wetlands.

8.1.10 Executive Order 12898, Environmental Justice

EO 12898, Environmental Justice, requires that environmental analyses of proposed Federal actions address any disproportionately high adverse human health or environmental effects on minority or low-income communities. Federal agencies' responsibility under this order shall also apply equally to Native American populations. In addition, each Federal agency must ensure that public documents, notices, and hearings are readily accessible to the public.

No disproportionately high or adverse human health or environmental effects on minority or low-income communities have been identified. Impacts of the project alternatives would affect the farming community and those economically linked to the farming community equally. Mailing notices and distribution of other project information includes property owners and potentially affected persons and institutions without any distinction based on minority or income status. The local farming community has been invited to all public meetings and their representatives have attended plan formulation meetings to ensure input into the planning

process. The Environmental Justice Compliance is also discussed under Socio-economics in Chapter 5.

8.1.11 Noxious Weed Act of 1974

The Noxious Weed Act (7 U.S.C. § 2801 *et seq*.) was authorized to control and manage the spread of nonnative plant species that may have adverse affect on agriculture, commerce, wildlife resources, or public health.. The Noxious Weed Act inhibits the transport, trade, or sales of noxious plant species in the U.S. The Noxious Weed Act gave the Secretary of Agriculture the authority to determine which plant species are noxious plant species and to establish measures to control them. As amended, the Noxious Weed Act requires all Federal agencies to establish a management plan to control the spread of noxious plant species in their jurisdiction. A management plan would be developed for the construction phase of this project and would be include in the Operations and Maintenance Manual for the project.

8.1.12 Migratory Bird Treaty Act of 1918

The Migratory Bird Treaty Act (16 U.S.C. § 703 *et seq*.) formed an agreement between Canada, Japan, Mexico, and Russia to protect migratory birds (Department of Energy Environmental Policy and Guidance 2001). The Migratory Bird Treaty Act establishes treaties and conventions to establish policies and management approaches to protect the migratory birds that migrate between the participating countries (Alaska USFWS 2003). The Migratory Bird Treaty Act regulates the trapping, capturing, killing, transportation, trade, or sales of migratory birds, their eggs, parts, and nests. The Migratory Bird Treaty Act is regulated and enforced by the Department of the Interior. Section 704 of the Migratory Bird Treaty Act gives the Secretary of the Interior the authority to determine the management measure required to ensure that take is compatible with the protection of migratory bird species according to distribution and population in the U.S. (Department of Energy Environmental Policy and Guidance 2001). Migratory birds and their nests are likely to occur within the footprint of proposed construction. If possible, construction activities would be scheduled to occur outside of the nesting season. If construction in potentially suitable habitats must occur during the nesting season, pre-construction surveys would be required to determine the presence of migratory birds or nests. If nests are identified, mitigation measures to minimize impacts would be required. If nests are identified, the area would be avoided until the end of the nesting season.

8.1.13 Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act)

The Magnuson-Stevens Act (16 U.S.C. § 1801 *et seq*.) was passed by Congress in 1976, and gave NMFS the authority to regulate fisheries in the U.S. The area of authority covers a range of 3 nautical miles from the land edge to 200 nautical miles out to sea. This area of authority is called the Exclusive Economic Zone. The goals of the Magnuson-Stevens Act were to phase out foreign fishing operations in the Exclusive Economic Zone, prevent overfishing, allow overfished species to recover, and protect and manage fishery resources. The project alternatives would not affect fisheries in the Exclusive Economic Zone.

The Magnuson-Stevens Act was amended in 1996, to place the focus on sustainability of fisheries resources, habitat conservation, and the standard for maximum sustainable levels for fisheries. Under the 1996 amendments, Federal agencies are mandated to consult with NMFS regarding any action authorized, funded, or undertaken that may adversely affect any EFH designated under the Magnuson-Stevens Act. EFH is habitat that is essential for the spawning, foraging, breeding, and growth of aquatic species. The San Joaquin River watershed below the Merced River is designated EFH for Chinook salmon (Pacific Fishery Management Council 1999). EFH for the Pacific coast salmon fishery is defined as those waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem and includes streams, lakes, ponds, wetlands, and other currently viable water bodies, as well as most of the habitat historically accessible to salmon in Washington, Oregon, Idaho, and California. As described in the assessment of water quality impacts, chevron levees would reduce the exposure of overland floodflows to pollutants and improve water quality. Improved water quality would increase suitability of aquatic habitats, including EFH, in the San Joaquin River and have a beneficial impact on local populations of fish and other aquatic wildlife.

8.1.14 Americans with Disabilities Act, Rehabilitation Act, and Architectural Barriers Act

The Americans with Disabilities Act of 1991 (42 U.S.C. § 12101 *et seq*.), the Rehabilitation Act (Public Law 93-112), and the Architectural Barriers Act (42 U.S.C. § 4151 *et seq*.) Title II, require projects administered by State and local governments to provide program accessibility to persons with disabilities as long as providing accessibility would not fundamentally change the purpose of the project. Section 504 of the Rehabilitation Act requires program accessibility for persons with disabilities to any program or activity receiving Federal financial assistance. The Architectural Barriers Act requires accessibility for persons with disabilities to Federally-financed facilities constructed or altered on behalf of the U.S. The future location of alternative transportation corridors, such as the proposed bicycle route along the CCID would be considered during the PED phase, and all necessary accessibility features would be incorporated into project design.

8.1.18 Noise Control Act of 1972

Congress passed the Noise Control Act (42 U.S.C. § 4909 *et seq*.) on October 27, 1972, to protect the quality of human life from adverse affects from noise. The Noise Control Act requires Federal agencies activities that may produce noise to comply with all Federal, State, and local laws and regulations that regulate noise levels. The Stanislaus County General Plan identifies noise emissions thresholds, which were incorporated into the significance thresholds used in the assessment of impacts resulting from the project. Construction related noise is not likely to exceed land use compatibility thresholds on agricultural lands, but could result in intermittent noise impacts to residential uses within 700 feet of construction activities. No staging areas would be located near residential properties, sensitive wildlife habitats, or other noise sensitive uses. Truck routes and detours would consider potential impacts to adjacent properties. Night-time construction would be restricted near noise sensitive land uses. All construction equipment would be properly maintained. The proposed levee alignment would affect lands zoned for residential use, and additional mitigation such as the construction of temporary sound barriers or sound-proofing of homes could be required.

8.2 STATE REQUIREMENTS

8.2.1 California Environmental Quality Act (CEQA)

CEQA applies to an action that is directly undertaken by a California public agency; is supported in whole or part by California public agency contracts, grants, subsidies, loans, or other assistance for a public agency; or involves the issuance by a California public agency of a permit, lease, license, certificate, or other entitlement for use by a public agency. CEQA requires State, regional, and local agencies to prepare environmental documents assessing the significant environmental impacts of the tentatively recommended plan, to circulate these documents to other agencies and the public for comment, and to consider comments in their decision-making.

The CEQA lead agency for this project is Stanislaus County. This Feasibility Report/EA/IS has been prepared jointly with the Federal lead agencies to meet CEQA requirements. Upon certifying the document, the CEQA lead agencies would adopt a reporting or monitoring program for the changes made to the project or the conditions of project approval to mitigate or avoid significant effects on the environment. The draft Feasibility Report/EA/IS constitutes partial compliance with CEQA. Full compliance would be achieved when the final Feasibility Report/EA/IS and Notice of Determination is submitted to the Office of Planning and Research.

8.2.2 California Endangered Species Act

Compliance with the California Fish and Game Code is required if a species listed as a candidate, threatened, or endangered under the California Endangered Species Act may be present in the project area and a Stanislaus County is acting as lead agency for CEQA compliance (Section 2090) or if the action may result in the “take” of a species listed under

California Endangered Species Act (Section 2081). Section 2081 of the California Fish and Game Code allows CDFG to issue incidental take permits for the take of State-listed threatened and endangered species. Take includes hunting, pursuing, catching, capturing, or killing, or attempting such activity.

This act requires that non-Federal lead agencies include within their CEQA documentation, an assessment of project effects on State-listed species. The lead agencies have completed a search of the CNDDB in 2011 to identify State-listed threatened and endangered species that have been recorded in the study area. Although there were limited records of state listed species occurring within construction footprints, numerous State-listed species have been observed throughout Stanislaus County, and many records are associated with Orestimba Creek upstream of the Delta-Mendota Canal. Proposed measures to avoid and mitigate potential impacts to State-listed species include pre-construction surveys and avoidance of areas actively used by State-listed species. Proposed construction measures would not jeopardize the continued existence of any State-listed species or result in the substantial destruction or adverse modification of habitat essential to the continued existence of the species. However, loss or degradation of essential habitat may be considered take, even if listed species are not proven to use the area. Further coordination with CDFG would determine the need for an incidental take permit and the development of additional mitigation measures if necessary.

The Natural Community Conservation Planning Act was added to the California Endangered Species Act in 1991. The purpose of the Natural Community Conservation Planning Act is to preserve species and their habitat while allowing for reasonable development to continue. The Natural Community Conservation Planning Act encourages cooperation between CDFG, landowners, and other interested parties to develop natural community cooperation plans. The natural community cooperation plans allow for early coordination to protect species and their habitats not currently listed (California Resources Agency, 2003). There are currently no habitat conservation plans that encompass the city of Newman or Orestimba Creek.

8.2.3 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act was enacted in 1969 *(California Water Code, Division 7, Water Quality)* to preserve, enhance and restore the quality of the State's water resources. The Porter-Cologne Water Quality Control Act established policy and standards for both surface and ground water and regulates the discharge of pollutants from both point and non-point sources. Although this act was passed prior to the Federal CWA, the CWA designates state agencies as responsible for establishing water quality standards and the state law does not supersede the federal law. The State Regional Water Quality Control Boards (WQCBs) are the agencies responsible for administering California's water quality standards.

Under Section 303(d) of the Federal CWA, the CVRWQCB has developed a Water Quality Control Plan (CVRWQCB, 2007) and maintains a list of water quality limited segments

(CVRWQCB, 2009). Waters on the 303(d) list do not meet water quality standards, even after point sources of pollution have installed the minimum required levels of pollution control technology. The Federal CWA requires that jurisdictions establish priority rankings for waters on the 303(d) list and develop action plans, incorporating TMDLs, to improve water quality. California Water Code section 13240 authorizes the CVRWQCB to formulate and adopt Basin Plans for all areas within their region. The Basin Plan is the basis for Section 401 state water quality certifications and issuance of section 402 NPDES permits.

The CVRWQCB list of Water Quality Limited Segments, also called the 303(d) list, in the study area includes both monitored segments of Orestimba Creek and the San Joaquin River from the Merced River to the Tuolumne River. Beneficial use of both segments of Orestimba Creek is impaired by high levels of agricultural pollutants including: Azinphos-methyl, Chlorpyrifos, DDE, and Diazinon. The segment below Kilburn Road is also impaired by sediment toxicity of unknown origin and by an unknown toxicity of agricultural origin. Beneficial use of the San Joaquin River is impaired by high levels of agricultural pollutants including Chlorpyrifos, DDT, and group A pesticides, and is also impaired by high levels of mercury.

In 1992, the State WQCB adopted a statewide general NPDES permit (Order No. 92-08-DWQ, General Permit No. CAS000002), which applies to construction projects resulting in land disturbance of 5 acres or greater. In order to obtain a statewide NPDES general construction permit, an action must comply with the CVRWQCBs Water Quality Control Plan for the Sacramento and San Joaquin River Basins, the Central Valley Pesticide TMDL and Basin Plan Amendment, San Joaquin River Organophosphorus Pesticide TMDL, San Joaquin River Dissolved Oxygen TMDL, and the San Joaquin River Upstream Salinity and Boron TMDL. Prior to construction, the County would obtain a NPDES general construction permit. Conditions of the permit would require development and implementation of a storm water pollution prevention plan to limit effluent discharge as a result of storm water runoff and performance of inspections of storm water pollution prevention measures during and after construction.

8.2.4 California Clean Air Act

In 1988, California passed the California Clean Air Act, which parallels the Federal Clean Air Act and calls for the designation of areas of attainment or non-attainment to State Ambient Air Quality Standards. The act established the State's standards and authority to regulate air quality issues. CARB is the State agency responsible for regulating air quality. CARB has established California Ambient Air Quality Standards, applicable within California, for all Federal criteria pollutants as well as sulfates, hydrogen sulfide, vinyl chloride, and visibility-reducing particles (Table 8-1). The California Clean Air Act requires each Air Pollution Control District in California to adopt strategies for achieving California Ambient Air Quality Standards by the earliest practicable date.

Table 8-1: State Ambient Air Quality Standards

Pollutant	Averaging Time	California Standard

Pollutant	Averaging Time	California Standard (parts per million)
Ozone	8-Hour	0.07
	1-Hour	0.09
Carbon Monoxide	8-Hour	9.00
	1-Hour	20.00
Nitrogen Dioxide	Annual	0.03
	1-Hour	0.18
Sulfur Dioxide	24-Hour	0.04
	1-Hour	0.25
		(micrograms per cubic meter)
PM-10	Annual	20.0
	24-Hour	50.0
PM-2.5	Annual	12.0
Lead	30-day	1.5

Source: CARB, 2008b

The State is divided into 15 air quality basins based on meteorological and geographic features. These air basins are then divided into 35 air districts that address local air pollution issues. Each district has primary responsibility for attainment and maintenance of air quality standards within their jurisdictional boundaries. Local air districts develop plans and programs to maintain clean air that is within the air quality standards of Federal and State laws, and are responsible for enforcing standards and regulating stationary sources. Additional detail is provided below in section 8.3.1.

8.2.5 California Global Warming Solutions Act

California Assembly Bill 32, the California Global Warming Solutions Act of 2006, identifies California as a substantial source of GHG emissions and requires a significant reduction in these emissions. GHG emissions levels are required to be reduced to 2000 levels by 2010, to 1990 levels by 2020, and 80 percent below 1990 levels by 2050. The emissions reduction is expected to be achieved through the continuation of existing state policies, and through the enforcement of a statewide GHG emissions limit to be incorporated starting in 2012.

Existing policies aimed at limiting GHG emissions include Assembly Bill 1493, which requires CARB to define standards for cars and light trucks manufactured after 2009 and is projected to result in an 18 percent reduction in emissions. In addition, SB 97, enacted in 2007, requires that the CEQA guidelines be amended to incorporate analysis and mitigation of GHG

emissions in CEQA documents. The Natural Resources Agency adopted the CEQA Guideline Amendments on December 30, 2009 under §15064.4.

The action alternatives would result in a temporary increase in GHG emissions as a result of project-related construction. The project could result in minor traffic delays during construction. Additional analysis of staging area location, truck routes, and detours would be conducted during the PED phase to minimize potential impacts on local traffic. The project would not permanently increase travel times through the affected areas. Flood risk reduction would primarily be extended to currently developed areas, agricultural lands protected by Williamson Act contracts, or areas not currently affected by the 1/100 ACE storm event. The project would not induce future development, or otherwise result in a long-term, indirect increase in vehicle related GHG emissions.

8.2.6 Central Valley Flood Protection Board Encroachment Permit

Under California law, no reclamation project of any kind may be started or carried out on or near the Sacramento and San Joaquin Rivers or their tributaries until plans have first been approved by CVFPB. The CVFPB's efforts focus on controlling floodwater; reducing flood damage; protecting land from floodwater erosion that would affect project levees; and controlling encroachment into flood plains and onto flood-control works, such as levees, channels, and pumping plants. Proposed measures would result in beneficial impacts by reducing flood damage risk and would not promote indirect development within the floodplain or onto flood control works.

Banks, levees, and channels of floodways along any stream, its tributaries, or distributaries may not be excavated, cut, filled, obstructed, or left to remain excavated during the flood season. The flood season for the San Joaquin River is November 1 through July 15. The CVFPB, at the prior written request of USACE, Sacramento District, may allow work to be done during flood season within the floodway, provided that, in the judgment of the CVFPB, forecasts for weather and river conditions are favorable.

Levees constructed, reconstructed, raised, enlarged, or modified within a floodway shall be designed and constructed in accordance with the USACE manual, "Design and Construction of Levees" (EM 1110-2-1913). Evaluation of levee embankment and foundation stability and a detailed settlement analysis must be conducted to ensure long-term stability during full flood stage. Additional standards for levee construction, including easement conditions, are provided in Title 23, Code of California Regulations, Division 1, Article 8, Section 120, Levees.

8.2.7 California Wild and Scenic Rivers Act of 1972

The purpose of this act is to preserve and protect wild and scenic rivers and their immediate environments for the benefit of present and future generations. The legislature must approve any action that would affect a designated river. The primary difference between

this act and the Federal act is that the Federal Energy Regulating Committee may issue a license to build a dam on a state-listed river, thus overriding the State statute. Neither Orestimba Creek nor the San Joaquin River is designated as a California Wild and Scenic River (California Public Resources Code Section 5093.50 *et seq.*).

8.2.8 Title 24 of the California Code of Regulations: California Building Code

The California Building Standards Commission (BSC) is an independent commission within the State and Consumer Services Agency that codifies and publishes approved building standards in one state building standards code (California Code of Regulations, Title 24). The California BSC provides guidance to architects, engineers, insurance companies, etc., when making decisions about the building industry. The BSC ensures that the California building codes effectively address areas such as health, fire and panic safety, employee safety, energy conservation, and handicapped accessibility. The BSC determines if such codes and standards are in the public interest. Construction standards for levees are found within the California Code of Regulations. Additional analysis and design would be required during the PED phase.

8.2.9 Williamson Act and Farmland Security Zone Act

The Williamson Act and the Farmland Security Zone Act reduce property taxes on qualifying agricultural land in exchange for a commitment from the landowner not to develop the land with uses other than those compatible with and supportive of agriculture. The Williamson Act creates an arrangement whereby private landowners contract with counties and cities to voluntarily restrict land to agricultural and open-space uses. This arrangement is a 10-year contract during which time the restricted parcels are assessed at a lower tax rate. The Farmland Security Zone Act is a 20-year contract. These contracts renew automatically each year. In order to terminate the contract, a landowner must file a notice of non-renewal that starts a 9-year process for contract termination. The contract may be canceled to avoid the 9-year termination process, but is subject to a 12.5 percent fee based on the assessed value of the property.

As noted in Section 5.2.15, within Newman's Planning Area and outside the SOI, lands held under Williamson Act Contracts occur on the flood side of the levee and would not be affected by the proposed project. The majority of lands within the area of flood damage risk reduction, especially within the Primary SOI and SOI, are not held under Williamson Act contracts or are held under Williamson Act contracts set to expire by 2014. Lands directly converted to non-agricultural use as a result of constructing the chevron levee are currently planned for development as residential areas within the next 20 years.

8.2.10 California Department of Pesticide Regulation

In an effort to address pesticide related impairments and their effects, the California Department of Pesticide Regulation (CDPR) has developed a water monitoring program which encompasses Orestimba and Del Puerto Creeks (Ensminger 2007). In 1991, the State Water Resources Control Board signed a Memorandum of Agency Agreement with the CDPR to ensure that pesticides registered for use in California are used in a manner that protects water quality and the beneficial uses of water, while recognizing the need for pest control. This agreement was revised in 1997 to facilitate implementation of the original agreement. The use of pesticides to control noxious weeds in the study area would be conducted according to product labels and would be coordinated through the 401 State Water Quality Certification and NPDES General Permit application process.

8.2.11 California Food and Agriculture Code

The California Department of Food and Agriculture lists 171 plants as noxious weeds (CDFA, 2008). A noxious weed is defined as any plant species that is, or is liable to be, troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate (California Food and Agricultural Code Section 5004). Any area which is infected with any pest, including noxious weeds, is considered a public nuisance, and it is unlawful for any persons to maintain and should be abated (California Food and Agriculture Code Sections 5401-5403). Noxious weeds were identified within the construction footprint and along adjacent agricultural margins. In order to control post-construction establishment of noxious weeds on disturbed soils, a noxious weed control plan would be incorporated into the construction plans. Noxious weeds would be controlled within the construction area until native plants are established and conditions are unfavorable for the establishment of noxious weeds.

8.3 LOCAL PLANS AND POLICIES

8.3.1 Air Pollution Control Districts

California has 35 local air pollution control districts throughout the state (CARB, 2009). Each district is responsible for establishing and enforcing air pollution regulations in order to attain and maintain all State and Federal ambient air quality standards. These districts permit stationary sources of air pollution and implement transportation control measures for their respective regions. In order to combat particular air quality problems within its region, each district adopts its own rules and regulation, as the types of sources of air emissions vary from district to district. Stanislaus County is within the Valley Air District. The Valley Air District is made up of eight counties in California's central valley: San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare and the valley portion of Kern. Federal and state laws require emission control measures in areas where air pollution exceeds standards. The San Joaquin Valley is one of these areas. The Valley Air District has developed air pollution control measures under three CARB-approved Air Quality Plans: the Extreme Ozone Attainment

Demonstration Plan, the Carbon Monoxide Maintenance Plan, and a PM_{10} Maintenance Plan. The tentatively recommended plan would comply with all control measures to mitigate impacts to air quality to less than significant, including minimization of the construction footprint, wetting of soils, and proper maintenance of construction equipment.

8.3.2 Public Works and Transportation Departments

An encroachment permit must be obtained when encroachments are proposed within, under, or over a county or city road, or cover rights-of-way. The non-Federal sponsor would consult the appropriate local agencies to obtain the encroachment permits once the project has been authorized. Conditions of the encroachment permit would include measures to ensure public safety and the acceptable flow of traffic.

8.3.3 Mosquito Abatement District

The Stanislaus County Mosquito and Vector Control District is responsible for conducting mosquito abatement and vector control in Stanislaus County. In addition, Stanislaus County maintains a Mosquito Surveillance Task Force. Both of these organizations serve under the County Board of Supervisors. Stanislaus County is the local sponsor and would determine if there is any additional needed mosquito abatement by the tentatively recommended plan.

8.3.4 Stanislaus County General Plan

Section 65300 of the California Government Code states that "Each planning agency shall prepare and the legislative body of each county and city shall adopt a comprehensive, long-term general plan for the physical development of the county or city, and of any land outside its boundaries which in the planning agency's judgment bears relation to its planning." The general plan is to consist of seven mandatory elements and as many optional elements as the local jurisdiction deems desirable. The mandatory elements include land use, circulation, housing, open space, conservation, safety, and noise. The Stanislaus County has also adopted one optional element, the agricultural element, as much of the county is used for agricultural purposes.

The County General Plan sets goals for management of each element and establishes policies and regulations for the accomplishment of these goals or to prevent implementation of conflicting actions. The policies and regulations established by the County General Plan were incorporated into significance thresholds where applicable. The tentatively recommended plan, including proposed mitigation measures, would comply with or enhance the achievement of the policies and regulations established by the County General Plan.

CHAPTER 9 – TENTATIVELY RECOMMENDED PLAN

This chapter describes the tentatively recommended plan, as well as the procedures and cost sharing required to implement the plan. A schedule and a list of further studies are also included.

9.1 TENTATIVELY RECOMENDED PLAN (TRP)

The plan identified as the TRP is the chevron levee with 3 feet of freeboard (Figure 9-1). The TRP is the LPP; however, Federal cost sharing would be capped at 65% of the NED plan. This plan is justified and has a benefit to cost ratio of 1.34. This plan allows the local community to meet both FEMA certification requirements and the State of California's criteria for the funding of flood risk management projects. A policy exception waiver from the ASA(CW) has been granted to allow the Federal government to recommend the LPP over the NED plan. This policy exception was determined to be warranted in order for the community to meet FEMA and State of California requirements.

The TRP is described in detail below.

9.1.1 Features and Accomplishments

The principle feature of the TRP is the construction of approximately 4 miles of levee along the east bank of the CCID Main Canal and a 1 mile cross-levee to reduce the flood risk to the city of Newman and adjacent agricultural areas.

The TRP includes the same elements as the NED plan, but raises the height of the chevron levee to include 3 feet of freeboard above the mean 0.5% WSEL. This freeboard was requested by the local sponsor in order to meet State of California requirements for an urban area which is identified as the 1/200 year median WSEL plus 3 feet of freeboard. The freeboard for the 0.5% (1/200) ACE may be reduced to 2 feet during PED if 95% assurance can be demonstrated in the final design.

Pursuant to 44 CFR, Part 65.10, FEMA requires a levee to be either: a) 3 feet above the median 1% WSEL with a 90% assurance for the 1% event or b) 2 feet above the median 1% WSEL with 95 % assurance for the 1% event. The NED levee is about 1.5 feet shorter than these criteria; however, the LPP achieves it. The State of California requires urban and urbanizing areas (with a population of 10,000 or greater) to achieve 200 year level of protection in order to qualify for State funding of flood risk management projects. The State's interim levee design guidelines require 3 feet of freeboard above the median 1/200 ACE WSEL or higher if required for wind setup and wave run up. It was determined that additional freeboard to account for wind waves would not be required. The proposed chevron levee alignment would be sheltered from wind waves by the existing CCID Main Canal berm. Analysis of the Lundy road segment indicated the wave height plus setup would be less than 3 feet at the 1/200 ACE median water surface elevation.

There is basically no quantifiable difference between the economic benefits attributed to the NED and the LPP; however, the LPP would allow the sponsor to meet State of California requirements as well as FEMA accreditation requirements.

The difference between the mean 1% and the .5% (the 100 year and 200 year) WSEL is only several inches due to the nature of alluvial fan flooding, which is broad and shallow. Changes in topography could alter the flow path in many different directions, although not to the extent that flood risk could be reduced for the City of Newman.

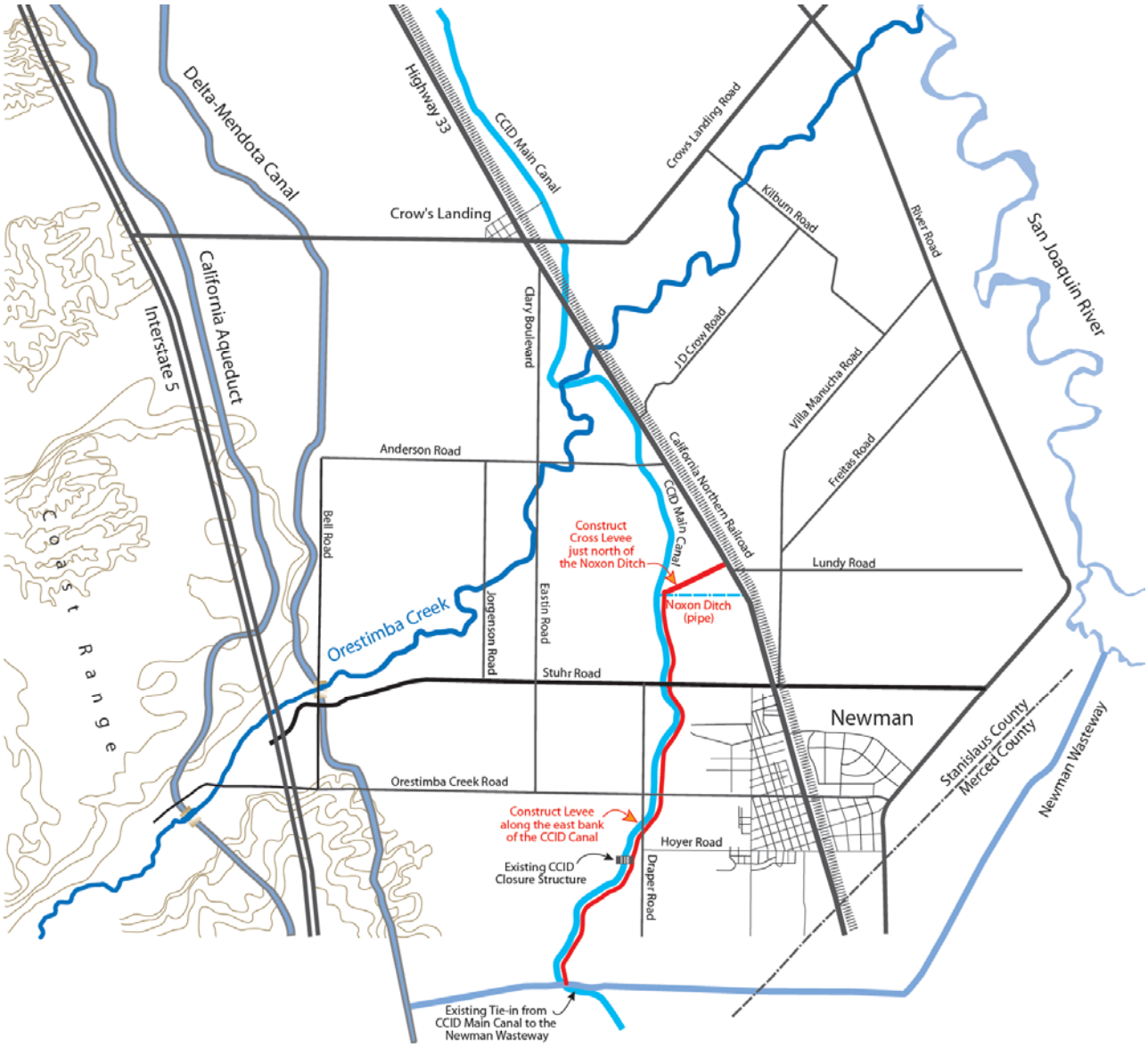

Figure 9-1: Tentatively Recommended Plan

Construction of the chevron levee would alter the nature of the existing floodplain by slightly increasing the depth and extent of flooding to the north of the proposed levee. Floodflows may pond in this area as the flows are metered through culverts under Highway 33 and the CNRR berm.

As stated above, the chevron levee would be constructed parallel to the east bank of the CCID Main Canal. Starting at the Newman Wasteway, the levee would continue north to a location near Lundy Road, at which point the levee alignment would angle diagonally away from the canal toward the northeast for another 0.7 miles to tie in to the CNRR embankment near an existing culvert. This existing culvert would function to reduce the frequency and duration of floodwater ponding on the north side of the levee. The levee would also extend an additional 35 feet east of the CNRR embankment to insure that floodwaters do not flank the proposed levee. The levee would be approximately 4.7 miles in total length.

The proposed levee is higher than roadway elevations at four crossing locations, and a gap in the top portion of the levee is required to meet highway vertical curve safety standards. A slotted abutment would be constructed in the levee on each side of these roadways. During a flood event, stop logs would be placed into the slotted abutments across the roadways. When installed, the stop log structure would be approximately 1 to 3 feet high (0.5-2 feet for NED plan) and would prevent floodwaters from flowing through the gap (Appendix C-3, Attachment A, Plate 20). This would not interfere with traffic because the roadway to the west of the structure would be flooded when the stop logs were in place. The stop-log closure structures would be located at four locations where existing roads cross the proposed levee alignment. These road crossings include Shells Road, Draper Road, Orestimba Creek Road, and Stuhr Road. Operation of these closure structures is critical to achieving the intended project performance. Failure to operate these closure structures could result in erosion and failure of the levee embankment.

Another gate closure would be constructed where the levee crosses the CNRR railroad embankment. The proposed levee is higher than the railway and a gap in the top portion of the levee is required to prevent interference with the levee grade. The levee grade cannot be changed because the height of the levee segment is dependent on floodwaters overtopping this grade. An abutment would be constructed in the levee on each side of the railway. During a flood event, floodgates hinged on the abutment would be closed across the railway. When installed, the swing gate structure would be approximately 2 to 3 feet high and would prevent floodwaters from flowing through the gap (Appendix C-3, Attachment A, Plate 21). This would not interfere with railway traffic because the railway north of the levee would be flooded when the swing gate structure was in place. Operation of these closure structures is critical to achieving the intended project performance. Failure to operate these closure structures could result in erosion and failure of the levee embankment.

Where the levee crosses State Highway 33, the highway would be raised to meet levee design elevations (Appendix C-3, Attachment A, Plate 12). Highway 33 would be raised over an additional 2000 foot length to account for longer vertical curves necessary to go over the higher levee.

Another component of the levee is a seepage berm. Geotechnical analysis shows a thin clay blanket with high exit gradient from station 106+00 to 164+00. Levee seepage could threaten levee stability in this area. A seepage berm needs to be constructed along the landside levee toe from station 106+00 to 164+00 (Plate 8, 9, and 19 in Attachment A).

The proposed LPP would also include a railroad embankment protection plan (Plates 12,13,14,15 and 19 in Appendix C-3, Civil Design). During small flood events and localized rainfall events, Orestimba Creek floodwater or local runoff would be conveyed to the east side of the railroad embankment through existing drainage culverts. However, the railroad would be overtopped during a large flood event. To mitigate for this condition, the east side of the railroad embankment would require a sand filter and be lined with rock revetment to prevent erosion. Approximately 10 culverts under the CNRR embankment would be extended to accommodate the seepage embankment and erosion protection. New upstream and downstream headwalls would be constructed at each culvert. The railroad embankment protection plan begins where the proposed levee crosses the railroad and ends where the railroad crosses Orestimba Creek. The distance is approximately 2 miles.

The borrow source for the levee construction has been identified as the Fink Road landfill. This is a regional land fill site owned and operated by Stanislaus County, the non-Federal sponsor. This landfill has also been identified as the disposal site for material determined unsuitable for levee construction. The distance from the Fink Road landfill to the construction site is about 12 miles.

9.1.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Once project construction is complete, the project would be turned over to the non-Federal sponsor. The non-Federal sponsor would then be responsible for the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the project in accordance with the OMRR&R manual. Operation and maintenance (O&M) requirements would include maintenance of the project levees and periodic operation of roadway and railroad closure structures. The annual cost for O&M of the tentatively recommended plan is estimated to be about $100,000. Floodwaters are assumed to reach the levee and associated features at the 1/10 ACE. Additional detail on the OMRR&R can be found in the Civil Design Appendix (Appendix C-3). Some of the additional requirements and assumptions for O& M are listed below:

- Caltrans will take full responsibility to repair flood water caused erosion of the embankment along Highway 33 in the study area.
- The existing culverts under Highway 33 and the CNRR Railroad would continue to operate, and the government will not be responsible for any culvert maintenance cost.
- CCID will allow residual floodwaters to be discharged into their canal following any overtopping failure of the canal. The Sponsor will be required to maintain and use portable pumps for this purpose.
- After construction CCID will obtain Section 408 approvals for any modification to the project including any modification necessary to meet irrigation delivery objectives.

- The sponsor will insure stop log structures and flood gates are tested and are fully operational.
- CCID and CNRR will maintain their embankment height to be no higher than the existing conditions from the north end of the proposed levee for a distance of two miles.

9.1.3 Real Estate

Acquisition of about 90 acres in fee title along with about 90 acres of temporary work easements would be required for the tentatively recommended plan. The non-Federal sponsor would acquire these lands as part of the project.

Real estate acquisition for the recommended plan is split among 23 landowners with the majority of the land owned by the CCID. Relocations are estimated to be about $6,000,000, which would consist of ramping Highway 33 and the CNRR over the new levee, and relocating affected utilities and irrigation ditches.

9.1.4 Plan Economics and Cost Sharing

The project first cost, estimated on the basis of October 2011 price levels, amounts to $44,000,000. Table 9-1 displays each cost by project feature. Estimated average annual costs were based on a 4 percent interest rate, a period of analysis of 50 years, and construction ending in 2017. Table 9-2 shows the project first costs and benefits. The total average annual flood damage reduction benefits are $3,128,000.

TABLE 9-1: Estimated Costs of Recommended Plan[1] ($1,000)

MCACES Account[2]	Description	Total First Cost
01	Lands and Damages[3]	2,700,000
02	Relocations[4]	6,000,000
11	Levees	26,500,000
18	Cultural Resources[7]	300,000
30	Preconstruction, Engineering, Design[8]	5,800,000
31	Construction Management[9]	2,800,000
	Total First Cost[10]	44,000,000

Notes:
[1]Based on October 2011 price levels, 4 percent rate of interest, and a 50-year period of analysis.
[2]Micro Computer-Aided Cost Engineering System (MCACES) is the software program and associated format used by USACE in developing cost estimates. Costs are divided into various categories identified as "accounts." Detailed costs estimates are presented in Appendix C, part 4, Cost Engineering.
[3]Real Estate land costs, which include no damages.
[4]Relocations include ramping Highway 33, a closure structure across the CNRR, and relocating affected utilities and irrigation ditches.
[7]Assumes approximately 0.4 percent of project first cost.

[8]12 percent of 02, 06, 11, and 18 accounts. PED is cost shared 75 percent Federal and 25 percent non-Federal during PED, then adjusted as part of the total project cost sharing to 65 percent Federal and 35 percent non-Federal during construction.
[9]8.5 percent of 02, 11, and 18 accounts.
[10] Numbers reported may be slightly different that those presented in the appendices due to rounding.

The estimated total project first cost for the tentatively recommended plan is $44,000,000. Federal costs are capped at 65% of the NED plan which is estimated to have a first cost of $35,200,000. Cultural Resource Preservation costs of $350,000 would be added as part of the Federal costs. A summary of cost sharing responsibilities is presented in Table 9-2.

TABLE 9-2: Summary of Cost Sharing Responsibilities for the Tentatively Recommended Plan[1]

Item	Federal[2]	Non-Federal
Flood Risk Management	22,880,000	21,100,000
Cultural Resource Preservation	350,000	
Total	23,230,000	21,100,000
Breakdown of Non-Federal		
LERRDs[3]		8,700,000
5% Cash Requirement		2,200,000
Remaining Cash		10,200,000
Total		21,100,000

Notes:
[1] Based on October 2011 price levels, 4 percent rate of interest, and a 50-year period of analysis.
[2]Federal Project First Costs are based on 65% of the NED Plan of $35.2 million.
[3] Non-Federal interests must provide all LERRDs and a minimum cash contribution of 5% of the total project cost.

9.1.5 Risk and Uncertainty

In general, the ability of the plan to provide the expected accomplishments depends on the following: the validity of pertinent assumptions, base data, and analytical techniques used in this study; and the successful completion of future studies, designs, and construction; and appropriate OMRR&R after construction.

Risks to the project performance from a hydraulic standpoint would be reduced by the additional 3 feet of freeboard that would be added to the mean 1/200 ACE water surface for the TRP. Compared to the NED plan, the additional freeboard reduces the chances of levee overtopping during the period of analysis resulting from:

- Changes to the floodplain topography caused by the common use of agricultural land leveling in the central valley;

- Failure of local (non-project) levees along the Orestimba Creek channel resulting in different flow paths along the project levee;
- Failure of the CCID Main Canal embankment in the canal reach north of the project resulting in different flow paths along the project levee;
- Possible increased CCID Main Canal embankment height in the canal reach resulting in different flow paths along the project levee; and
- Normal maintenance practices by the CNRR may increase the railroad embankment height in the segment north of the project. The increased height would result in the increased probability of higher stages on the water side of the levee.

9.1.6 Executive Order 11988

EO 11988 requires Federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities."

The Water Resources Council Floodplain Management Guidelines for implementation of EO 11988, as referenced in USACE ER 1165-2-26, require an eight-step process that agencies should carry out as part of their decision-making on projects that have potential impacts to or within the floodplain. The eight steps reflect the decision-making process required in Section 2(a) of the EO. The eight steps and responses to them are summarized below.

1. **Determine if the proposed action is in the base flood plain.**

Yes, the project is located in the base flood plain. Due to the nature of alluvial fan flooding, this flood plain is variable and dependent upon features located within the flood plain that could alter the direction of the flood flows, such as roads, railroads, and canals. All of these features are present in the Orestimba Creek floodplain.

2. **If the action is in the base flood plain, identify and evaluate practicable alternatives to the action or to location of the action in the base flood plain.**

Chapter 3 of this document has an analysis of alternatives. The TRP was evaluated in accordance with Section 308 of WRDA 1990, which required that structures built in the 100-year flood plain with a first floor elevation less than the 100-year flood elevation not be included in the benefit base for justifying Federal flood damage reduction projects. The TRP does not include the

value of structures built in the base flood plain after 1991. Based on the alternative evaluation, the TRP would have the least effect on the flood plain compared to the other alternatives.

3. **If the action must be in the flood plain, advise the general public in the affected area and obtain their views and comments.**

Public involvement activities are described in Chapter 6, Public Involvement, Review and Consultation.

4. **Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial flood plain values. Where actions proposed to be located outside the base flood plain will affect the base flood plain, impacts resulting from these actions should also be identified.**

Potential impacts associated with the TRP are summarized in Chapter 5 of this report.

5. **If the action is likely to induce development in the base flood plain, determine if a practicable non-flood plain alternative for the development exists.**

The TRP is not likely to induce development in the base flood plain because the existing flood plain is only three feet deep, which is shallow enough for new structures to be raised above this elevation for a reasonable financial cost. Therefore, it is assumed that the TRP would not alter development patterns from the without project condition.

Within the study area, population growth and urban development are driven by local, regional, and national economic conditions. Local land use decisions within the unincorporated area are within the jurisdiction of Stanislaus County. Stanislaus County has adopted a general plan, consistent with state law, which provides an overall framework for growth and development within the county, including the project area.

Environmental analyses have been completed for the TRP pursuant to NEPA and CEQA. These analyses disclose the environmental effects associated with their implementation and describe mitigation measures adopted to eliminate or reduce the severity of environmental effects.

The TRP is consistent with existing land use and project plans in the study area that were approved and initiated before the need for the proposed levee improvements had become apparent. Development in these areas is proceeding in accordance with the applicable plans.

As documented Chapters 4 and 5, there are about 160 acres of Important Farmland within the urban impact area that would have a greatly reduced flood risk with the construction of the TRP. These acres are not part of any approved development plans. As discussed above, the additional flood protection provided by the TRP would not alter future development patterns or result in increased development in areas afforded greater flood protection, since potential development in these areas could be removed from the base flood plain through construction of raised building

pads or foundations. This potential development would be subject to the discretion of the Stanislaus County Board of Supervisors, based on applicable environmental review and planning studies. Detailed evaluation of these potential environmental effects would be speculative at this time.

6. **As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore and preserve the natural and beneficial flood plain values. This should include reevaluation of the "no action" alternative.**

Mitigation measures are identified and would be implemented as part of the project to minimize the project's potentially adverse impacts.

7. **If the final determination is made that no practicable alternative exists to locating the action in the flood plain, advise the general public in the affected area of the findings.**

The TRP is scheduled to be released for public review in the summer of 2012. A public meeting will be held during this review.

8. **Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order.**

The objective of the project is to reduce the probability and consequences of flooding in the study area. The project is responsive to the EO 11988 objective of "avoidance, to the extent possible, of long- and short-term adverse impacts associated with the occupancy and modification of the base flood plain and the avoidance of direct and indirect support of development in the base flood plain wherever there is a practicable alternative" because the proposed features focus on reducing the threat of flooding to the existing urban area, altering a very small footprint within the flood plain. These features would reduce the hazard and risk associated with floods thereby minimizing both the probability and the consequences of flooding within the urban area, and would preserve the natural and beneficial values of the base flood plain.

9.2 PLAN IMPLEMENTATION

This section describes the remaining steps to potential authorization of the project by Congress.

9.2.1 Report Completion

The draft Feasibility Report/EA/IS will be circulated for public and agency review for 30 days. A public meeting, as required by law, will be held to obtain comments from the public, agencies,

and other interested parties. After completion of the public review period, comments will be considered and incorporated into the Feasibility Report/EA/IS, as appropriate. Comments received during the public and agency review period, as well as responses to them, will be presented in Appendix F – Comments and Responses. The final Feasibility Report/EA/IS will be provided to any public agency that provides comments on the draft report. Stanislaus County will certify that the final IS was prepared in compliance with CEQA.

9.2.2 Report Approval

The draft Feasibility Report/EA/IS will be circulated for 30 days to agencies, organizations, and individuals who have an interest in the proposed project. All comments received will be considered and incorporated into the final EA/IS, as appropriate. This project is being coordinated with all appropriate Federal, State, and local government agencies. USACE Headquarters would coordinate the public comments, receive comments from affected Federal and State agencies, and complete its own independent review of the final report.

After its review of the final Feasibility Report/EA/IS, including consideration of public comments, USACE Headquarters would prepare the Chief of Engineers' Report. This report would be submitted to the ASA(CW), who would coordinate with the Office of Management and Budget and submit the report to Congress.

9.2.3 Project Authorization and Construction

Once the final report is approved by the Chief of Engineers and the project is authorized by Congress, construction funds must be appropriated by Congress before a Project Partnership Agreement can be signed by USACE and sponsor to begin construction.

9.2.4 Division of Responsibilities

Federal Responsibilities

USACE would accomplish preconstruction, engineering, and design (PED) studies. Once the project is authorized and funds are appropriated, a Project Partnership Agreement would be signed with the State of California as the non-Federal sponsor. After the sponsor provides the cash contribution, lands, easements, rights-of-way, relocations, and disposal areas, as well as assurances, and the Federal Government would construct the project.

Non-Federal Responsibilities

Specific items of local cooperation are identified in Chapter 10. The State of California, as the non-Federal sponsor, plans to enter into local cost-sharing flood control agreements with Stanislaus County, and possibly others to cost share the non-Federal project cost with local entities in accordance with State law. Stanislaus County and the City of Newman intend to form a Benefit

Assessment District to raise funds to pay for the local share and maintenance of the project. A local levee district may also be formed to operate and maintain the flood control portions of the project. It is anticipated that the local levee district would be formed prior to construction of the project.

Views of Non-Federal Sponsor

The non-Federal sponsor supports the TRP. Local interests have been supportive of the study and project. Throughout development of this feasibility report, there has been significant coordination with Stanislaus County, the City of Newman, the State of California, private landowners, and CCID.

Financial Capability of Sponsor

The total estimated non-Federal first cost of the project is $21,100,000 including lands, easements, right of ways, relocations, and disposal areas (LERRDs) using October 2011 price levels. Actual costs may be slightly greater at the time of construction due to inflation. The total estimated value for the project lands, including LERRDs is $8,700,000.

Project Cost-Sharing Agreements

A Design Agreement must be executed between USACE and the non-Federal sponsor in order to cost share the development of detailed plans and specifications. Before construction is started, the Federal Government and the non–Federal sponsor would execute a Project Partnership Agreement. This agreement would define responsibilities of the non-Federal sponsor for project construction as well as operation, maintenance, repair, replacement, and rehabilitation and other assurances.

9.3 SCHEDULE

If the project is authorized in 2013, construction activities could start as early as 2015. Following is a schedule showing the approval and construction phases of the project.

Division Commander's Notice	May 2013
Chief of Engineers Report	July 2013
Potential Authorization	October 2013
USACE and Sponsor Sign Design Agreement	March 2014
Preconstruction Engineering and Design	March 2014 – March 2015
Initiate Construction	May 2015
Complete Physical Construction	October 2017

9.4 FURTHER STUDIES

During the PED phase, several additional studies would be conducted as part of developing detailed designs for the project. These studies include:

- Additional geotechnical analysis of underlying substrates, including an analysis of the canal liner;
- Topographic surveys for project design;
- Preconstruction surveys to avoid direct impacts to nesting birds and other sensitive species;
- Water quality analysis of construction activities and methods.
- Detailed hydraulic analysis to ensure height meets State of California requirements for 0.5% (1/200) ACE flood with assurance.
- Intensive cultural resources survey, evaluations, and mitigation as appropriate, in consultation with the State Historic Preservation Officer (SHPO), and Native American Tribes; as specified in the Programmatic Agreement (PA).

As mentioned in Chapter 1, this study would only partially address the San Joaquin River Basin Authority, and is therefore, called an "Interim Feasibility Report" which indicates that the study is addressing the water resource issues of a specific area within the authority, rather than the entire area authorized for study. Additional studies to address other water resource issues within the Basin could be initiated based on Congressional direction.

CHAPTER 10 – RECOMMENDATIONS

This chapter describes the Items of Cooperation for a Structural Flood Damage Reduction (Single Purpose) Project that will be specifically authorized.

I recommend that the Orestimba Creek Flood Risk Management plan be authorized for implementation, as a Federal project, with such modifications thereof as in the discretion of the Commander, U.S. Army Corps of Engineers, may be advisable. The estimated first cost of the recommended plan is $44,700,000 and the estimated annual OMRR&R cost is $180,000 (2011 price levels). The estimated fully funded Federal first cost is $24,900,000. Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to:

a. Provide a minimum of 35 percent, but not to exceed 50 percent of total project costs as further specified below:

    1. Provide 25 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

    2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs;

    3. Provide, during construction, a contribution of funds equal to 5 percent of total project costs;

    4. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project;

    5. Provide, during construction, any additional funds necessary to make its total contribution equal to at least 35 percent of total project costs;

b. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

c. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

d. Agree to participate in and comply with applicable Federal flood plain management and flood insurance programs;

e. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a flood plain management plan within one year after the date of signing a project cooperation agreement, and to implement such plan not later than one year after completion of construction of the project;

f. Publicize flood plain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

g. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

h. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

i. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

j. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

k. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

l. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total

project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

m. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*);

n. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

o. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

p. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and

q. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources

project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

_____
William J. Leady, P.E.
Colonel, U.S. Army
District Engineer

Environmental Resources Branch

DRAFT
FINDING OF NO SIGNIFICANT IMPACT
Orestimba Creek Project
Stanislaus County, California

The U.S. Army Corps of Engineers, Sacramento District, has determined that implementing the proposed flood risk project in the vicinity of Orestimba Creek would have no significant effects on the quality of the human environment. The study area is located on the west side of the San Joaquin River in Stanislaus County, California.

The project involves construction of a chevron levee along the city of Newman's northwestern perimeter. The chevron levee maximizes benefits to the urban area by reducing flood dangers associated with Orestimba Creek overflows. The north side of the chevron levee would be constructed along one mile of an unnamed farm road near Lundy Road, about one mile north of town. The approximately four-mile western segment would be constructed along the eastern bank of the existing CCID Main Canal from the unnamed farm road south to the Newman Wasteway.

A draft Feasibility Report and Environmental Assessment-Initial Study (EA/IS) was prepared to evaluate the potential effects to natural and cultural resources in the proposed project area. Based on the evaluation of potential effects and mitigation measures described in the EA/IS, I have determined that the implementation of either the NED Plan or the Locally Preferred would have no significant adverse effects on existing resources. No additional environmental documentation is required, and the project activities may proceed as proposed.

_____ _____
Date William J. Leady, P.E.
Colonel, U.S. Army
District Engineer

CHAPTER 11 – LIST OF RECIPIENTS*

The following agencies, organizations, and persons will be notified of the availability of the Draft Feasibility Report/EA/IS. The notification will provide the location of hardcopies and a web address for accessing an electronic version of the document. Comments received during the 30-day public and agency comment period and responses to those comments will be presented in Appendix F – Comments and Responses.

11.1 ELECTED OFFICIALS AND REPRESENTATIVES

- Governor of California
  - Honorable Edmund G. Brown

- U.S. Senate
  - Honorable Dianne Feinstein
  - Honorable Barbara Boxer

- House of Representatives
  - Honorable Jeffery Denham

- California Senate
  - Honorable Anthony Cannella

- California Assembly
  - Honorable Cathleen Galgiani

11.2 U.S. GOVERNMENT DEPARTMENTS AND AGENCIES

- USDA, Natural Resources Conservation Service
- Department of the Interior
  - Bureau of Reclamation
  - U.S. Fish and Wildlife Service
- Federal Emergency Management Agency

11.3 STATE OF CALIFORNIA GOVERNMENT AGENCIES

- California Department of Transportation
- Governor's Office of Emergency Services

- Resources Agencies
    - Department of Conservation
    - Department of Fish and Game
    - Department of Parks and Recreation
    - Department of Water Resources
    - The Central Valley Flood Protection Board
- Office of Historic Preservation
- State Clearinghouse
- California Environmental Protection Agency
    - Air Resources Board
    - State Water Resources Control Board
    - Regional Water Quality Control Board, Central Valley Region

11.4 LOCAL GOVERNMENT

- City of Newman
- Stanislaus County
    - Board of Supervisors
    - Public Works
    - Office of the Executive Officer

11.5 LOCAL AGENCIES

- Newman City Library
- Central California Irrigation District

11.6 SPECIAL INTEREST GROUPS

- Orestimba Creek Flood Control Agency
- Northern California Railroad
- Union Pacific Railroad
- The Nature Conservancy

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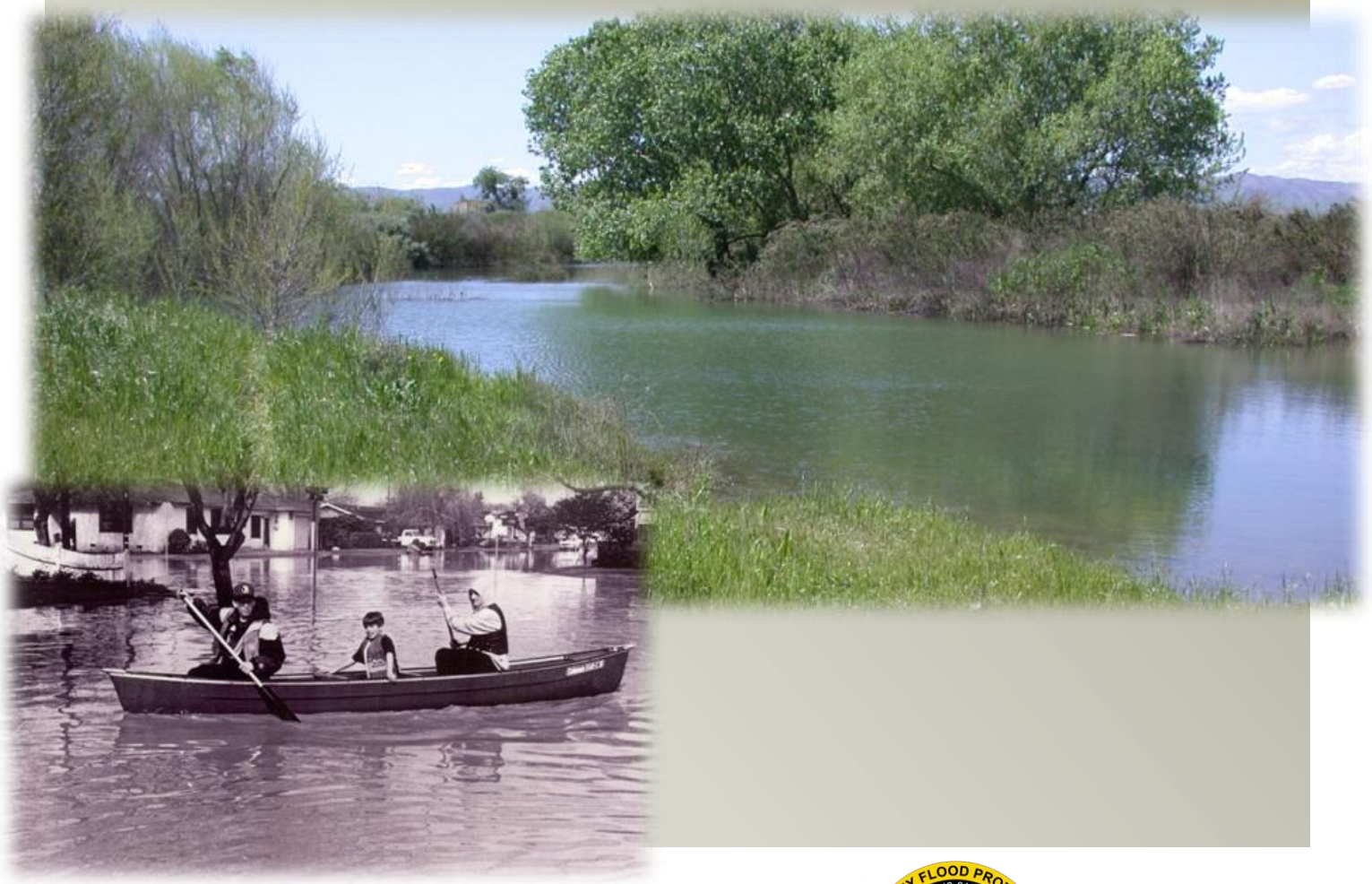
Orestimba Creek

West Stanislaus County, California

Draft Report

Appendices

December 2012



US Army Corps of Engineers ®
Sacramento District

Central Valley Flood Protection Board
Public Safety and Flood Management
State of California

Stanislaus County

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* *NOTE TO THE READER: The Environmental Assessment for this study has been integrated into the following Feasibility Report in accordance with ER 1105-2-100. Sections of the report that are required for compliance with the National Environmental Policy Act (NEPA) are noted by an asterisk (*) in the Table of Contents.*

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

California Regional Office
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nature.org

February 6, 2005

The Honorable Dennis Cardoza
U. S. House of Representatives
2222 M Street Suite 305
Merced, CA 95340

Dear Representative Cardoza,

The Army Corps of Engineers has recently begun a Feasibility Study for the Orestimba Creek in Stanislaus County which seeks to find a way to minimize the recurrent flooding of the City of Newman and the surrounding agricultural areas. We understand that it is the Corps' goal to select a project that will balance cost, protection of property and protection of the important natural resources in this flood-prone area.

As a property owner within this Feasibility Study area, The Nature Conservancy wishes to be involved in the discussion of any flood management project that may affect our landholdings. We appreciate the Corps' inclusiveness in developing a stakeholder group where information is shared and ideas discussed with all interested parties.

The Nature Conservancy is concerned with the protection of the valuable natural along Orestimba Creek. We are encouraged by the Corps' willingness to include design alternatives that examine ways of protecting – and perhaps enhancing – these resources while achieving reasonable flood protection goals.

We welcome the Corps taking the lead in this community planning process. And while we must await the final outcome of this process to determine the potential impact of various options on our property, we look forward to continuing to participate in the stakeholder group that the Corps has created.

Respectfully,

Lloyd Wagstaff
Mt. Hamilton Project Director

C: David Van Rijn, ACOE Project Manager
Col. Ronald Light, ACOE
George Stillman, Stanislaus County
Rod Mayer, DWR
Senator Barbara Boxer
Senator Dianne Feinstein

Recycled Paper

March 18, **2004**

SACRAMENTO FISH
& WILDLIFE OFFICE
RECEIVED
MAR 29 2004

Mr. Kenneth Hitch
Chief, Planning Division
U.S. Army Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95814-2922

West Stanislaus County Flood Damage Reduction and
Ecosystem Restoration Project (Orestimba Creek)

Dear Mr. Hitch:

On September 19, 2003, staff from the California Department of Fish and Game (Department), Fish and Wildlife Service (Service), Corps of Engineers (Corps), Congressman Cardoza's office, and other interested parties met to discuss your agency's West Stanislaus County Flood Damage Reduction and Ecosystem Restoration Project (Project). As you know, one of the proposed Project's alternatives is the construction of a dry dam (detention basin) on Orestimba Creek immediately upstream of the California Aqueduct in western Stanislaus County. The Orestimba Creek drainage contains a significant remnant Central California Sycamore Alluvial Woodland (CCSAW) forest, a significant element of the ecosystem that is important to protect. In this letter, we provide a follow-up to the September 19, 2003, site visit and discussion, by providing the Department and Service staff's early professional judgment on the likely effects of this "dry dam" alternative on the CCSAW associated with Orestimba Creek. These preliminary comments also do not address any State or Federal endangered species concerns with the project.

The CCSAW is a distinctive plant community in California and is found both up- and downstream of the California Aqueduct. along Orestimba Creek. According to Project reports, about 77 acres of the 249 acres of CCSAW located upstream of the aqueduct would be inundated during a 100-year flood event, if a 2,200 cubic feet per second (cfs) "dry dam" was constructed. In addition, 84

additional acres may be affected downstream of the proposed dam. Because the "dry dam" is one of the major Project alternatives, it is extremely important to consider its likely effects on this unique plant community early in the planning process. The following bullets are based upon our staff's experience and knowledge. Please use this information in your analyses of the "dry dam" and other alternatives to help assess the potential effects to the CCSAW along Orestimba Creek.

CCSAW is extreme Iv limited. and existina stands are adverse Iv affected. Approximately 2,000 acres of CCSAW exist worldwide, all of which occur in 17 stands within California. The natural hydrologic regime of CCSAW is impacted by existing upstream dams on 7 of the 17 stands. Gravel mines are causing impacts to 7 of the stands, and grazing is impacting 14 stands (CDFG, 1997)

The Orestimba Creek CCSAW has a Stand Quality Rankina of 2. meanina it is the second best stand in the world. This ranking was based on a detailed study of the 17 known stands of CCSAW (CDFG, 1997). The ranking criteria included two different assessments of stand quality. Each of these assessments included disturbance factors and size factor. One of these assessments emphasized "value for species requiring large extents of sycamore woodland habitat," and the other emphasized value for species "requiring the largest proportion of fragmentation and edge effects."

There has been a loss of CCSAW in California. Information is uncertain about the pre-European distribution of CCSAW in California, but some loss has definitely occurred, including the inundation of a large stand beneath the waters of the San Luis Reservoir (based on vegetation type maps produced of the area in the 1930s).

Natural flood characteristics of CCSAW. Flooding that occurs within areas where sycamores grow is overbank flooding. Overbank flooding occurs generally during the tree's dormant season (winter), for relatively short durations, and water depths during these times are not very deep.

Svcamore flood tolerance limits. CCSAW can tolerate inundation for prolonged periods of several days, as long as inundation occurs during the dormant season, outside the tree's growing season (typically from March until November). Any prolonged increase beyond the 100-year inundation duration of 12-14 days, could have a disastrous effect on sycamore tree survival. In other studies of sycamores in California, prolonged flooding resulted in up to 50% mortality of sycamores (Harris et al., 1975, cited *in* Whitlow and Harris, 1979).

Dry dam construction could affect reaeneration of the Orestimba CCSAW.
Operation of the dry dam on Orestimba Creek may change sycamore seed distribution. In areas that would pond, sycamore seeds could wash away, thereby eliminating sexual regeneration. Seeds could be carried away and/or deposited high above the normal stream channel where chances for survival would be minimal.

Fine sediment deDosition could adverselv affect CCSAW. Sycamores do better in areas where deep, coarse sediment has accumulated, because the water table drops rapidly through the growing season and does not remain high enough for willows and cottonwoods to out-compete them. The dry dam could cause additional fine sediment deposition at and upstream of the reservoir site. Physical changes to the soil/substrate profile over time are a concern.

Sycamore trees have little tolerance of artificial Iv manipulated water levels. If water flow is eliminated too early in the year, the soil-water reservoir available to the root system may be depleted before the growing season ends. If the water table is raised a few feet during the growing season, roots may be injured due to poor aeration. Sycamores can handle flooding followed by a gradual draw-down. This is the natural situation seen in central California stands of this community. However, immediate draw-down after flooding and abnormally high water tables for regular periods have deteriorated stands (CDFG, 1997). This could be a detrimental downstream effect from the proposed dry dam. A more protracted release of water after a flood impoundment would increase the likelihood of other more permanent moisture-loving willows and cottonwoods, and decrease the survivorship of sycamores.

Depth of inundation. We know of no studies that have looked at impacts to sycamores from being potentially inundated to the tops of the trees. Corps engineers have preliminarily modeled the 1 OO-year event as having a maximum ponding depth of about 40 feet for the 2,200 cfs outlet structure, and about 36 feet for the 4,200 cfs outlet structure.

Sycamores in detention basins. Personal observations of Department staff on sycamores in southern California detention basins suggest that sycamores do not survive in the detention basin environment, whereas cottonwoods and willow
species do.

Seedlina survival. Higher elevation channels on alluvial terraces prove to be better locations for sycamore trees to become established because of less flow, flooding, and scour. In order to successfully establish, seedlings need to be protected from scour, but also need to be kept moist long enough for their roots to elongate and reach into deeper moist substrate. Thus, CCSAW appears to have specific ranges of inundation, flood flows, groundwater percolation/retention, and stream hydrology, all of which have implications for sycamore survival. Cattle graze on sycamores, and should be excluded from areas where sycamore recruitment is intended. Grazing in CCSAW should be carefully monitored, so that long-term stand maintenance is not compromised. The work underway by The Nature Conservancy (TNC) upstream on Orestimba Creek may prove helpful in this regard.

Restoration of CCSAW is uncertain. We know of no successful CCSAW restoration attempts in California. This may be due to the unique suite of circumstances naturally required for sycamore recruitment and survival on alluvial plains.
Examples of unsuccessful mitigation are shown in studies done by Department of Water Resources (DWR) conducted downstream of the San Luis Reservoir and at DWR-owned land at Orestimba Creek.

For the above reasons, if the proposed dry dam alternative is selected and constructed, significant detrimental effects to the CCSAW on Orestimba Creek appear likely. Further, based on the technical information available to our professional staff, such impacts could well be irreplaceable in-kind.

Additionally, for the reasons above, and others related to the values of retaining Orestimba Creek's function to its confluence with the San Joaquin River, the Department and Service encourage the Corps to carefully evaluate other alternatives, or develop composite alternatives to complete the Project's objectives while eliminating any adverse affects to the existing CCSAW. For example, at the September 19, 2003, meeting, Mr. Bill Loudermilk suggested that a "comprehensive" approach be investigated, i.e., one that would not cause adverse effects to the CCSAW and improve the function of Orestimba Creek watershed, but still provide flood control to Newman. Furthermore, staff from TNC, Congressman Cardoza's office, the Department, and Stanislaus County met in June 2003 to discuss various flood control options for Orestimba Creek. One option that was discussed is the possibility of having a number of small incremental projects constructed throughout the Orestimba Creek waterway that could serve to alleviate the flooding problem, and also provide habitat restoration. Alternatives such as these have potential and certainly should be investigated further.

Finally, the preceding paragraphs are based on our knowledge of the CCSAW and the proposed project as we understand it to date. In order to *more fully* evaluate the potential effects to CCSAW from the proposed downstream dry dam, much more information is needed. Consequently, a detailed list of information needs was provided in a table by Service staff to Corps staff (Mr. Fraser Gensler [former Study Planner] and Mr. Josh Garcia) on July 24,2003. As provided in that table, we still need the following information at a *minimum:* (1) a current and detailed written Project Description, (2) staging area, borrow site, and disposal site footprints, (3) wetland delineations results (shown on aerial photographs), (4) sediment transport study results (for upstream and downstream of the California Aqueduct), (5) hydrology study results (for upstream and downstream of the California Aqueduct), (6) proposed downstream modification designs and descriptions (e.g., bridge replacements), (7) locations of haul routes, (8) ecosystem restoration opportunities, (9) flood inundation/duration maps for downstream of the California Aqueduct where CCSAW is located, and (10) Dr. Richard Harris's independent assessment on the potential effects to CCSAW from the upstream dry dam. We look forward to working with your staff in obtaining this crucial information.

We hope the information in this letter is of use to you in further developing the flood control project. We will continue our involvement in the planning process as you proceed. If you have any questions concerning this letter, please contact Clarence J. Mayott of the Department at (559) 243-4017, extension 225, or Caroline Prose of the Service at (916) 414-6575.

W. E. Loudermilk

Date: 3/22/04

W. E. Loudermilk, Regional Manager
Department of Fish and Game San Joaquin Valley and Southern Sierra Region

cc:

See Distribution List

Date:

Wayne White, Field Supervisor U.S. Fish and Wildlife Service Sacramento Office

cc:

Mr. Josh Garcia
U.S. Army Corps of Engineers, Sacramento District

Mr. David Tedrick
U.S. Army Corps of Engineers, Sacramento District

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California Department of Fish & Game

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Ms. Karen Enstrom
California Department of Water Resources

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LITERATURE CITED

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Date:

W. E. **Loudermilk,** Regional Manager Department of Fish and Game San Joaquin Valley and Southern Sierra Region

cc:

See Distribution List

LOUDERMILK:jp

Date:

Wayne White, Field Supervisor U.S. Fish and Wildlife Service Sacramento Office

SURNAME *~.181*
FG-4SS

STATE OF CALIFORNIA -- THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, Governor

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

RECEIVED
SEP 2 2008
STANISLAUS COUNTY
DEPARTMENT OF PUBLIC WORKS

August 28, 2008

Mr. Matthew Machado
Public Works Director
County of Stanislaus
1010 10th Street, Suite 3500
Modesto, California 95354

___Matt M.
___Laurie B.
___Diane H.
___Scott A.
___David L.
___Dave N.
___Other(s)_____

Dear Matt:

As the U.S. Army Corps of Engineers (Corps) nears completion of technical analyses for the West Stanislaus Feasibility Study, and prepares to identify the National Economic Development (NED) alternative, I am writing to outline a combination of policies, legislation and regulations that will guide the state's investment in construction of a flood risk management project.

The State of California has supported Stanislaus County in its role as lead non-federal sponsor of the West Stanislaus Feasibility Study since 2002, when a Local Feasibility Cost Sharing Agreement was executed by the Reclamation Board (now Central Valley Flood Protection Board (CVFPB). Over the past six years, Department of Water Resources (DWR) staff to the CVFPB have actively participated in numerous Project Development Team meetings with County and Corps staff, meetings with local, state and federal elected officials, and workshops with local stakeholders. Considering the variety and complexity of issues encountered during the course of the study, it will be gratifying to all parties to be able to conclude the alternatives evaluation and selection process and move toward completion of the feasibility study and eventual implementation of an effective flood risk management project.

Minimum Level of Protection

As you know, a key consideration for state funding support is for the selected project to achieve a 200-year level of flood protection for the City of Newman. This stems from requirements cited in Senate Bill 5 (SB 5, chaptered on October 10, 2007), Sections 2, 3, and 4. SB 5 defines "urban level of flood protection" as "the level of protection that is necessary to withstand flooding that has a 1-in-200 chance of occurring in any given year using criteria consistent with, or developed by, [DWR]", and defines an "urban area" as "a developed area in which there are 10,000 residents or more." In short, since the City of Newman currently has over 10,000 residents, by year 2015 it will be necessary to achieve, or annually show adequate progress towards achieving, 200-year protection -- or face development restrictions in the 200-year floodplain. Since one of the state's policy goals is to help urban communities develop and implement a strategy to obtain 200-year protection, it is necessary for the Orestimba project to be formulated at the 200-year level in order to be eligible for state funding.

Cost-Share Considerations

The objective of the Corps Feasibility Study is to conclude with a National Economic Development (NED) alternative that will reasonably maximize net economic benefits. The state's cost-share for construction will either be based upon the non-federal cost of the Corps' NED alternative, or upon the non-federal share of a cost-beneficial "Locally Preferred Plan" ultimately authorized by the federal government that provides an urban level of protection (200-year or greater) to the City of Newman, and is consistent with the state's strategic flood risk management goals. Determination of the potential state cost-share will be guided by AB 1147 regulations, and the source of state funding will likely be from one or more of the alternatives described later in this letter.

State Plan of Flood Control Limitations

The primary source of funding for new flood risk reduction projects in the Central Valley is Proposition 1E. However, most Proposition 1E funds can only be used for the state's share of construction funding for the flood damage reduction component of a project that is a facility of the State Plan of Flood Control (SPFC), or for constructing new SPFC features to increase flood protection for an urbanized area that is already protected by SPFC levees. According to the enabling legislation, Section 5096.821(b) of Proposition 1E allows appropriation of funds to DWR for the purpose of "improving or adding facilities to the SPFC to increase levels of protection for urban areas." Since there are currently no SPFC facilities within the project area near Newman, Proposition 1E funds from Section 5096.821 cannot be used for this project.

Timing and Potential Alternative Funding Options

Since the current project schedule could lead to a Congressional authorization no sooner than 2010, with a "new start" construction appropriation not likely until 2011 or 2012, it is possible that either additional bond funding, or an improved state General Fund situation will enable the state to provide its share of construction costs directly through either of those sources. When the project receives state and federal authorization, the state could subsequently budget for an approved project through the capital outlay process. Until that time, the state remains committed to continuing to cost share the feasibility study and preconstruction engineering and design with Proposition 84 funds.

Crediting and Reimbursement Options

Alternatively, the state may be able to use credit from state investments in other federal projects in the Central Valley. Crediting reforms for the Central Valley are being developed for the next Water Resources Development Act. If enacted, the state's cost share for projects such as this could then be partly or entirely funded by the federal government. A third alternative is for Stanislaus County to receive reimbursement from Section 5096.824 of Proposition 1E through the Flood Control Subventions Program. Under this program, the County would execute the cooperation agreement with the

Corps after federal and state authorization of the project, provide the entire non-federal share of project costs during construction, and seek reimbursement from the state for its share of eligible non-federal costs as work is completed.

Federal Sponsorship

It should be noted that under any funding scenario (whether the project is directly cost shared through a capital outlay program or reimbursed through the Flood Control Subventions Program), DWR would recommend to the Central Valley Flood Protection Board that the County of Stanislaus, the City of Newman, or another appropriate local agency execute the cooperation agreement with the Corps, and provide the required assurances to the federal government. The state would act solely as a cost sharing party, under the terms of a Local Project Cost Sharing Agreement.

AB 1147

With regard to the proportion of non-federal costs the state might share, Assembly Bill 1147 (AB 1147) legislation chaptered on September 30, 2000 requires the future state cost-share to be between 50 to 70 percent of the nonfederal cost-share for federal projects authorized by the Legislature. The higher cost-sharing percentages are reserved for multi-objective projects. Draft AB 1147 regulations recently concluded a public review, and DWR is currently evaluating the comments. It is likely that an additional opportunity for public review will be forthcoming later this summer. We will notify you directly of such a review opportunity, and encourage you to participate in that process.

Consideration of State Water Project Facilities

While the primary intent of this letter is to provide a concise summary of state funding considerations, I would be remiss if I did not reiterate some of the unique concerns that DWR has due to proximity of the project site for the dry dam alternative with California State Water Project (SWP) facilities and real estate. The California Aqueduct is the primary conveyance feature of the SWP, and water supply reliability is one of the most critical issues related to the SWP. Since the Aqueduct is located directly downstream from the proposed site of the dry dam, the Corps' cost analysis for the dry dam alternative will include design considerations to alleviate the risk to water supply reliability.

The above considerations are all important factors DWR will need to carefully weigh while determining appropriate participation in whatever project alternative is eventually recommended for federal authorization and construction. DWR believes that achieving an urban level of flood protection for the City of Newman is an important goal, and we look forward to seeing the results from the West Stanislaus County Feasibility Study.

DWR staff is ready to provide assistance as needed to help complete the feasibility study, and then pursue authorization of a federal project for construction. If you have any questions regarding the information in this letter or would like to meet to discuss these policies in greater detail, please contact me at (916) 574-0601.

Sincerely,

George T. Qualley, Chief
Division of Flood Management
Department of Water Resources

Attachments

cc: Colonel Thomas C. Chapman
District Engineer
U. S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Jay Punia, Executive Officer
Central Valley Flood Protection Board
3310 El Camino Avenue, LL 40
Sacramento, California 95821

State of California - The Resources Agency
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DEPARTMENT OF FISH AND GAME
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February 7 2006

Dave Vanrijn, Project Manager
United States Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

Dear Mr. Vanrijn:

Letter of support for investigation of addition alternatives to
Orestimba Creek Flood Control Project

The Department of Fish and Game (Department) would like to express its support of the Orestimba Creek Flood Control Project being planned by Stanislaus County (County) and the United States Army Corps of Engineers (USACOE). The Department recognizes the importance of protecting the town of Newman and western Stanislaus County from episodic flood events that destroy valuable agricultural and urban property. The Department has been involved in this planning process since its inception and will continue to participate until an acceptable solution is found. We are pleased by the latest decisions to explore options that improve wildlife habitat along Orestimba Creek as well as providing flood control protection and urge that necessary assessment and subsequent project construction be sufficiently funded. We realize that the flooding of the Newman area is a ubiquitous problem to the westside of the San Joaquin Valley and hope that Orestimba Creek will serve as a model for similar flood control projects in the future.

The USACOE's process of project evaluation has produced several project alternatives. The USACOE's past approach favored construction of flood control structures (levees, dams or impound basins) that would store excess flows to prevent flooding. Most of these alternatives would likely generate significant impacts on natural resources, and at this point, we must counsel against their adoption as proposed. Most recent discussions have centered on a possible solution that develops Orestimba Creek and nearby valley floor drainages to more naturally functioning waterways in conjunction with the construction of a dam immediately upstream of the California Aqueduct. Conceptually, this would be accomplished by increasing Orestimba Creek's capacity by a combination of fluvial improvements to the waterway and adjacent land. Exact locations of these in-stream improvements need to be determined. The upstream dam would either no longer be necessary or a smaller dam would re-regulate flood-event water to match the improved flow capacity of Orestimba Creek.

Although largely acceptable to the Department, there are two concerns with this "blended" alternative. One concern with the inclusion of a dam and re-regulating reservoir is the potential for impacts to the large, mature Sycamore woodland along Orestimba Creek. The location, size, and operation of the proposed dam could adversely affect this Sycamore woodland.

Resource agencies, scientists, and non-governmental conservation entities place significant value on this rare natural community. Additional analyses of potential impacts to this resource need to be included in the evaluation of alternatives, and minimization measures should be included into any final design criteria. A second concern is the need for more comprehensive information upon which to base floodplain design of Orestimba Creek. Without adequate information, optimal flood control function and habitat quality are not likely to be achieved. In order to fully evaluate and produce specific design criteria for the conceptual flood control Project discussed above, more physical information regarding Orestimba Creek is necessary. The Department concurs completely with the USCOE and the County in prioritizing the collection of this missing information before alternatives are finalized. The Department fully supports a project which creates functional waterways that possess working floodplains, improved riparian corridors, and enhanced sediment transport systems. The Department recommends that any flood control project include these basic improvements to Orestimba Creek which will create a viable wildlife corridor connected from the San Joaquin River to the upper watershed in western Stanislaus County. A functional creek and floodplain should be primary in designing a blended alternative. Hopefully, improvements to the area's waterways will show adequate management of peak flows. If this proves impossible, additional flood control measures will need to be interacted into a refined alternative.

The Department thanks both the County and the USCOE for their commitment to investigate newternatives to the serious flooding problem along Orestimba Creek. We are pleased to see the process of alternative selection moving forward in a positive and responsible manner and will continue to work productively with all involved in order to find a solution to this crucial problem.

If you have any comments or questions, please contact Clarence J. Mayott at the address above or telephone number, extension 225.

Sincerely,

W. E. Loudermilk

W. E. Loudermilk
Regional Manager

cc: See Page Three

cc: Col. Ronald Light
United States Army Corps of Engineers
Sacramento District
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Fresno, California 93721

City of Newman

1162 Main Street • P.O. Box 787 • Newman, CA 95360 • (209) 862-3725
www.cityofnewman.com • E-mail info@cityofnewman.com

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RECEIVED
MAR 02 2006

February 22, 2006

Congressman Dennis Cardoza
415 West 18th Street
Merced, CA 95340

RE: Army Corps of Engineers' Orestimba Creek project.

Dear Congressman Cardoza:

The City of Newman would like to thank you for the continual support of the Orestimba Creek flood control project in Stanislaus County. Through your foresight and vigilance, this project has evolved into a flood control project that will enhance wildlife habitat and restore the Orestimba Creek to a more natural setting and course. The result will be a project that can be touted as a win-win situation for flood control and environmental conservation.

An important aspect to the Orestimba Creek project is maintaining the momentum that we have achieved over that past couple of years. Formulating strong partnerships with local governments that have committed financial resources to a project should rank high on the Federal governments list of projects to approve. The City of Newman is dedicated ensuring this project is completed.

In closing, the City of Newman thanks you for your continual support and guidance on the Orestimba Creek project. With your assistance, this project has continued to evolve to meet the needs and goals of all the stakeholders and affected agencies. Please let the City know how we can assist you and keep the momentum moving forward.

Sincerely,

John G. Fantazia

JOHN G. FANTAZIA
Mayor

4/m
ack'd receipt

cc: Senator D. Feinstein, U.S. Senate
Senator B. Boxer, U.S. Senate
Colonel R. Light, Army Corps of Engineers
Dave Vanrijn, Army Corps of Engineers
R. Mayer, Dept. of Water Resources

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RECEIVED
MAR 0 2 2006

February 21, 2006

U.S. Senator Barbara Boxer
2500 Tulare St., Suite 5290
Fresno, CA 93721

RE: U.S. Army Corps of Engineer's Orestimba Creek project. Newman CA

Dear Senator Boxer,

In 1995 and 1998, the City of Newman flooded when heavy rains lead to Orestimba Creek overflowing its banks. Flood waters contaminated with agricultural residues and raw sewage engulfed our City. City staff and residents were called to action to evacuate the San Luis Convalescent Hospital in the middle of the night as flood waters threatened the residents. Our Historic Downtown and its businesses sustained millions of dollars in damage as water depths reach nearly two feet. The physical conditions that contributed to these disasters still exist today.

Following those events, the City and Stanislaus County began working with the U.S. Army Corp of Engineers to study the project and develop solutions. A project which originated as a flood control project has evolved into a multi-level project that includes flood control, stream bed renovation and wildlife habitat and corridor rejuvenation. Overall, this project will enhance agricultural production around the creek, restore natural habitat for wildlife and provide the City of Newman a measure of protection against future disaster due to flood waters.

This project became increasingly necessary with the first fatality as a result of Orestimba Creek. On December 31, 2005, heavy rainfall pushed Orestimba Creek to flood Eastin Road (County road) with nearly four feet of water. The solo vehicle struck the water and the driver lost control of the vehicle. A passenger succumbed to a non-collision injury as a result of entering the water following the collision (source: CHP accident report).

In closing, floods waters caused by heavy rainfall in the Orestimba Creek watershed have resulted in millions of dollars in damage to Newman businesses and played a contributing factor in the death of one person. The City of Newman requests your support by voting to continue funding of the US Army Corp of Engineers Orestimba Creek project in Stanislaus County, CA. Your assistance is necessary to protect the health and safety of our community members and our local economy.

Thank you for your support,

John G. Fantazia

JOHN G. FANTAZIA
Mayor

cc: Senator D. Feinstein, U.S. Senate
Congressman D. Cardoza, U.S. Congress, 18th District
Colonel R. Light, Army Corps of Engineers
Dave Vanrijn, Army Corps of Engineers
R. Mayer, Dept. of Water Resources

City of Newman

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February 21, 2006

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Fresno, CA 93721

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John G. Fantazia

JOHN G. FANTAZIA
Mayor

cc: Senator B. Boxer, U.S. Senate
Congressman D. Cardoza, U.S. Congress, 18th District
Colonel R. Light, Army Corps of Engineers
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R. Mayer, Dept. of Water Resources

Chapter 16.50 FLOOD DAMAGE PREVENTION

16.50.010 Statutory authorization.

The Legislature of the State of California has, in Government Code Sections 65302, 65560 and 65800, conferred upon local government units authority to adopt regulations designed to promote the public health, safety and general welfare of its citizenry. Therefore, the Board of Supervisors of Stanislaus County does hereby adopt the following floodplain management regulations. (Ord. CS 638 §1 (part), 1996).

16.50.020 Findings of fact.

A. The flood hazard areas of Stanislaus County are subject to periodic inundation which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety and general welfare.

B. These flood losses are caused by uses that are inadequately elevated, floodproofed or protected from flood damage. The cumulative effect of obstructions in areas of special flood hazards which increase flood heights and velocities also contribute to the flood loss. (Ord. CS 638 §1 (part), 1996).

16.50.030 Statement of purpose.

It is the purpose of this chapter to promote the public health, safety and general welfare, and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

A. Protect human life and health;

B. Minimize expenditure of public money for costly flood control projects;

C. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;

D. Minimize prolonged business interruptions;

E. Minimize damage to public facilities and utilities such as water and gas mains; electric, telephone and sewer lines; and streets and bridges located in areas of special flood hazard;

F. Help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future blighted areas caused by flood damage;

G. Ensure that potential buyers are notified that property is in an area of special flood hazard; and

H. Ensure that those who occupy the areas of special flood hazard assume responsibility for their actions. (Ord. CS 638 §1 (part), 1996).

16.50.040 Methods of reducing flood losses.

In order to accomplish its purposes, this chapter includes methods and provisions to:

A. Restrict or prohibit uses which are dangerous to health, safety and property due to water or erosion hazards, or which result in damaging increases in erosion or flood heights or velocities;

B. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;

C. Control the alteration of natural floodplains, stream channels and natural protective barriers, which help accommodate or channel flood waters;

D. Control filling, grading, dredging and other development which may increase flood damage; and

E. Prevent or regulate the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards in other areas. (Ord. CS 638 §1 (part), 1996).

16.50.050 Lands to which this chapter applies.

This chapter shall apply to all areas of special flood hazards within the unincorporated areas of Stanislaus County. (Ord. CS 638 §1 (part), 1996).

16.50.060 Basis for establishing the areas of special flood hazard.

The areas of special flood hazard identified by the Federal Insurance Administration (FIA) of the Federal Emergency Management Agency (FEMA) in the

report entitled “Flood Insurance Study For the Unincorporated Areas of Stanislaus County,” dated September 2004, and accompanying flood insurance rate maps (FIRMs) and flood boundary and floodway maps (FBFMs), dated September 2004, and all subsequent amendments and/or revisions, are adopted by reference and declared to be a part of this chapter. This flood insurance study and attendant mapping is the minimum area of applicability of this chapter and may be supplemented by studies for other areas which allow implementation of this chapter and which are recommended to the board of supervisors by the floodplain administrator. The study, FIRMs and FBFMs are on file at the county administration building, Department of Public Works 1010 10th Street, Modesto, California. (Ord. CS 1017 §31, 2007: Ord. CS 638 §1 (part), 1996).

16.50.070 Compliance.

No structure or land shall hereafter be constructed, located, extended, converted or altered without full compliance with the term of this chapter and other applicable regulations. Violation of the requirements of this chapter (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Nothing herein shall prevent the board of supervisors from taking such lawful action as is necessary to prevent or remedy any violation. (Ord. CS 638 §1 (part), 1996).

16.50.080 Abrogation and greater restrictions.

This chapter is not intended to repeal, abrogate or impair any existing easements, covenants or deed restrictions. However, where this chapter and another chapter, ordinance, easement, covenant or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail. (Ord. CS 638 §1 (part), 1996)

16.50.090 Interpretation.

In the interpretation and application of this chapter, all provisions shall be:

A. Considered as minimum require-ments;

B. Liberally construed in favor of the governing body; and

C. Deemed neither to limit nor repeal any other powers granted under state statutes. (Ord. CS 638 §1 (part), 1996).

16.50.100 Warning and disclaimer of liability.

The degree of flood protection required by this chapter is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur on rare occasions. Flood heights may be increased by man-made or natural causes. This chapter does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This chapter shall not create liability on the part of Stanislaus County, any officer or employee thereof, the State of California, or the Federal Insurance Administration, Federal Emergency Management Agency, for any flood damages that result from reliance on this chapter or any administrative decision lawfully made hereunder. (Ord. CS 638 §1 (part), 1996).

16.50.110 Severability.

This chapter and the various parts thereof are hereby declared to be severable. Should any section of this chapter be declared by the courts to be unconstitutional or invalid, such decision shall not affect the validity of the chapter as a whole, or any portion thereof other than the section so declared to be unconstitutional or invalid. (Ord. CS 638 §1 (part), 1996).

16.50.120 Definitions.

Unless specifically defined below, words or phrases used in this chapter shall be interpreted so as to give them the meaning they have in common usage and to give this chapter its most reasonable application.

1. “Accessory use” means a use which is incidental and subordinate to the principal use of the parcel of land on which it is located.

2. “Alluvial fan” means a geomorphologic feature characterized by a cone or fan-shaped deposit of boulders, gravel and fine sediments that have been eroded from mountain slopes, transported by flood flows and then deposited on the valley floors, and which is subject to flash flooding, high velocity flows, debris flows, erosion, sediment movement and deposition, and channel migration.

3. “Apex” means the point of highest elevation on an alluvial fan, which on undisturbed fans is generally the point where the major stream that formed the fan emerges from the mountain front.

4. “Appeal” means a request for a review of the floodplain administrator’s interpretation of any provision of this chapter.

5. “Area of shallow flooding” means a designated AO or AH zone on the flood insurance rate map (FIRM). The base flood depths range from one to three feet; a clearly defined channel does not exist; the path of flooding is unpredictable and indeterminate; and velocity flow may be evident. Such flooding is characterized by ponding or sheet flow.

6. “Area of special flood hazard” see “special flood hazard area”.

7. “Base flood” means a flood which has a one-percent chance of being equaled or exceeded in any given year (also called the “100-year flood”). Base flood is the term used throughout this chapter.

8. “Basement” means any area of the building having its floor subgrade—i.e., below ground level—on all sides.

9. “Building” see “structure”.

10. “Development” means any man-made change to improved or unimproved real estate including, but not limited to, buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

11. “Encroachment” means the advance or infringement of uses, plant growth, fill, excavation, buildings, permanent structures or development into a floodplain which may impede or alter the flow capacity of a floodplain.

12. “Existing manufactured home park or subdivision” means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets and either final site grading or the pouring of concrete pads) is completed before the effective date, November 13, 1980, of the floodplain management regulations codified in this chapter.

13. “Expansion to an existing manufactured home park or subdivision” means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets and either final site grading or the pouring of concrete pads).

14. “Flood, flooding or flood water” means a general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters; the unusual and rapid accumulation or run-off of surface waters from any source.

15. “Flood boundary and floodway map (FBFM)” means the official map on which the Federal Emergency Management Agency or Federal Insurance Administration has delineated both the areas of special flood hazards and the floodway.

16. “Flood hazard boundary map (FHBM)” means the official map on which the Federal Emergency Management Agency or Federal Insurance Administration has delineated the areas of flood hazards.

17. “Flood insurance rate map (FIRM)” means the official map on which the Federal Emergency Management Agency or Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

18. “Flood insurance study” means the official report provided by the Federal Insurance Administration that includes flood profiles, the flood insurance rate map, the flood boundary and floodway map and the water surface elevation of the base flood.

19. “Floodplain or flood-prone area” means any land area susceptible to being inundated by water from any source—see “flooding”.

20. “Floodplain administrator” is the individual appointed to administer and enforce the floodplain management regulations.

21. “Floodplain management” means the operation of an overall program of corrective and preventive measures for reducing flood damage and preserving and enhancing, where possible, natural resources in the floodplain including, but not limited to, emergency preparedness plans, flood control works, floodplain management regulations and open space plans.

22. “Floodplain management regulations” means this chapter, zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as grading and erosion control) and other application of police power which control development in flood-prone areas. This term describes federal, state or local regulations in any combination thereof which provide standards for preventing and reducing flood loss and damage.

23. “Floodproofing” means any combination of structural and nonstructural additions, changes or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents.

24. “Floodway” means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. Also referred to as “regulatory floodway”.

25. “Floodway fringe” is that area of the floodplain on either side of the “regulatory floodway” where encroachment may be permitted.

26. “Fraud and victimization,” as related to §§16.50.230, 16.50.240, 16.50.250 and 16.50.260 of this chapter, means that the variance granted must not cause fraud on, or victimization of, the public. In examining this requirement, the board of supervisors will consider the fact that every newly constructed building adds to government responsibilities and remains a part of the community for fifty to one hundred years. Buildings that are permitted to be constructed below the base flood elevation are subject during all those years to increased risk of damage from floods, while future owners of the property and the community as a whole are subject to all the costs, inconvenience, danger and suffering that those increased flood damages bring. In addition, future owners may purchase the property, unaware that it is subject to potential flood damage and can be insured only at very high flood insurance rates.

27. “Functionally dependent use” means a use which cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers and ship building and ship repair facilities and does not include long-term storage or related manufacturing facilities.

28. “Governing body” is the board of supervisors of Stanislaus County who is empowered to adopt and implement regulations to provide for the public health, safety and general welfare of its citizenry.

29. “Hardship,” as related to §§16.50.230, 16.50.240, 16.50.250 and 16.50.260 of this chapter, means the exceptional hardship that would result from a failure to grant the requested variance. The board of supervisors requires that the variance be exceptional, unusual, and peculiar to the property involved. Mere economic or financial hardship alone is not exceptional. Inconvenience, aesthetic considerations, physical handicaps, personal preferences, or the disapproval of one’s neighbors likewise cannot, as a rule, qualify as an exceptional hardship. All of these problems can be resolved through other means without granting a variance, even of the alternative is more expensive, or requires the property owner to build elsewhere or put the parcel to a different use than originally intended.

30. “Highest adjacent grade” means the highest natural elevation of the ground surface, prior to construction, next to the proposed walls of a structure.

31. “Historic structure” means any structure that is:

A. Listed individually in the National Register of Historic Places (a listing maintained by the Department of the Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;

B. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district preliminarily determined by the Secretary to qualify as a registered historic district;

C. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of the Interior; or

D. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either by an approved state program as determined by the Secretary of the Interior or directly by the Secretary of the Interior in states with approved programs.

32. “Levee” means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control or divert the flow of water so as to provide protection from temporary flooding.

33. “Levee system” means a flood protection system which consists of a levee, or levees, and associated structures, such as closure and drainage devices, which are constructed and operated in accord with sound engineering practices.

34. “Lowest floor” means the lowest floor of the lowest enclosed area, including basement—see “basement”.

A. An unfinished or flood resistant enclosure below the lowest floor that is usable solely for parking of vehicles, building access or storage in an area other than a basement area, is not considered a building’s lowest floor, provided it conforms to applicable non-elevation design requirements, including, but not limited to:

1. The wet floodproofing standard in §16.50.170.C.3.

2. The anchoring standards in §16.50.170.A.

3. The construction materials and methods standards in §16.50.170.B.

4. The standards for utilities in §16.50.180.

B. For residential structures, all subgrade enclosed areas are prohibited as they are considered to be basements (see “basement” definition). This prohibition includes below-grade garages and storage areas.

35. “Manufactured home” means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when attached to the required utilities. The term “manufactured home” does not include a “recreational vehicle”.

36. “Manufactured home park or subdivision” means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

37. “Mean sea level” mans, for purposes of the National Flood Insurance Program, the National Geodetic Vertical Datum (NGVD) of 1929 or other datum, to which base flood elevation shown on the flood insurance rate map are referenced.

38. “New construction”, for floodplain management purposes, means structures for which the “start of construction” commenced on or after the effective date of floodplain management regulations adopted by this community, and includes any subsequent improvements to such structures.

39. “New manufactured home park or subdivision” means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date (November 13, 1980) of floodplain management regulations adopted by this community.

40. “Obstruction” includes, but is not limited to, any dam, wall, wharf, embankment, levee, dike, pile, abutment, protection, excavation, channelization, bridge, conduit, culvert, building, wire, fence, rock, gravel, refuse, fill, structure, vegetation or other material in, along, across or projecting into any watercourse which may alter, impede, retard or change the direction and/or velocity of the flow of water, or due to its location, its propensity to snare or collect debris carried by the flow of water, or its likelihood of being carried downstream.

41. “One-hundred year flood” or “100-year flood”—see “base flood”.

42. “Public safety and nuisance”, as related to §§16.50.230, 163.50.240, 16.50.250 and 16.50.260 of this chapter, means that the granting of a variance must not result in anything which is injurious to safety or health of an entire community or neighborhood, or any considerable number of persons, or unlawfully obstructs the free passage or use, in the customary manner, of any navigable lake or river, bay, stream, canal or basin.

43. “Recreational vehicle” means a vehicle which is:

A. Built on a single chassis;

B. Four hundred square feet or less when measured at the largest horizontal projection;

C. Designed to be self-propelled or permanently towable by a light-duty truck; and

D. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel or seasonal use.

44. “Regulatory floodway” means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

45. “Remedy a violation” means to bring the structure or other development into compliance with state or local floodplain management regulations, or, if this is not possible, to reduce the impacts of its noncompliance. Ways that impacts may be reduced include protecting the structure or other affected development from flood damages, implementing the enforcement provisions of this chapter or otherwise deterring future similar violations, or reducing state or federal financial exposure with regard to the structure or other development.

46. “Riverine” means relating, formed by or resembling a river (including tributaries), stream, brook, etc.

47. “Sheet flow area”—see “area of shallow flooding”.

48. “Special flood hazard area (SFHA)” means an area having special flood or flood-related erosion hazards and is shown on an FHBM or FIRM as Zone A, AO, AR, AE, A99 or AH.

49. “Start of construction” includes substantial improvement and other proposed new development and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days from the date of the permit. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does in include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

50. “Structure” means a walled and roofed building that is principally above ground; this includes a gas or liquid storage tank or a manufactured home.

51. “Substantial damage” means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before- damaged condition would equal or exceed fifty percent of the market value of the structure before the damage occurred.

52. “Substantial improvement” means any reconstruction, rehabilitation, addition or other proposed new development of a structure, the cost of which equals or

exceeds fifty percent of the market value of the structure before the “start of construction” of the improvement. This term includes structures which have incurred “substantial damage”, regardless of the actual repair work performed. The term does not, however, include either:

A. Any project for improvement of a structure to correct existing violations or state or local health, sanitary or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions; or

B. Any alteration of a “historic structure”, provided that the alteration will not preclude the structure’s continued designation as a “historic structure”.

53. “Variance” means a grant of relief from the requirements of this chapter which permits construction in a manner that would otherwise be prohibited by this chapter.

54. “Violation” means the failure of a structure or other development to be fully compliant with this chapter. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance in this chapter is presumed to be in violation until such time as that documentation is provided.

55. “Water surface elevation” means the height, in relation to the National Geodetic Vertical Datum (NGVD) or 1929, (or other datum, where specified), of floods of various magnitudes and frequencies in the floodplains of riverine areas.

56. “Watercourse” means a lake, river, creek, stream, wash, arroyo, channel or other topographic feature on or over which waters flow at least periodically. Watercourse includes specifically designated areas in which substantial flood damage may occur. (Ord. CS 1017 §32, 2007; Ord. CS 638 §2 (part), 1996)

16.50.130 Establishment of development permit.

A development (construction) permit shall be obtained before any construction or other development begins within any area of special flood hazard established in §16.50.060. Application for a development (construction) permit shall be made on forms furnished by the county building official and may include, but not be limited to: plans in triplicate drawn to scale showing the nature, location, dimensions and elevation of the area in question; existing or proposed structures, fill, storage of materials, drainage facilities; and the location of the foregoing. Specifically, the following information is required:

A. Proposed elevation, in relation to mean sea level, of the lowest floor (including basement) of all structure—zone AO, elevation of highest adjacent grade and proposed elevation of lowest floor of all structures; or

B. Proposed elevation in relation to mean sea level to which any nonresidential structure will be floodproofed, if required in §16.50.170.C.3; and

C. All appropriate certifications listed in §16.50.150.D of this chapter; and

D. Description of the extent to which any watercourse will be altered or relocated as a result of proposed development. (Ord. CS 638 §2 (part), 1996).

16.50.140 Designation of the floodplain administrator.

The director of public works or designee is hereby appointed to administer, implement and enforce this chapter by granting or denying development (construction) permits in accordance with its provisions. (Ord. CS 638 §2 (part), 1996).

16.50.150 Duties and responsibilities of the floodplain administrator.

The duties and responsibilities of the floodplain administrator shall include, but not be limited to, the following:

A. Permit review: Review all development permits to determine that:

1. Permit requirements of this chapter have been satisfied;

2. All required federal, state, and local governmental agency permits or approvals have been obtained before approving the development permit;

3. The site is reasonably safe from flooding; and

4. The proposed development does not adversely affect the carrying capacity of areas where base flood elevations have been determined but a floodway has not been designated. For purposes of this chapter, “adversely affects” means that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will increase the water surface elevation of the base flood more than one foot at any point.

B. Review and use of any other base flood date: When base flood elevation data has not been provided in accordance with §16.50.060, the floodplain administrator shall obtain, review and reasonably utilize any base flood elevation and floodway data

available from a federal or state agency, or other source, in order to administer §§16.50.170, 16.50.180, 16.50.190, 16.50.200, 16.50.210 and 16.50.220 of this chapter. Any such information shall be submitted to the board of supervisors for adoption.

C. Notification of other agencies: In alteration or relocation of a watercourse:

1. Notify adjacent communities and the California Department of Water Resources prior to alteration or relocation;

2. Submit evidence of such notification to the Federal Insurance Administration, Federal Emergency Management Agency; and

3. Assure that the flood carrying capacity within the altered or relocated portion of said watercourse is maintained.

D. Documentation of floodplain development: Obtain and maintain for public inspection and make available, as needed, the following:

1. Certification required by §16.50.170.C.1 (lowest floor elevations);

2. Certification required by §16.50.170.C.2 (elevation or floodproofing of non-residential structures);

3. Certification required by §16.50.170.C.3 (wet floodproofing standard);

4. Certification of elevation required by §16.50.190.B (subdivision standards); and

5. Certification required by §16.50.220.A (floodway encroachments).

E. Map determinations: Make interpretations where needed, as to the exact location of the boundaries of the areas of special flood hazard, for example, where there appears to be a conflict between a mapped boundary and actual field conditions. The person contesting the location of the boundary shall be given a reasonable opportunity to appeal the interpretation as provided in as related to §§16.50.230, 16.50.240, 16.50.250 and 16.50.260 of this chapter.

F. Remedial action: Take action to remedy violations of this chapter as specified in §16.50.070. (Ord. CS 638 §2 (part), 1996).

16.50.160 Appeals.

The board of supervisors of Stanislaus County shall hear and decide appeals when it is alleged there is an error in any requirement, decision, or determination made by the

floodplain administrator in the enforcement or administration of this chapter. (Ord. CS 638 §2 (part), 1996).

16.50.170 Standards of construction.

In all areas of special flood hazards the following standards are required:

A. Anchoring:

1. All new construction and substantial improvements shall be adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy, as determined by an engineering analysis.

2. All manufactured homes shall meet the anchoring standards of §16.50.200.

B. Construction Materials and Methods: All new construction and substantial improvement shall be constructed:

1. With materials and utility equipment resistant to flood damage;

2. Using methods and practices that minimize flood damage;

3. With electrical, heating, ventilation, plumbing and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the

components during conditions of flooding; and

4. If within Zones AH or AO, so that there are adequate drainage paths around structures on slopes to guide flood waters around and away from proposed structures.

C. Elevation and Floodproofing: (See §§16.50.120.8 for definition of “basement”, 16.50.120.34 for “lowest floor”, 16.50.120.51 for “substantial damage”, and 16.50.120.52 for “substantial improvement”.)

1. Residential construction, new or substantial improvement, shall have the lowest floor, including basement;

a. In an AO zone, elevated above the highest adjacent grade to a height equal to or exceeding the depth number specified in feet on the FIRM, or elevated at least two feet above the highest adjacent grade if no depth number is specified;

b. In an A zone, elevated to or above the base flood elevation, as determined by this community;

c. In all other zones, elevated to or above the base flood elevation.

Upon the completion of the structure, the elevation of the lowest floor including basement shall be certified by a registered professional engineer or surveyor, and verified by the community building inspector to be properly elevated. Such certification or verification shall be provided to the floodplain administrator.

2. Non-residential construction, new or substantial improvement, shall either be elevated to conform with §16.50.170.C.1 or together with attendant utility and sanitary facilities:

a. Be floodproofed below the elevation recommended under §16.50.170.C.1 so that the structure is watertight with walls substantially impermeable to the passage of water;

b. Have structure components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy; and

c. Be certified by a registered professional engineer or architect that the standards of this section (16.50.170.C.2) are satisfied. Such certification shall be provided to the floodplain administrator.

3. All new construction and substantial improvement with fully enclosed areas below the lowest floor (excluding basements) that are usable solely for parking of vehicles, building access or storage, and which are subject to flooding, shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwater. Designs for meeting this requirement must <u>exceed</u> the following minimum criteria:

a. Be certified by a registered professional engineer or architect; or

b. Have a minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, valves or other coverings or devices provided that they permit the automatic entry and exit of floodwater.

4. Manufactured homes shall also meet the standards in §16.50.200. (Ord. CS 638 §2 (part), 1996).

16.50.180 Standards for utilities.

A. All new and replacement water supply and sanitary sewage systems shall be designed to minimize or eliminate:

1. Infiltration of flood waters into the systems; and

2. Discharge from systems into flood waters.

B. Onsite waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding. (Ord. CS 638 §2 (part), 1996).

16.50.190 Standards for subdivisions.

A. All preliminary subdivision proposals shall identify the flood hazard area and the elevation of the base flood.

B. All subdivision plans will provide the elevation of proposed structure(s) and pad(s). If the site is filled above the base flood elevation, the lowest floor and pad elevations shall be certified by a registered professional engineer or surveyor and provided to the floodplain administrator.

C. All subdivision proposals shall be consistent with the need to minimize flood damage.

D. All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize flood damage.

E. All subdivisions shall provide adequate drainage to reduce exposure to flood hazards. (Ord. CS 638 §2 (part), 1996).

16.50.200 Standards for manufactured homes.

A. All manufactured homes that are placed or substantially improved, within zones A1-30, AH and AE on the community's flood insurance rate map, on sites located:

1. Outside of a manufactured home park or subdivision;

2. In a new manufactured home park or subdivision;

3. In an expansion to an existing manufactured home park or subdivision; or

4. In an existing manufactured home park or subdivision on a site upon which a manufactured home has incurred “substantial damage” as the result of a flood, shall be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated to or above the base flood elevation and be securely fastened to an adequately anchored foundation system to resist flotation, collapse, and lateral movement as certified by a registered professional engineer or architect.

B. All manufactured homes to be placed or substantially improved on sites in an existing manufactured home park or subdivision within zones A1-30, AH and AE on the community’s flood insurance rate map that are not subject to the provisions of §16.50.200.A will be securely fastened to an adequately anchored foundation system to resist flotation, collapse and lateral movement, and elevated so that either the:

1. Lowest floor of the manufactured home is at or above the base flood elevation as certified by a professional engineer or licensed surveyor; or

2. Manufactured home chassis is supported by reinforced piers or other foundation elements of at least equivalent strength that are no less than thirty-six inches in height above grade. (Ord. CS 638 §2 (part), 1996.

16.50.210 Standards for recreational vehicles.

All recreational vehicles placed on sites within zones A1-30, AH and AE on the community’s flood insurance rate map will either:

A. Be on the site for fewer than one hundred eighty consecutive days, and be fully licensed and ready for highway use—a recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick-disconnect type utilities and security devices, and has no permanently attached additions; or

B. Meet the permit requirements of §16.50.130 of this chapter and the elevation and anchoring requirements for manufactured homes in §16.50.200.A. (Ord. CS 638 §2 (part), 1996).

16.50.220 Floodways.

Located within areas of special flood hazard, established in §16.50.060, are areas designated as floodways. Since the floodway is an extremely hazardous area due to the velocity of flood waters which carry debris, potential projectiles, and erosion potential, the following provisions apply:

A. Prohibit encroachments, including fill, new construction, substantial improvement and other new development, unless certification by a registered professional engineer or architect is provided demonstrating that encroachments shall not result in any increase in the base flood elevation during the occurrence of the base flood discharge.

B. If §16.50.220.A is satisfied, all new construction and substantial improvement and other proposed new development shall comply with all other applicable flood hazard reduction provisions of §§16.50.170, 16.50.180, 16.50.190, 16.50.200, 16.50.210 and 16.50.220. (Ord. CS 638 §2 (part), 1996)

16.50.230 Nature of variances.

The variance criteria set forth in §§16.50.230, 16.50.240, 16.50.250 and 16.50.260 of the chapter are based on the general principle of zoning law that variances pertain to a piece of property and are not personal in nature. A variance may be granted for a parcel of property with physical characteristics so unusual that complying with the requirements of this chapter would create an exceptional hardship to the applicant or the surrounding property owners. The characteristics must be unique to the property and not shared by adjacent parcels. The unique characteristic must pertain to the land itself, not to the structure, its inhabitants or the property owners.

It is the duty of the board of supervisors to help protect its citizens from flooding. This need is so compelling and the implications of the cost of insuring a structure built below flood level are so serious that variances from the flood elevation or from other requirements in the flood chapter are quite rare. The long term goal of preventing and reducing flood loss and damage can only be met if variances are strictly limited. Therefore, the variance guidelines provided in this chapter are more detailed and contain multiple provisions that must be met before a variance can be properly granted. The criteria are designed to screen out those situations in which alternatives other than a variance are more appropriate. (Ord. CS 638 §2 (part), 1996).

16.50.240 Appeal board.

A. In passing upon requests for variances, the board of supervisors shall consider all technical evaluations, all relevant factors, standards specified in other sections of this chapter, and the:

1. Danger that materials may be swept onto other lands to the injury of others;

2. Danger of life and property due to flooding or erosion damage;

3. Susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the existing individual owner and future owners of the property;

4. Importance of the services provided by the proposed facility to the community;

5. Necessity to the facility of a waterfront location, where applicable;

6. Availability of alternative locations for the proposed use which are not subject to flooding or erosion damage;

7. Compatibility of the proposed use with existing and anticipated development;

8. Relationship of the proposed use to the comprehensive plan and floodplain management program for that area;

9. Safety of access to the property in time of flood for ordinary and emergency vehicles;

10. Expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters expected at the site; and

11. Costs of providing governmental services during and after flood conditions, including maintenance and repair of public utilities and facilities such as sewer, gas, electrical, and water system, and streets and bridges.

B. Any applicant to whom a variance is granted shall be given written notice over the signature of a community official that:

1. The issuance of a variance to construct a structure below the base flood level will result in increased premium rates for flood insurance up to amounts as high as $25.00 for $100.00 of insurance coverage; and

2. Such construction below the base flood level increases risks to life and property. A copy of the notice shall be recorded by the floodplain administrator in the office of the Stanislaus County recorder and shall be recorded in a manner so that it appears in the chain of title of the affected parcel of land.

C. The floodplain administrator will maintain a record of all variance actions, including justification for their issuance, and report such variances issued in its biennial report submitted to the Federal Insurance Administration, Federal Emergency Management Agency. (Ord. CS 638 §2 (part), 1996).

16.50.250 Conditions for variances.

A. Generally, variances may be issued for new construction, substantial improvement, and other proposed new development to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing that the procedures of articles IV and V of this chapter have been fully considered. As the lot size increases beyond one-half acre, the technical justification required for issuing the variance increases.

B. Variances may be issued for the repair or rehabilitation of "historic structures" (as defined in §16.50.120.31 of this chapter) upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as an historic structure and the variance is the minimum necessary to preserve this historic character and design of the structure.

C. Variances shall not be issued within any mapped regulatory floodway if any increase in flood levels during the base flood discharge would result.

D. Variances shall only be issued upon a determination that the variance is the "minimum necessary" means to afford relief with a minimum of deviation from the requirements of this chapter. For example, in

the case of variances to an elevation requirement, this means the board of supervisors need not grant permission for the applicant to build at grade, or even to whatever elevation the applicant proposes, but only to that elevation which the board of supervisors believes will both provide relief and preserve the integrity of this chapter.

E. Variances shall only be issued upon a:

1. Showing of good and sufficient cause;

2. Determination that failure to grant the variance would result in exceptional "hardship" (as defined in Section 16.50.120.29 of this chapter) to the applicant; and

3. Determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, or extraordinary public expense, create a nuisance (as defined in Section 16.50.120.42—"Public safety and nuisance"), cause fraud or victimization (as defined in Section 16.50.120.26) of the public, or conflict with existing local laws or ordinances.

F. Variances may be issued for new construction, substantial improvement, and other proposed new development necessary for the conduct of a functionally dependent use provided that the provisions of Sections 16.50.250.A—16.50.250.E are satisfied and that the structure or other development is protected by methods that minimize flood damages during the base flood and does not result in additional threats to public safety and does not create a public nuisance.

G. Upon consideration of the factors of Section 16.50.240.A and the purposes of this chapter, the board of supervisors may attach such conditions to the granting of variances as it deems necessary to further the purposes of this chapter. (Ord. CS 638 §2 (part), 1996).

16.50.260 Setting hearing date and time.

The board of supervisors shall hear and decide appeals and requests for variances from the requirements of this chapter. Any appeal or request for variance shall be in writing and clearly set forth the reasons why the appeal or variance ought to be granted. The board shall set a specific time at a regular meeting to hear an appeal or request for variance no later than forty-five days from the date it is filed with the clerk of the board, and the appellant notified thereof in writing. Notice of the hearing shall be given by mailing, at least ten days prior to the hearing, of post card notices through the United States mail with postage prepaid, to all property owners within five hundred feet of the property on which the proposed variance is to be established, as shown on the current assessment roll of the county, and using addresses from the last adopted tax roll. (Ord. CS 638 §2 (part), 1996).

PROGRAMMATIC AGREEMENT
BETWEEN
THE U.S. ARMY CORPS OF ENGINEERS AND
THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICER,
REGARDING
THE ORESTIMBA CREEK PROJECT
STANISLAUS COUNTY, CALIFORNIA

WHEREAS, the Orestimba Creek Project (Project) is authorized under a House Resolution of 1964 that addressed water resources development in the San Joaquin River Basin, California, and under the Flood Control Act of 1962 (Public Law 87-874), that provides the U.S. Army Corps of Engineers (Corps) the authority to study flood risk management and related water resources problems in the Sacramento and San Joaquin valleys; and

WHEREAS, the Corps is proceeding with the Project, and has determined that the approved project alternatives constitute an Undertaking as defined in the Advisory Council on Historic Preservation Procedures 36 CFR § 800.16(y); and

WHEREAS, the purpose of the Project is to reduce flood risk in the City of Newman, California, and in the surrounding agricultural areas. The study area is located in Stanislaus County, California, along an existing irrigation canal west of the City of Newman. The project area extends approximately 4.6 miles, from the Southern Pacific Railway at Lundy Road to the Newman Waste-way Levee. A map of the project area is included as Appendix 1 to this Programmatic Agreement (PA); and

WHEREAS, the Corps has determined that effects on properties that are either included in, or are eligible for inclusion in the National Register of Historic Places (NRHP) cannot be fully determined prior to final approval of the Project and selection of approved alternatives; this agreement addresses all phases and segments of the Project; and

WHEREAS, the Corps has consulted with the California State Historic Preservation Officer (SHPO) and notified the Advisory Council on Historic Preservation (ACHP) of their opportunity to consult pursuant to Section 106 of the National Historic Preservation Act of 1966 (Section 106), and the implementing regulations described under 36 CRF Part 800, and by letter dated August 23, 2012, the ACHP declined to participate in the consultation; and

WHEREAS, the Corps has consulted with the non-Federal cost-sharing agency, Stanislaus County, and has invited them to participate as a concurring party; and

WHEREAS, the Corps has contacted, and will continue to consult with, the Tule River Indian Tribe, the Southern Sierra Miwuk Nation, the North Valley Yokuts Tribe, the Amah Mutsun Tribal Band, Buena Vista Rancheria, the California Miwuk Tribe, and other Native individuals; and invited them to consult on this agreement; and

WHEREAS, the definitions set forth in 36 CFR § 800.16, with amendments, effective August 5, 2004, are incorporated herein by reference and apply throughout this PA;

NOW, THEREFORE, the Corps and the SHPO agree that the proposed undertaking shall be implemented in accordance with the following stipulations in order to take into account the effects of the undertaking on historic properties and to satisfy the Corps' Section 106 responsibilities for all individual aspects of the undertaking.

STIPULATIONS

The Corps shall ensure that the following measures are carried out:

Stipulation I
Professional Qualification

The Corps shall ensure that historic, architectural, and archaeological work conducted pursuant to this agreement is carried out by, or under the direct supervision of, a person or persons who meet the qualifications set by the Secretary of the Interior for Archaeology and Historic Preservation under 36 CFR Part 61.

Stipulation II
Area of Potential Effects

A. The Corps shall define and document the area of potential effects for all defined alternatives (APE) in consultation with SHPO. If future project design requires redefining the APE, the Corps shall consult with SHPO in a timely manner to amend the APE.

B. The APE shall include the footprint of all construction activities, staging areas, haul roads, and mitigation sites. The APE may also include sensitive structures within range of vibratory or sonic disturbances, and historic properties and districts close enough to project construction that the integrity of their setting or feeling could be affected.

C. The APE may include portions of the study area indicated on the map included as Appendix 1.

D. In the event that the Corps and the SHPO cannot agree on an APE, the Corps shall resolve the dispute in accordance with Stipulation XIII.

Stipulation III
Identification and Evaluation

A. The Corps shall acquire a current and complete records and literature search from the Central California Information Center at California State University, Stanislaus, prior to conducting archaeological surveys of the APE. Records and literature searches shall be considered complete and current for a period of three years after they are conducted unless, in the professional opinion of Corps archaeologists, more frequent updates are required.

B. The Corps shall maintain ongoing consultation with Native American groups and individuals, as described in Stipulation V (A), to identify properties that are of religious and cultural significance to them and that may be eligible for the National Register. Traditional Cultural Properties will be evaluated in accordance with the guidance presented in National Register Bulletin 38: *Guidelines for Evaluating and Documenting Traditional Cultural Properties.*

C. The Corps shall complete and report the results of all required cultural resources inventories of the undertaking's APE in a manner consistent with the "Secretary of the Interior's Standards and Guidelines for Identification" (48 FR 44720-23) and take into account the National Park Service's publication, "The Archeological Survey: Methods and Uses" (1978: GPO stock #024-016-00091). Inventories shall include both archaeological surveys and inventories of historic buildings, structures, and

districts as appropriate. The Corps shall include a geoarchaeological evaluation of the APE in its survey and shall undertake subsurface reconnaissance as appropriate. Surveys shall include areas not previously surveyed and areas where the Corps, in consultation with SHPO, deems previous surveys to be inadequate. The Corps will also include additional areas that may be affected by changes in the project design, borrow areas, haul roads, staging areas, extra work space, mitigation sites, and other ancillary areas related to the undertaking. If identified cultural resources do not need to be evaluated but can be determined eligible based on the results of the survey, context statements, and historic documentation, then the Corps may request SHPO concurrence with those determinations without further study. The Corps shall submit reports produced after intensive surveys to SHPO for review. The Corps shall deliver its submissions to the SHPO by email, fax, or hand delivery, whichever is most expedient. SHPO shall have 30 calendar days after receipt to provide comments to the Corps.

D. The Corps shall include in its site recordation documents all unrecorded archaeological sites, linear features, and isolates encountered in the course of the survey. The Corps shall prepare updated records of previously recorded sites as necessary. The Corps' survey shall record all prehistoric sites and all historical sites, structures, buildings, and engineering features greater than forty-five (45) years of age. Historic sites to be recorded shall include, but not be limited to: commercial, residential, and ecclesiastical buildings, roads, trails, railways, bridges, levees, culverts, and agricultural features, including ditches.

E. The Corps shall use the California Department of Parks and Recreation (DPR) Form 523 to record all newly discovered historic or prehistoric archaeological sites and isolates, previously recorded archaeological sites, and where necessary, shall create updated site records using the DPR 523 Form. Isolates shall be numbered sequentially, plotted on a map, and recorded on a single table within the report. The Corps shall examine non-linear sites that extend outside of the APE in their entirety unless access to land is prohibited or the scale of the resource makes doing so prohibitive. In the event access cannot be gained, the Corps shall consult with SHPO regarding appropriate means of evaluating a given site. The Corps shall record linear resources (i.e., railway, ditch, canal, levee, etc.) that appear on General Land Office (GLO) plat maps or are known from other archival data to be potentially significant, or which have associated features or dateable artifacts on DPR 523 site Forms. The Corps will treat linear resources not mentioned on GLO plat maps, or that appear on GLO plat maps but which are not associated with features or dateable artifacts, or do not otherwise appear to be significant, on the basis of known archival data as "isolated feature segments" and shall record them in tabular form. Such records shall include, at a minimum, a ground-truthed map of the linear feature within the APE. Historic structures and buildings shall be recorded using the State Historic Preservation Office, Historic Resources Inventory form.

F. If the National Register significance of a cultural resource requires testing or another form of formal evaluation, an Evaluation Plan (EP) will be developed to provide for consistent and thorough evaluation. The Corps shall ensure that EPs prepared for previously unevaluated cultural resources identified within the APE are consistent with the "Secretary of the Interior's Standards and Guidelines for Evaluation" (48 FR 44723-26). The Corps shall develop individual EPs to address different categories of potentially eligible historic properties. The Corps shall develop a Discovery Evaluation Plan (DEP) and a Construction Monitoring Plan (CMP) as components of an EP. An EP shall be used whenever the Corps, in consultation with the SHPO, determines that a cultural resource should be evaluated and use of the EP is essential to determine the boundaries and data potential of the site. If the Corps undertakes any archaeological testing, such testing shall be sufficient to define and delineate the site clearly, and to determine the site's eligibility for inclusion in the NRHP. Archaeological excavation undertaken by the Corps under this Stipulation shall not exceed four (4) cubic meters of soil or five percent (5%) of the surface of the site without consultation with the SHPO. Should the Corps, in consultation with the SHPO, determine that a given resource is eligible for the NRHP; a Historic Property Treatment Plan, as described under Stipulation VII, shall be produced for that property.

G. The Corps shall submit the EP for concurrent review to the SHPO and appropriate Native American Tribes The Corps shall deliver its submissions by either either email, fax, or hand delivery, whichever is most expedient. The Corps shall allow reviewers 30 calendar days after receipt to comment on the draft EP. The Corps shall ensure that any comments received within that time are taken into account and considered for incorporation into the final EP, as appropriate. If the Corps cannot concur with comments made by SHPO and/or Native American Tribes, the Corps will resolve the dispute in accordance with Stipulation XIII. Failure of the SHPO to comment within the specified time shall not preclude the Corps from finalizing and implementing the draft EP. The Corps shall ensure that the SHPO is expeditiously provided with copies of the final EP.

H. The Corps and the SHPO may develop standard protection plans (SPP) for classes of resources that occur commonly in the APE and that may be encountered unexpectedly during construction. SPPs shall include a clear description of the class or classes of resources covered and the specific actions that the Corps will take to mitigate or avoid adverse effects to those resources.

I. The Corps shall submit all SPPs for concurrent review to the SHPO and appropriate Native American Tribes. Submissions shall be delivered in the most expeditious manner possible: by email, fax, or hand delivery. The Corps shall allow reviewers 30 calendar days after receipt to comment on the draft SPP. The Corps shall ensure that any comments received within that time are taken into account and considered for incorporation into the final SPP, as appropriate. If the Corps cannot concur with comments made by SHPO and/or Native American Tribes, the Corps will resolve the dispute in accordance with Stipulation XIII. Failure of the SHPO to comment within the specified time shall not preclude the Corps from finalizing and implementing the draft SPP. The Corps shall ensure that the SHPO is expeditiously provided with copies of the final SPP.

J. The Corps, in consultation with SHPO, shall ensure that determinations of eligibility are made in accordance with the criteria set forth in 36 CFR §60.4 for all properties not covered by an SPP. This applies to all historic properties within the APE, including additional areas that may be affected by changes in the project design, borrow areas, haul roads, staging areas, extra work space, mitigation sites, and other ancillary areas related to the undertaking. If the Corps and the SHPO cannot agree on the eligibility of a property for the NRHP, the Corps shall obtain a determination from the Keeper of the National Register in accordance with 36 CFR Part 63. The determination of the Keeper shall be final for purposes of this PA. Any other disputes shall be settled following the procedure set forth under Stipulation XIII.

Stipulation IV

Determinations of Effect

The Corps shall apply the Criteria of Adverse Effect pursuant to 36 CFR §800.5(a) (1) to all historic properties within the APE that will be affected by the Project. The Corps shall make determinations of effect in consultation with the SHPO and other interested parties. If the Corps determines that the project will result in no adverse effects to historic properties, then the Corps may issue a notice to proceed with construction. If adverse effects are unavoidable, the Corps shall develop a Historic Properties Treatment Plan following the procedures set forth under Stipulations VII and VIII.

Stipulation V
Tribal Consultation and Treatment of Human Remains

A. The Corps shall ensure that the Tribes identified above are invited to participate in the development and implementation of the terms of this PA. The Corps shall also invite these Tribes to participate in the identification and evaluation of historic properties. The specific manner in which this Tribal involvement will occur shall be set forth in the HPTPs.

B. The Corps shall ensure that Native American human remains, grave goods, items of cultural patrimony, and sacred objects encountered during the undertaking that are located on state or private land are treated in accordance with the requirements California State Health and Safety Code, Section 7050.5, NRS 383.

C. If Native American human remains, grave goods, items of cultural patrimony, and sacred objects are encountered during the undertaking on federal or tribal land, the Corps shall ensure that they are treated in accordance with the requirements of California State Health and Safety Code, Section 7050.5, NRS 383, and the Native American Graves Protection and Repatriation Act of 1990, as amended.

Stipulation VI
Non-Federal Stakeholder Involvement

A. The Corps has identified potentially interested Native American groups, in consultation with the Native American Heritage Commission (NAHC). In consultation with appropriate Tribes and the NAHC, the Corps will identify historic properties of traditional religious and cultural importance.

B. Following the guidance provided in National Register Bulletin 38, the Corps shall seek comments from all potentially interested Native American groups when making determinations of eligibility for any Traditional Cultural Properties.

C. The Corps has consulted with Stanislaus County and DWR in the development of this agreement. Both agencies are concurring parties and will be given the opportunity to comment on the identification and treatment of historic properties.

D. The Corps shall give members of the public an opportunity to comment on the identification and treatment of historic properties.

E. The Corps shall allow all reviewers 15 calendar days after receipt to provide comments to the Corps. The Corps shall take into account all comments provided by reviewers, and incorporated them into the final survey and evaluation reports as appropriate. The Corps shall resolve disputes in accordance with Stipulation XIII.

F. Pursuant to Section 36 CFR § 800.6(c)(2-3) of the ACHP's regulations, the Corps shall consider requests by consulting parties and others to become concurring parties to this Programmatic Agreement.

Stipulation VII
Preparation of Historic Property Treatment Plans

The Corps, in consultation with SHPO, shall ensure that a HPTP is developed for the mitigation of anticipated effects on historic properties that will result from the Project and that cannot be avoided.

Further, the Corps, in consultation with SHPO, will ensure the development of location and property specific Data Recovery Plans.

A. Avoidance of adverse effects on historic properties is the preferred treatment approach. The HPTP shall discuss and justify the chosen approaches to the treatment of project historic properties and those treatment options considered, but rejected. If preservation of part or all of any historic properties is proposed, the treatment plan shall include discussion of the following:

1. Description of the area or portions of the historic properties to be preserved in-place, and an explanation of why those areas or portions of sites were chosen;
2. Explanation of how the historic properties will be preserved in-place, including both legal and physical mechanism for such preservation;
3. A plan for monitoring and assessing the effectiveness of mechanisms to preserve the historic properties; and
4. A plan for minimizing or mitigating future adverse effects on the historic properties, if preservation in-place mechanisms prove to be ineffective.

B. When avoidance is not feasible, the Corps, in consultation with the SHPO, shall ensure the development of an appropriate treatment plan designed to lessen or mitigate project-related effects to historic properties. For properties eligible under National Register criteria A, B, or C, as described in 36 CFR §60.4, the Corps may consider mitigation other than data recovery in the treatment plan (e.g., HABS/HAER recordation, oral history, historic markers, exhibits, interpretive brochures, or publications, etc.). Where appropriate, the Corps shall include a provision in the treatment plans stipulating the development of a publication for the general public, the content of such a document, and the minimum number of copies to be produced.

C. When data recovery is proposed, the Corps, in consultation with the SHPO, shall ensure the development of a data recovery plan that is consistent with the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation and the ACHP's "Recommended Approach for Consultation on Recovery of Significant Information from Archaeological Sites" (ACHP June 17, 1999). Components to be included in research designs and data recovery plans are found in Appendices 2 and 3 to this PA.

D. Each phase or segment specific treatment plan shall relate directly to the HPTP prepared for the project, providing specific direction for the conduct of data recovery within any project segment. Appendix 3 lists components to be included in data recovery plans.

E. The Corps shall invite the interested public, including Native American groups, to provide input on the identification, evaluation, and proposed treatment of historic properties. The Corps shall involve the interested public through letters of notification, public meetings, and/or site visits, as the Corps deems appropriate.

Stipulation VIII
Review of Treatment Plan

The Corps shall ensure that draft HPTPs are submitted concurrently to the SHPO, the ACHP, and appropriate Native American groups and individuals for review and comment. The Corps shall allow reviewers 30 calendar days after receipt of the draft HPTP to provide comments. The Corps shall take into account any comments received during this time and incorporate them into the final HPTP as appropriate. In the event that disputes are not easily remedied, the Corps shall resolve them in accordance with Stipulation XIII. Failure to comment within this time shall not preclude the Corps from finalizing

and implementing the HPTP. The Corps shall expeditiously provide all reviewers with copies of the final HPTP.

A. If the Corps revises the HPTP, it shall allow any party, including the SHPO, 15 calendar days to review the revised HPTP. Failure of the SHPO to comment within the specified time shall not preclude the Corps from finalizing and implementing the revised HPTP in accordance with the terms of this stipulation.

B. Once the reviewing parties determine that the HPTP is adequate, the Corps shall issue permission to proceed with the implementation of the plans.

C. The Corps shall provide final drafts of the HPTP to SHPO and the ACHP.

Stipulation IX
Modifications of Project Scope

A. Identification and Evaluation

1. If modification of the project scope becomes necessary or if activities are proposed in ancillary areas, such as borrow or disposal areas, that have not been previously surveyed for historic properties, the Corps shall ensure that the APE, defined as described under Stipulation II (B), of the modified project or un-surveyed ancillary area is inventoried. Any properties located within those modified APEs that may be affected by the undertaking shall be evaluated.

2. The Corps shall identify and evaluate such properties in the manner specified in Stipulations II through V.

3. If the Corps discovers any historic properties eligible for listing on the NRHP in the modified APE, the Corps shall develop and implement a supplemental HPTP in the manner specified in Stipulations VII and VIII.

B. The Corps may approve construction in any area subject to the provisions of this stipulation after the Corps and the SHPO have consulted and agreed, in writing, that such construction will not affect historic properties, or that the area does not contain historic properties.

Stipulation X
Notices To Proceed With Construction

A The Corps may issue Notices to Proceed (NTP) for individual construction segments, defined by the Corps in its construction specifications, under any of the following conditions:

1. the Corps and SHPO have determined that there are no historic properties within the APE for a particular construction segment; or

2. the Corps and SHPO have determined that there will be no adverse effects caused to historic properties within the APE for a particular construction segment; or

3. the Corps after consultation with the SHPO and interested persons has implemented an adequate treatment plan for the construction segment; and

(a) the fieldwork phase of the treatment option has been completed, and

(b) the Corps has accepted and approved a summary of the fieldwork performed and a reporting schedule for that work.

Stipulation XI
Unanticipated Discovery of Historic Properties

If properties potentially eligible for the NRHP are discovered during construction, the Corps shall cease ground disturbing activities until it has satisfied the provisions of 36 CFR §800.13(b), "discoveries without prior planning". The Corps shall contact the SHPO within 48 hours of the discovery. The SHPO has 48 hours to respond following initial contact by the Corps. The Corps shall provide the SHPO and the ACHP an opportunity to review and comment on proposed treatment in accordance with Stipulation VIII.

Stipulation XII
Curation

The Corps shall ensure that all cultural materials and associated records resulting from identification, evaluation, and treatment efforts conducted under this PA are curated in accordance with 36 CFR Part 79, except as specified in Stipulation V. Archaeological items and materials from privately owned lands may be returned to the land owners if so requested. Prior to their return, these items and materials should be maintained in accordance with 36 CFR Part 79 until all specified analyses are complete.

Stipulation XIII
Dispute Resolution

A. Should any signatory to this PA object within 15 calendar days to plans provided for review pursuant to this PA or to actions proposed or carried out pursuant to this PA, with the exception ofdeterminations of NRHP eligibility (see Stipulation III [J]), the Corps shall notify the SHPO and consult to resolve the objection. If the Corps determines that the objection cannot be resolved, the Corps shall forward all documentation relevant to the dispute to the ACHP. Within 45 days after receipt of all pertinent documentation, the ACHP shall either:

1. Provide the Corps with recommendations that the Corps shall take into account in reaching the final decision regarding the dispute; or

2. Notify the Corps that it will comment pursuant to 36 CFR §800.7, and proceed to comment. Any ACHP comment provided in response to such a request shall be taken into account by the Corps in accordance with 36 CFR §800.7 with reference to the subject of the dispute.

B. Any recommendation or comment provided by the ACHP will pertain only to the subject of the dispute. The Corps's responsibility to carry out all actions required by this PA that are not subject of the dispute shall remain unchanged.

Stipulation XIV
Amendments, Noncompliance, and Termination

A. If any signatory believes that the terms of this PA cannot be carried out or are not being met, or that an amendment to its terms should be made, that signatory shall immediately consult with the other signatories to consider and develop amendments to this PA pursuant to 36 CFR §800.6(c)(7).

B If this PA is not amended as provided for in this stipulation, the Corps, or the SHPO may terminate it. The party terminating the PA shall provide all other signatories with an explanation in writing of the reasons for termination, in accordance with 36CFR §800.6(c)(8).

C. If this PA is terminated and the Corps determines that the undertaking authorizing the project will proceed, the Corps shall comply with 36 CFR §800.3-800.6.

Stipulation XV
Duration of the PA

A. Five (5) years after the execution of the PA, the signatories shall meet to discuss project progress and the efficacy of the PA. Signatories will have the option to implement modifications or revisions to the PA at this point.

B. If the project has not been implemented within ten (10) years of the date of execution of the PA and the PA has not been terminated, the signatories shall consult on a date not less than 90 days prior to the tenth anniversary of the execution of this PA to reconsider its terms. Reconsideration may include continuation of the PA as originally executed, amendment, or termination. If the PA is terminated because the undertaking no longer meets the definition of an "undertaking" set forth in 36 CFR §800.16(y), Stipulation XIV (C) shall apply.

C. This PA shall be in effect through the Corps's implementation of the undertaking, and shall terminate and have no further force or effect when the Corps, in consultation with the SHPO, determines that the terms of this PA have been fulfilled in a satisfactory manner and/or Corps involvement in the project has ended. The Corps shall provide the other signatories with written notice of its determination and of termination of this PA.

Stipulation XVI
Effective Date

This PA shall take effect on the date that it has been fully executed by the Corps and the SHPO.

EXECUTION of this PA by the Corps and the SHPO; and its transmittal to the ACHP, and subsequent implementation of its terms, evince that the Corps has afforded the ACHP an opportunity to comment on the undertaking and its effects on historic properties; that the Corps shall take into account the effects of the undertaking on historic properties; and that the Corps has satisfied its responsibilities under Section 106 of the National Historic Preservation Act and applicable implementing regulations for all aspects of the undertaking.

SIGNATORIES:

U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT

BY: _____ DATE: 24 SEPT 2012

William J. Leady, P.E., Colonel, U.S. Army Corps of Engineers, District Commander

CALIFORNIA STATE HISTORIC PRESERVATION OFFICE

BY: _____ DATE: 9/28/12

for Milford Wayne Donaldson, FAIA, State Historic Preservation Officer

CONCURRING PARTIES:

STANISLAUS COUNTY

BY: _____ DATE: _____

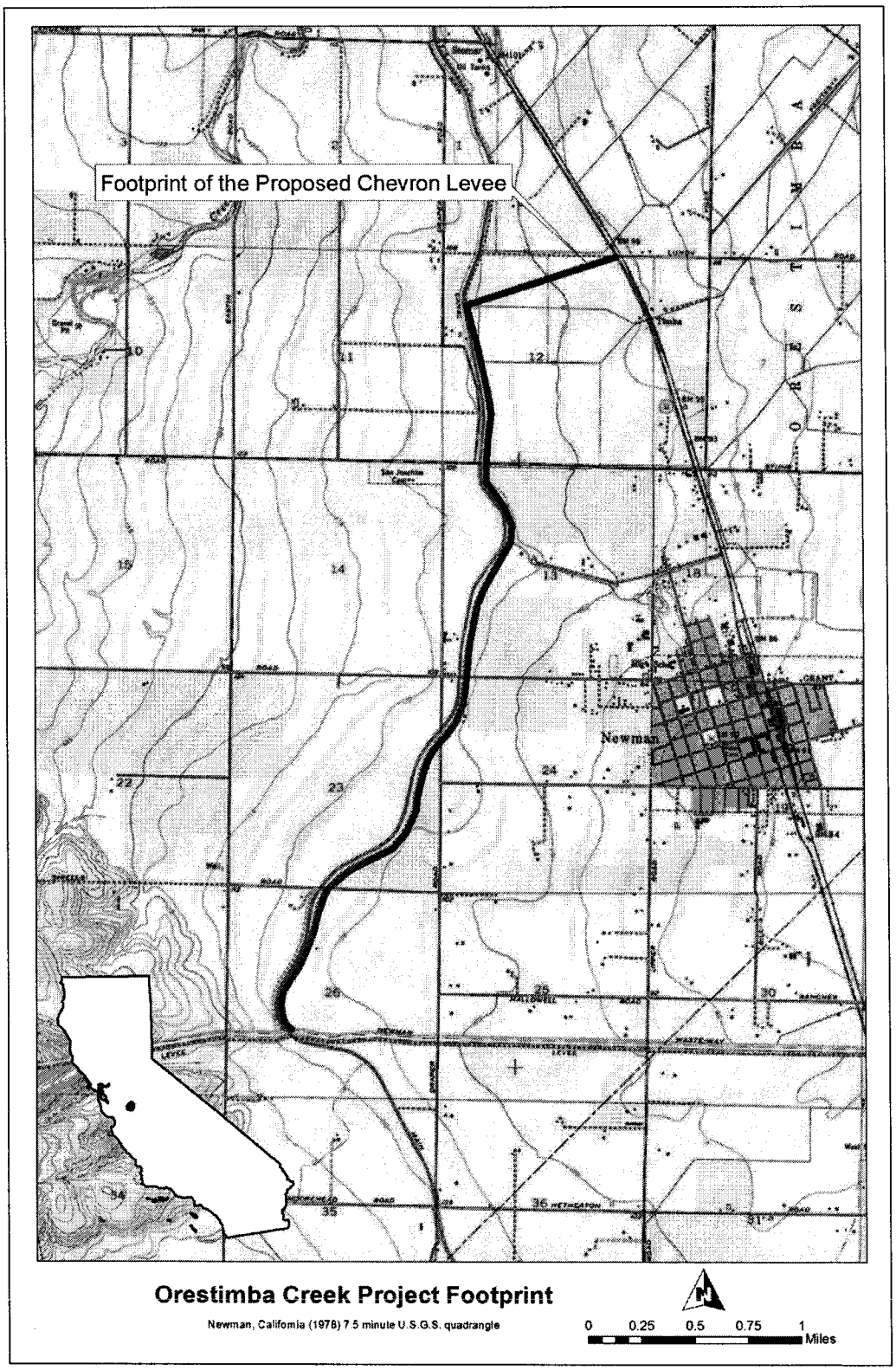
TITLE:

STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES

BY: _____ DATE: _____

TITLE:

Appendix 1
Study Area Map



Appendix 2
Standards and Guidelines for Research Designs

Research designs prepared for this undertaking shall specify, at a minimum:

- The property, or properties, or portions of properties where data recovery is to be carried out;
- Any property, or properties or portions of properties that will be destroyed with data recovery;
- The research questions to be addressed through the data recovery, with an explanation of their relevance and importance;
- The field methods to be used, with an explanation of their relevance to the research questions;
- The methods to be used in analysis, data management, and dissemination of data, including a schedule;
- The proposed disposition of recovered materials and records;
- Proposed methods by which the parties to the Programmatic Agreement will be kept informed of the work and afforded the opportunity to participate; and
- A proposed schedule for the submission of progress reports to the California State Historic Preservation Officer.

Appendix 3
Historic Property Treatment Plans (HPTP) shall address:

- The historic properties or portions of historic properties where treatment will be implemented;
- Any historic properties or portions of historic properties that will be destroyed or altered without treatment;
- If the property or properties are eligible under criteria (a), (b), or (c), a mitigation plan other than data recovery may be considered. These may include, but are not limited to HABS/HAER recordation, oral history, historic markers, exhibits, interpretive brochures or publications.
- If the property or properties are eligible under criterion (d), a research design including the research questions and goals that the data recovery on a property could inform, an explanation of the theoretical and substantive relevance and importance of the proposed research, and specifically how the proposed actions will inform those questions and goals;
- The field and analysis methods to be used, with an explanation of their relevance to the goals of the mitigation;

- The methods to be used in data management and dissemination of data, including a schedule;

- The proposed disposition of recovered materials and records;

- Proposed methods for disseminating results of work to cultural resources professionals and separately to the interested public;

- Proposed methods by which appropriate Native American groups and individuals, local governments, and other interested persons will be kept informed about implementation of the HPTP and afforded an opportunity to comment;

- A proposed schedule for submission of progress reports to the Corps, SHPO, and the Council;

- Methods and procedures for the recovery, analysis, treatment, and disposition of human remains, associated grave goods, and objects of cultural patrimony that reflect any concerns and/or conditions identified as a result of consultations between the Corps and any affected Native American Group (see Stipulation V);

- Qualifications of consultants employed to undertake the implementation of the STP, meeting at minimum those standards described in Stipulation I.

Avoidance of adverse effects on historic properties is the preferred treatment approach. The HPTP will discuss and justify the chosen approaches to the treatment of project historic properties and those treatment options considered, but rejected. If preservation of part or all of any historic properties is proposed, the treatment plan will include discussion of the following:

1. Description of the area or portions of the historic properties to be preserved in-place, and an explanation of why those areas or portions of sites were chosen;
2. Explanation of how the historic properties will be preserved in-place, including both legal and physical mechanism for such preservation;
3. A plan for monitoring and assessing the effectiveness of mechanisms to preserve the historic properties; and
4. A plan for minimizing or mitigating future adverse effects on the historic properties, if preservation in-place mechanisms prove to be ineffective.

Selected Elements by Scientific Name

California Department of Fish and Game

California Natural Diversity Database

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFG SSC or FP
Agelaius tricolor	ABPBXB0020	None	None	G2G3	S2	SSC
tricolored blackbird						
Buteo swainsoni	ABNKC19070	None	Threatened	G5	S2	
Swainson's hawk						
Eremophila alpestris actia	ABPAT02011	None	None	G5T3Q	S3	WL
California horned lark						
Perognathus inornatus inornatus	AMAFD01061	None	None	G4T2T3	S2S3	
San Joaquin pocket mouse						
Rana draytonii	AAABH01022	Threatened	None	G4T2T3	S2S3	SSC
California red-legged frog						
Sycamore Alluvial Woodland	CTT62100CA	None	None	G1	S1.1	
Sycamore Alluvial Woodland						

Record Count: 6

U.S. Fish & Wildlife Service

Sacramento Fish & Wildlife Office

Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the Counties and/or U.S.G.S. 7 1/2 Minute Quads you requested

Document Number: 121105031429

Database Last Updated: September 18, 2011

Quad Lists

Listed Species

Invertebrates

Branchinecta lynchi
- vernal pool fairy shrimp (T)

Desmocerus californicus dimorphus
- valley elderberry longhorn beetle (T)

Lepidurus packardi
- vernal pool tadpole shrimp (E)

Fish

Acipenser medirostris
- green sturgeon (T) (NMFS)

Hypomesus transpacificus
- delta smelt (T)

Oncorhynchus mykiss
- Central Valley steelhead (T) (NMFS)

Oncorhynchus tshawytscha
- Central Valley spring-run chinook salmon (T) (NMFS)
- winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

Ambystoma californiense
- California tiger salamander, central population (T)

Rana draytonii
- California red-legged frog (T)

Reptiles

Gambelia (=Crotaphytus) sila
- blunt-nosed leopard lizard (E)

Thamnophis gigas
- giant garter snake (T)

Mammals

Dipodomys nitratoides exilis
- Fresno kangaroo rat (E)

Vulpes macrotis mutica
- San Joaquin kit fox (E)

Quads Containing Listed, Proposed or Candidate Species:

NEWMAN (424D)

County Lists

No county species lists requested.

Key:

(E) *Endangered* - Listed as being in danger of extinction.

(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.

(P) *Proposed* - Officially proposed in the Federal Register for listing as endangered or threatened.

(NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.

Critical Habitat - Area essential to the conservation of a species.

(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.

(C) *Candidate* - Candidate to become a proposed species.

(V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.

(X) *Critical Habitat* designated for this species

Important Information About Your Species List

How We Make Species Lists

We store information about endangered and threatened species lists by U.S. Geological Survey 7½ minute quads. The United States is divided into these quads, which are about the size of San Francisco.

The animals on your species list are ones that occur within, **or may be affected by** projects within, the quads covered by the list.

- Fish and other aquatic species appear on your list if they are in the same watershed as your quad or if water use in your quad might affect them.
- Amphibians will be on the list for a quad or county if pesticides applied in that area may be carried to their habitat by air currents.
- Birds are shown regardless of whether they are resident or migratory. Relevant birds on the county list should be considered regardless of whether they appear on a quad list.

Plants

Any plants on your list are ones that have actually been observed in the area covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the surrounding quads through the California Native Plant Society's online Inventory of Rare and Endangered Plants.

Surveying

Some of the species on your list may not be affected by your project. A trained biologist and/or botanist, familiar with the habitat requirements of the species on your list, should determine whether they or habitats suitable for them may be affected by your project. We recommend that your surveys include any proposed and candidate species on your list. See our Protocol and Recovery Permits pages.

For plant surveys, we recommend using the Guidelines for Conducting and Reporting Botanical Inventories. The results of your surveys should be published in any environmental documents prepared for your project.

Your Responsibilities Under the Endangered Species Act

All animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal.

> Take may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR §17.3).

Take incidental to an otherwise lawful activity may be authorized by one of two

procedures:

- If a Federal agency is involved with the permitting, funding, or carrying out of a project that may result in take, then that agency must engage in a formal consultation with the Service.

  During formal consultation, the Federal agency, the applicant and the Service work together to avoid or minimize the impact on listed species and their habitat. Such consultation would result in a biological opinion by the Service addressing the anticipated effect of the project on listed and proposed species. The opinion may authorize a limited level of incidental take.

- If no Federal agency is involved with the project, and federally listed species may be taken as part of the project, then you, the applicant, should apply for an incidental take permit. The Service may issue such a permit if you submit a satisfactory conservation plan for the species that would be affected by your project.

  Should your survey determine that federally listed or proposed species occur in the area and are likely to be affected by the project, we recommend that you work with this office and the California Department of Fish and Game to develop a plan that minimizes the project's direct and indirect impacts to listed species and compensates for project-related loss of habitat. You should include the plan in any environmental documents you file.

Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

Although critical habitat may be designated on private or State lands, activities on these lands are not restricted unless there is Federal involvement in the activities or direct harm to listed wildlife.

If any species has proposed or designated critical habitat within a quad, there will be a separate line for this on the species list. Boundary descriptions of the critical habitat may be found in the Federal Register. The information is also reprinted in the Code of Federal Regulations (50 CFR 17.95). See our Map Room page.

Candidate Species

We recommend that you address impacts to candidate species. We put plants and animals on our candidate list when we have enough scientific information to eventually propose them for listing as threatened or endangered. By considering these species early in your planning process you may be able to avoid the problems that could develop if one of these candidates was listed before the end of your project.

Species of Concern

The Sacramento Fish & Wildlife Office no longer maintains a list of species of concern. However, various other agencies and organizations maintain lists of at-risk species. These lists provide essential information for land management planning and conservation efforts. More info

Wetlands

If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6520.

Updates

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be

February 03, 2013.

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA 95814-2922

REPLY TO ATTENTION OF

Environmental Resources Branch

FINDING OF NO SIGNIFICANT IMPACT
Orestimba Creek Project
Stanislaus County, California

The U.S. Army Corps of Engineers, Sacramento District, has determined that implementing the proposed flood risk project in the vicinity of Orestimba Creek would have no significant effects on the quality of the human environment. The study area is located on the west side of the San Joaquin River in Stanislaus County, California.

The project involves construction of a chevron levee along the City of Newman's northwestern perimeter. The chevron levee maximizes benefits to the urban area by reducing flood dangers associated with Orestimba Creek overflows. The north side of the chevron levee would be constructed along one mile of an unnamed farm road near Lundy Road, about one mile north of town. The approximately four-mile western segment would be constructed along the eastern bank of the existing CCID Main Canal from the unnamed farm road south to the Newman Wasteway.

A draft Feasibility Report and Environmental Assessment-Initial Study (EA.IS) was prepared to evaluate the potential effects to natural and cultural resources in the proposed project area. Based on the evaluation of potential effects and mitigation measures described in the EA/IS, I have determined that the implementation of either the NED Plan or the Locally Preferred would have no significant adverse effects on existing resources. No additional environmental documentation is required, and the project activities may proceed as proposed.

_____ _____

Date

William J. Leady, P.E.
Colonel, U.S. Army
District Engineer

CHANNEL MODIFICATION – EFFECTS ASSESSMENT

1 INTRODUCTION

During the analysis for the Orestimba Creek Flood Risk Reduction Project, the channel modifications segment of the project was determined to be in exceedance of the cost/benefit ratio requirements. While this portion of the project does not qualify under Federal funding, the option may be taken for the local sponsor (City of Newman) to construct the modifications as previously designed and analyzed under the Locally Preferred Plan.

2 AFFECTED ENVIRONMENT

2.1 Geomorphology

A qualitative geomorphic and channel stability assessment of Orestimba Creek was conducted in 2007 based on an examination of existing conditions observed at road crossings. Orestimba Creek can be divided into three distinct reaches based on channel morphology: upper, middle, and lower (Figure 2-1). The upper reach extends from the foothills of the Diablo Range to the low water crossing at Bell Road. The middle reach extends from the low water crossing to a sharp bend in the channel just east of Morris Road, and the lower reach extends from the Morris Road bend to the San Joaquin River.

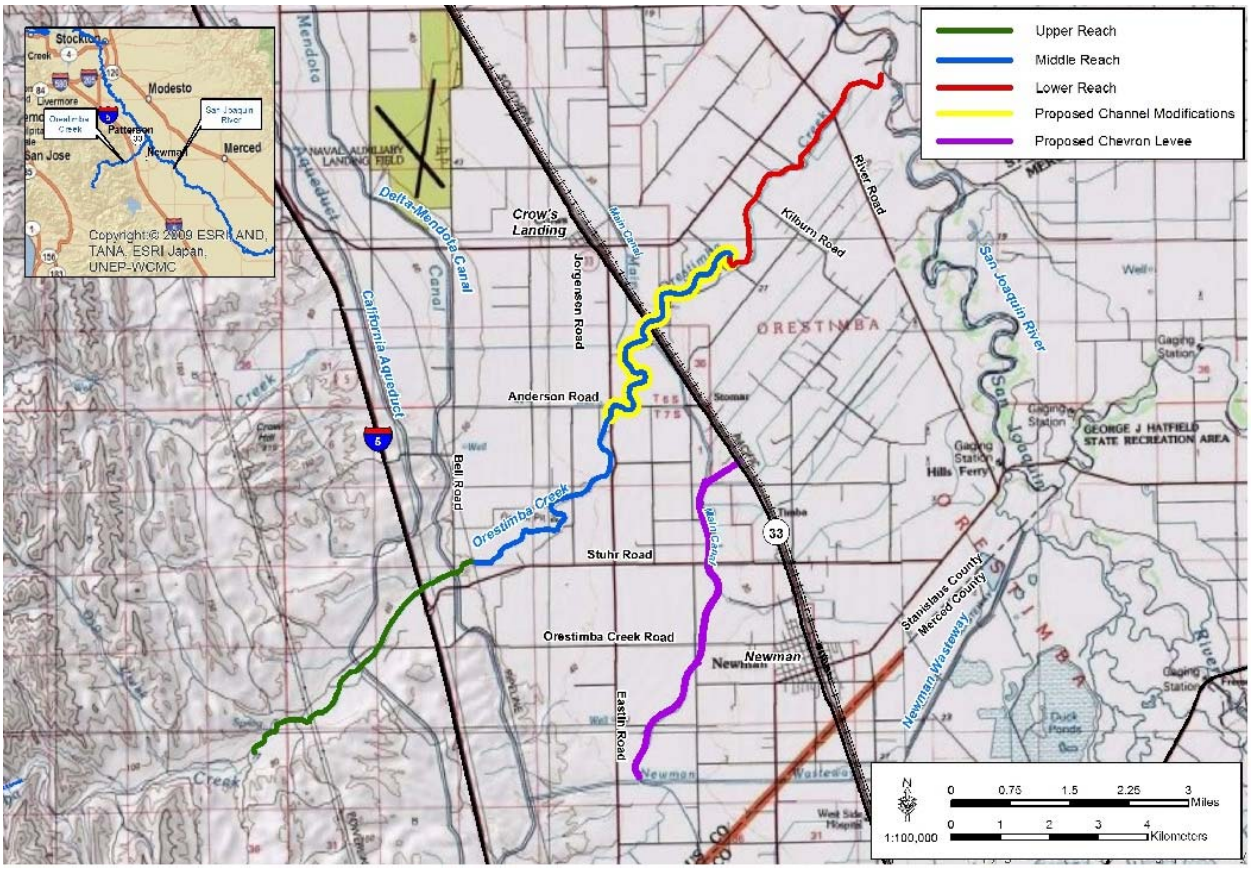


Figure 2-1: Geomorphic Reaches of Orestimba Creek below the Diablo Range

Upper Reach

The upper reach is characterized by a relatively natural, wide, shallow cobble-bed channel. In the upper reach, the channel is generally greater than 25 feet wide and less than 2 feet deep. The channel in this reach is heavily scoured. A low flow channel meanders among gravel beds deposited during high flows. Abandoned oxbow channels and pools scoured into the bedrock are evident in the upstream portions of this reach.

Middle Reach

The upstream limit of the middle reach is defined by a large grade control structure, which protects the Delta-Mendota Canal siphon from down-cutting of the channel. The structure consists of a driven sheet pile wall with a grouted riprap surface, banks, and invert. The channel elevation drops 10 to 12 feet at the structure. The channel in this reach can generally be characterized as wide, shallow, and sinuous with a low-flow channel and inset floodplain. In the middle reach, the main channel is generally less than 15 feet wide and up to

5 feet deep. The main channel begins to meander in this reach; however, the channel cross-section is a relatively uniform "U" shape.

The channel and banks of the middle reach upstream of Eastin Road have been extensively modified, primarily by sand and gravel mining. Between Eastin Road and Jorgenson Road, historic mining has lowered the floodplain on both sides of the channel by as much as 6 to 8 feet. The mined areas are hummocky in places and contain very little riparian vegetation. The west bank just upstream of the Eastin Road crossing contains a low levee for a short distance. Upstream of Jorgensen Road and below the grade control structure, an active gravel mining operation has altered the natural morphology of the channel in a similar way, but to a greater extent.

There are two 90-degree bends in the middle reach just downstream of the historic sand and gravel mining: one at the intersection of Eastin and Anderson roads and one just upstream of the Anderson Road Bridge. Although the bridge does not constrict the channel, the sharp turns made by the channel here likely create significant backwater, which in turn probably contributes to overbank flooding along the low banks in this area. Upstream of the Anderson Road Bridge to the low water crossing at Eastin Road, the channel is wide, but does not appear to have as much capacity as the reach below Anderson Road. Northward flooding over the road west of the Anderson Road Bridge has been documented in the past. The banks just downstream of the Eastin Road low water crossing are much higher than at Anderson Road and are protected with concrete rubble mixed with fill dirt.

The channel bank in the middle reach from Anderson Road to about 3,000 feet downstream of Highway 33 and between the Morris Road crossing and the Morris Road bend have been cleared and mechanically regraded and appear to be bounded by a low levee. Dense, low vegetation occupies the channel bottom, and there is a low-flow channel inset into the main channel that conveys irrigation return flows. Although some backwater conditions may occur above the restrictive CNRR trestle just north of Highway 33, the channel in this segment appears to have sufficient capacity to convey most flows.

The portion of the middle reach from 3,000 feet downstream of Highway 33 to the Morris Road bend can be characterized as a relict meander belt. This meander belt is defined by 4- to 5-foot-high terrace scarps to the north and south, and by an inset lower floodplain between the terrace scarps and the channel. The scarps and relict meander belt/inset floodplain may be the remnants of a relict hydrographic apex of the creek's prehistoric alluvial fan. The scarps rapidly diminish in height downstream. This is typical of the area surrounding a hydrographic apex on an active alluvial fan. However, at some point in the distant past, the fan became inactive with the channel subsequently developing a meandering flow path and entrenched itself into the surrounding floodplain. The meandering planform may have developed in response to the flatter landscape slope at and upstream of Morris Road.

The presence of the inset floodplain, which is likely able to contain significant flood storage, and the highly sinuous channel upstream of the Morris Road Bend have probably contributed to the lack of entrenchment of the channel in the middle reach, similar to that seen

in the lower reach. Backwater and floodplain storage during floodflows upstream of the bend apex have not allowed significant degradation of the channel to progress very far upstream of the bend. However, long-term low flows associated with irrigation drainage are contributing to the development of an inset low-flow channel upstream of the bend apex.

Lower Reach

In the lower reach, the stream channel is relatively straight and deeply entrenched with steep, densely vegetated sideslopes. A low-flow channel bordered by a low, shallow wetland bench is present along downstream portions of this reach. Large mature trees and other riparian vegetation grow densely on the bank slopes down to the toe of the slope. The wide range in age of this vegetation including mature trees, the density of the vegetation on the entire bank face, and the lack of leaning or fallen trees in the channel indicates that the channel bed and banks are relatively stable vertically and laterally. Small islands with grass and small shrubs are evident in the channel bottom indicating that the channel bed is also relatively stable. Minor bank failures due to gravity slides and slumping are evident, but infrequent.

An examination of the topographic contours surrounding the lower reach shows Orestimba Creek perched well above the surrounding land, as indicated by contours extending downstream along the channel margins. The spacing of the contours would suggest that the ground several hundred feet lateral to the channel margins is as much as 5 feet lower than the top bank of the channel. There are remnants of a 4- to 5-foot-high man-made levee extending from the Morris Road bend downstream for about 2,000 feet on the northwest bank and about 3,600 feet on the southeast bank. The levees likely contained floodflows in the upper portion of the lower reach as flows from the upstream inset floodplain converged at the bend apex. Historically, these floodflows likely overwhelmed the unentrenched downstream channel; thus, the need for levees along the downstream channel. The levees probably prevented or controlled most overbank flooding, especially to the southeast, prior to historic entrenchment of the downstream channel along this reach.

Sediment Transport and Channel Stability

As part of this feasibility study, reconnaissance-level sediment engineering and channel stability analyses were conducted to estimate average annual sediment yields along Orestimba Creek within the study area (Tetra Tech, Inc., 2000). Sediment yield analysis considered total sediment load, including wash and bed material load. Samples of bed and bank materials along Orestimba Creek were obtained at several locations. Wide variations in material sizes are evident along the channel. Fine sediments such as silt and clay are predominant in bed material samples taken downstream of the Delta-Mendota Canal, and in both bed and banks near Jorgensen Road. These fines may represent the vertical limit of mining within this reach or exposure of an erosion-resistant layer due to headcutting upstream of the gravel mining operation. Elsewhere, soils are less fine.

Channel stability was also evaluated for existing conditions (Tetra Tech, Inc., 2000). Historical channel change was documented, trends were assessed, and areas along the channel were identified where problems might be anticipated under future without project conditions.

From this analysis, it was noted that significant lowering of the channel's bed in the middle reach of the channel within the gravel mining operation between the Delta-Mendota Canal and Jorgensen Road occurred during the period from 1952 to 1999. Downstream of this location, less severe channel downcutting has occurred. It is unclear whether this downstream downcutting has occurred in response to upstream removal of sediment load, to differences in channel maintenance activities, or to differences in accuracy of topographic mapping.

Some shifting in the channel location also became evident during the historical channel change analysis. Shifting is particularly evident near the Morris Road crossing and the historic meander belt. It is unclear as to whether this is due to natural or human-induced activities. There appear to be no strong, consistent trends in regard to channel stability. Hydraulic modeling of bed shear stresses indicate that, even under relatively frequent flood conditions, channel boundary materials are not sufficiently large enough to prevent future changes along the channel. As the existing condition is expected to prevail in the future, continued downcutting along the channel might be expected. Overflow from the channel above Highway 33 and the railroad has acted to increase historical stability of the channel in the lower reach by sheltering it from the effects of extreme flood conditions, and it is anticipated that this condition would continue. Modification of the channel in the middle reach may accelerate instability of the channel gradient and planform in the lower reach (Tetra Tech, Inc., 2000).

For the purposes of evaluating average annual sediment yield, two methodologies were used. The first of these methods, the Flaxman method, estimated an annual yield of 933 tons per square mile. This equates to an annual yield of 125,000 tons at the California Aqueduct. It was estimated that about half of this is composed of fine sediment, and the remainder is sand or larger sediment. Estimation of sediment yield was also performed using Tetra Tech, Inc's bed material transport capacity procedure. Sediment yield was estimated for two locations, one upstream near the California Aqueduct, and a second downstream near River Road. This allows for evaluation of the effects that a potential project might have on sediment inflow and outflow. Computed results agreed to a reasonable extent with measured data at the River Road location. Computed transport at the steeper upstream location is much higher than at the downstream location (Tetra Tech, Inc., 2000).

Results indicate an average bed material yield of 51,000 tons per year at the upstream location, but only 4,400 tons at the downstream location. The differences in transport capacities are due to the decrease in slope and increase in width moving downstream. It appears that in-channel mining activities (withdrawal of sediment from system) have minimized any buildup of sediment that would have occurred downstream of the mining. Based on measurement of suspended load, it was estimated that approximately 84,000 tons of wash load are delivered at the California Aqueduct concentration point in a given year. Adding this suspended load to the 51,000 tons of bed load results in a total of approximately 135,000 tons of sediment per year. At River Road, the total yield is approximately 88,400 tons per year. The difference in yields is due to sediment lost to mining and deposition on the fan surface during flood events. Estimates of total yield using the Flaxman equation result in a figure of approximately 125,000 tons per year (Tetra Tech, Inc., 2000).

2.2 Hydrology

The hydrologic reaches of Orestimba Creek correspond to the geomorphic reaches identified above (Figure 2-1).

Upper Reach

In the upper reach, the channel falls approximately 80 feet in elevation along a distance of approximately 3 miles, and the channel slope is approximately 0.5 percent. The upstream limit of the reach is defined by the extent of flooding that would have resulted from construction of a dry dam in this reach. Although this alternative is no longer being considered, the limits of the assessed portion of the creek remain the same. Flows are typically a result of runoff collected by headwaters during winter storms and are generally of large volume and short duration. This reach is dry during most of the summer, except for isolated pools scoured into bedrock. The vegetation in the riparian zone remains relatively undisturbed.

Middle Reach

The elevation of the channel drops as much as 15 feet as it passes over the Bell Road low water crossing. Over the approximately 7-mile length of the middle reach, the channel elevation falls approximately 75 feet, and the channel slope is approximately 0.2 percent. Flows occur as a result of runoff delivered from upstream areas during winter, runoff collected from the surrounding lands during summer, irrigation return flows, and possibly groundwater discharge. The rate of flow in the middle reach is slower than that of the upper reach for three reasons: the slope of the channel is substantially more gradual, the channel bends tend to slow the flows, and the Highway 33 Bridge and railroad trestle tend to constrict flows. Due to this slower rate of flow, much of the finer sediment is deposited within the channel, creating substrate for vegetative growth. A low-flow channel meanders through freshwater marshes occurring over a large portion of the reach. The riparian vegetation throughout this reach is generally highly disturbed or non-existent and is constricted to a narrow band outside the channel banks.

Lower Reach

Heavy flows, resulting from winter and summer rains, are somewhat regulated by the constriction in the channel at these bridges and rarely overtop the channel banks. A connection with the CCID Main Canal occurs just upstream of the Highway 33 bridge and railroad trestle in the middle reach. Irrigation returns from the canal, agricultural drains, and possibly groundwater discharge result in a generally continuous and regular flow of water throughout the summer in the lower reach and downstream portions of the middle reach. This condition has resulted in a deep, incised channel that is up to 25 feet wide and 20 feet deep and free of shallow areas or sediment deposits. Over the approximately 3.6-mile length of this reach, the channel elevation falls approximately 35 feet, and the channel slope is slightly less than the 0.2 percent slope of the middle reach. The riparian vegetation in this reach is generally restricted to the steep banks within the channel and helps to stabilize soils and maintain the channel morphology.

The Orestimba Creek channel has a very limited flow conveyance capacity. Because of this limited conveyance, flows have historically broken out of the channel upstream of Highway 33 and have not returned to the channel downstream. Accordingly, undersized portions of the channel downstream have not witnessed overflow at the frequency expected given their low capacity. Sand and gravel extraction activities have increased the capacity of the channel between the Delta-Mendota Canal and Jorgensen Road. Reduction of channel gradient in this area, with an attendant drop in water velocity, has decreased carrying capacity and increased sediment deposition within this reach. This deposition has decreased the sediment supply to downstream reaches of the channel, contributing to downcutting of the channel. Flow velocities are high enough to move considerable quantities of bed material. Perhaps because of the significant transport capacity and reduced sediment load downstream of Jorgensen Road, some change in the channel through the alluvial fan is evident in the period from 1952 to 1999.

The relative stability of the lower reach of the channel may be due to the breakout of large channel-forming flood events upstream of Highway 33, and the resulting minimization of this potential in the lower reach. Alternatives that involve increasing channel capacity would have to incorporate measures to ensure channel stability. Average annual sediment load to the upstream portion of the alluvial fan was estimated at 130,000 tons per year, of which approximately half is expected to be fine sand and larger. Detention options must consider that a significant portion of this load may drop out within the structure and should consider the implications of this for the downstream channel and for maintenance issues.

2.3 Waters of the U.S. and Wetlands

A delineation of wetlands and Waters of the U.S. identified four potential jurisdictional wetlands in the upper reach of the study area (USACE, 2002). These included three small seasonal wetlands in shallow depressions adjacent to a gravel road and one small freshwater marsh in an old borrow pit. During a 2008 general biological survey conducted from road crossings, intermittent freshwater marsh was observed within the channel of Orestimba Creek between Jorgenson and Anderson roads. Because these areas are located below the Ordinary High Water Mark, they are considered part of the creek and would be regulated as a Special Aquatic Site, and specifically as a vegetated shallow (40 C.F.R. § 230.3). The area meets the functional criteria of a jurisdictional wetland; however, because discharge affects wetlands and vegetated shallows differently, the jurisdictional status of the marsh is as a Special Aquatic Site. Orestimba Creek, as the tributary of a tidally influenced river, meets the definition of a jurisdictional Water of the U.S. (40 C.F.R. § 122.2).

Freshwater marsh communities, which meet the definition of a Special Aquatic Site, were also observed within the channel of Orestimba Creek (see Freshwater Marsh in Figures 2-2 and 2-11 in Section 2.4, Vegetation Communities).

2.4 Vegetation Communities

The study area east of the California Aqueduct was surveyed from bridges, low water crossings, and from roads adjacent to the creek, due to a lack of rights-of-entry.

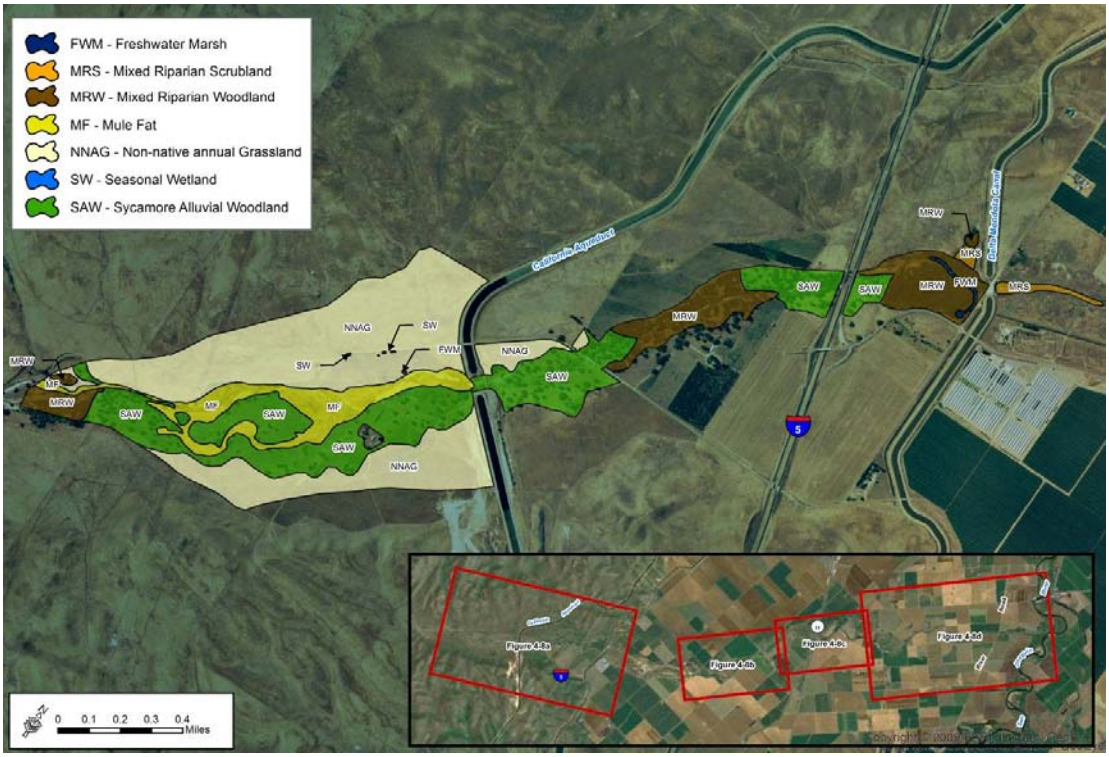


Figure 2-2: Vegetation Communities within the Riparian Zone of Orestimba Creek

Figure 2-3: Vegetation Communities within the Riparian Zone of Orestimba Creek

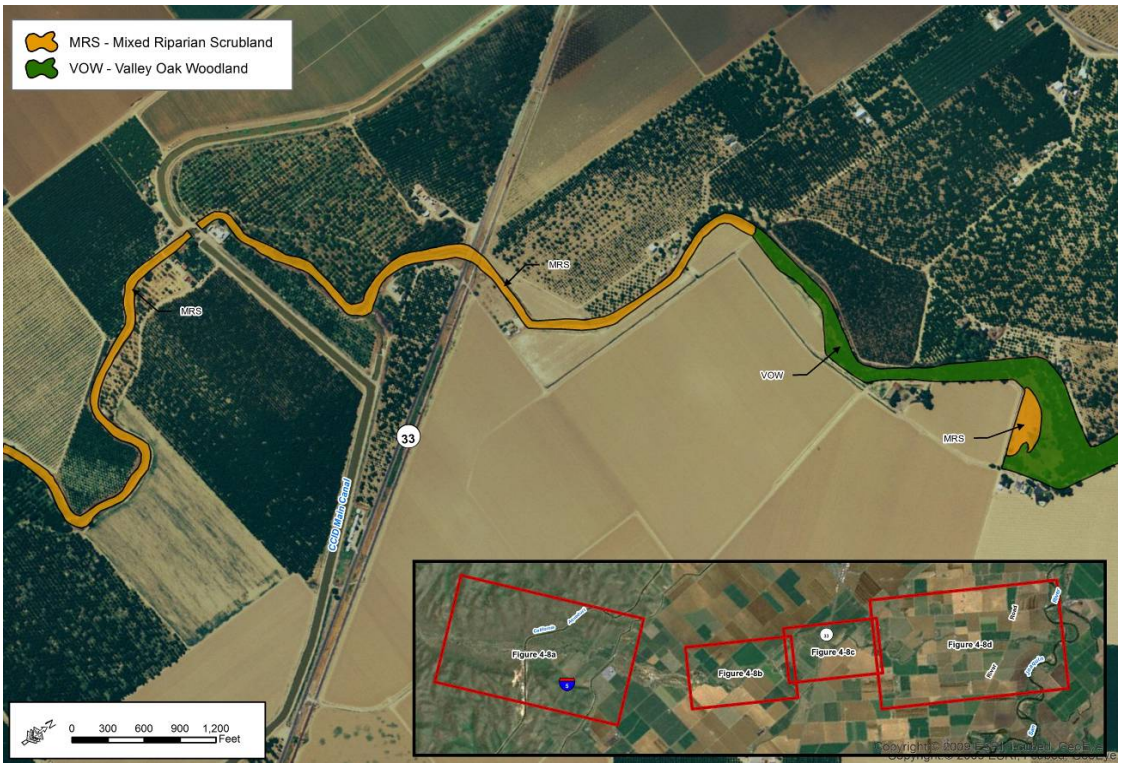


Figure 2-4: Vegetation Communities within the Riparian Zone of Orestimba Creek

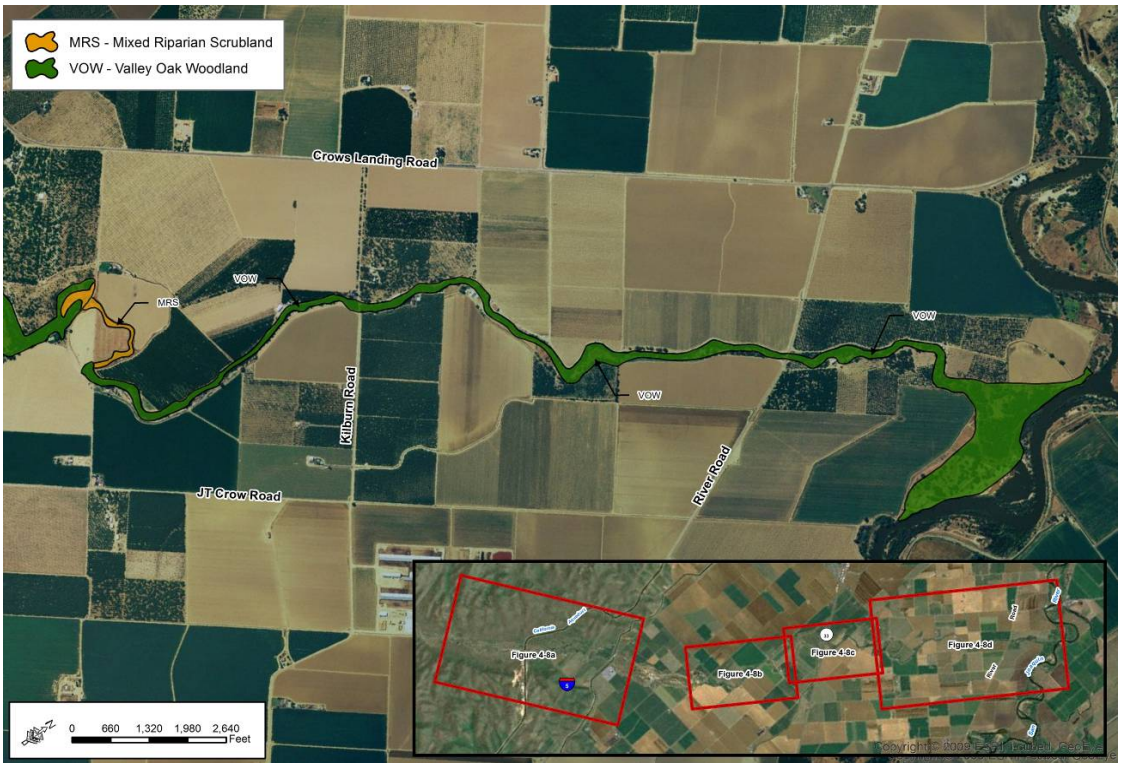


Figure 2-5: Vegetation Communities within the Riparian Zone of Orestimba Creek

Figure 2-6: Levee alignment through agricultural areas

The classification system used to classify the vegetation communities of the Orestimba Creek riparian area for this assessment is based on A Manual of California Vegetation (Sawyer and Keeler-Wolf, 1997) used by the California Native Plant Society (CNPS). A total of eight natural vegetation communities occur within the Orestimba Creek watershed between its confluence with the San Joaquin River and its headwaters area in the Diablo Range. The CNPS system vegetation series equivalents are provided in the summaries below.

Sycamore Alluvial Woodland

This vegetation community is equivalent to the Sycamore series of the CNPS system, is identified as Sycamore Alluvial Woodland by the CDFG, and is designated as a sensitive natural community. This community covers approximately 250 acres and occurs along Orestimba Creek immediately upstream and downstream of the California Aqueduct (Figure 2-7). The grove of California sycamore (*Platanus racemosa*) in this area is considered to be of both local and regional significance. It is cited as one of the largest remaining old growth Sycamore groves in the San Joaquin Valley and in the California. The California sycamore is the dominant species in this ecotype. The community is found most often on sandy loams or loams with good access to groundwater. California sycamore growth and survival requires the edges of streams and lakes where the water table drops enough during the summer to permit good soil aeration during the growing season. The understory was very open and mainly composed of annual grasses such as foxtail fescue (*Vulpia myuros*), soft chess (*Bromus hordeaceus*), and hare barley (*Hordeum munnum leporinium*).

While California sycamore trees are not considered rare, Sycamore Alluvial Woodland, which is characterized by California sycamores growing on sediment deposited by a flowing stream, is recognized as a rare natural community throughout the state. The Sycamore Alluvial Woodland in the study area consists almost entirely of mature California sycamore trees. Asexual reproduction of a California sycamore tree was observed near a roadway which was excluded from cattle grazing, and seedlings and saplings are rare or absent from grazed areas.

Sycamores require high soil moisture during the winter and spring and well-aerated soils through the summer. The suggested water regime for California sycamore is annual groundwater recharge in the winter and spring with gradual drawdown into the summer. Sycamores are intolerant of long-term exposure to water-logged, unaerated soils. The Sycamore Alluvial Woodland on Orestimba Creek has been degraded by grazing and soil compaction, particularly the downstream portion of the stand between the power transmission lines and the California Aqueduct.

There are fewer than six viable occurrences and less than 2,000 acres of Sycamore Alluvial Woodland in the state of California, and CNPS ranks the community as very threatened (Sawyer and Keeler-Wolf, 1997). Threats include reservoir construction and water diversion, cattle grazing, and agricultural development.

Figure 2-7: Sycamore Alluvial Woodland, Mulefat Shrubland, and Non-native Annual Grassland

Seasonal Wetlands

Three small seasonal wetlands were delineated as a result of an EDAW wetland survey conducted in 2001 (USACE, 2002). This community is not represented in the CNPS system. The dominant species observed were stalked popcornflower (*Plagiobothrys stipitatus*), cocklebur (*Xanthium strumarium*), and Mediterranean barley (*Hordeum marinum gussonianum*). Other species included annual bluegrass (*Poa annua*). These seasonal wetlands occur adjacent to a roadway on the northern edge of the study area above the California Aqueduct.

Mulefat Shrubland

This vegetation community is equivalent to the Mulefat series of the CNPS classification system. The dominant plant species was mulefat (*Baccharis salicifolia*), which formed nearly monotypic stands in a narrow strip along the channel banks (Figure 2-7). Tamarisk (*Tamarix* spp.), a non-native and invasive shrub, was observed in association with this community. This vegetation community was observed above the California Aqueduct and in a small patch below the low water crossing on Jorgenson Road.

Freshwater Marsh

This vegetation community most closely resembles the Cattail series of the CNPS classification system, is identified as Coastal and Valley Freshwater Marsh by the CDFG, and is designated a sensitive natural community. The freshwater marsh community occurs in permanently flooded to irregularly exposed areas of the channel. The dominant species observed were either cattails (*Typha* spp.) or knotweed (*Polygonum* spp.), which typically formed monotypic stands. Other species observed in association with this community included soft rush (*Juncus effuses*), chairmaker's bulrush (*Schoenoplectus americanus*), saltgrass (*Distichlis spicata*), hairy crabgrass (*Digitaria sanquinalis*), common spike rush (*Eleocharis machrostachya*), and other grasses, sedges, and herbs. Freshwater marsh was observed in the upper reaches of Orestimba Creek in isolated pools (Figure 2-8). Freshwater marsh was also observed between Jorgenson Road and the CCID Main Canal where bends in the channel, bridges, and other channel restrictions impede water flow and allow sediment to be deposited in the channel (Figure 2-9).

Figure 2-8: Freshwater Marsh Bordering Isolated Pools in Upper Reach

Figure 2-9: Freshwater Marsh in Sediment Laden Channel of Middle Reach

Mixed Riparian Shrubland

This vegetation community most closely resembles the Mixed Willow series of the CNPS classification system. Gooding's willow (*Salix gooddngii*), red willow (*S. laevigata*), arroyo willow (*S. lasiolepis*), and Fremont cottonwood (*Populus fremontii*) saplings were dominant to sparse in this community (Figure 2-10). Other shrubs included mulefat and tree tobacco (*Nicotiana glauca*). Herbaceous plants often formed a substantial component of the total vegetative cover and includes cocklebur, curly doc (*Rumex crispus*), common sunflower (*Helianthus annus*), yellow star-thistle (*Centaurea solstitialis*), ripgut grass, Canada lettuce (*Lactuca canadensis*), mustards (*Brassica* spp.), and other herbaceous species. This community occurs both upstream and downstream of the gravel mine, and in a nearly continuous patch from Eastin Road to approximately 1 mile downstream of Highway 33 where agricultural fields abut the stream channel.

Figure 2-10: Mixed Riparian Shrubland

Mixed Riparian Woodland

This vegetation community most closely resembles the Fremont Cottonwood series of the CNPS system, is identified as Great Valley Mixed Riparian Forest by the CDFG, and is designated as a sensitive natural community. Dominant tree species were mature Fremont cottonwood mixed with large arroyo, red, and Gooding's willows. Understory vegetation included watercress (*Nasturtium officinale*) and rabbitsfoot grass (*Polypogon monspeliensis*). Freshwater marsh was commonly associated with this community. This community occurs in two large patches between Orestimba Road and the Delta-Mendota Canal where the riparian zone is 400 to 800 feet wide, in a narrow strip below the gravel mine, and in a small patch just north of Anderson Road.

Valley Oak Woodland

This vegetation community is equivalent to the Valley Oak series of the CNPS system. Valley oak (*Quercus lobata*) was the dominant species and was typically represented by mature trees (Figure 2-11). The CDFG identifies this community as Great Valley Oak Riparian Forest and as a sensitive natural community. Other common trees included Fremont cottonwood, red willow, arroyo willow, box elder (*Acer negundo*), and northern California walnut (*Juglans hindsii*). Common shrubs and vines included Douglas' sagewort (*Artemesia douglasiana*), blue elderberry (*Sambucus nigra cerulea*), Himalayan blackberry (*Rubus armeniacus*), Pacific poison-oak (*Toxicodendron diversilobum*), and woodbine (*Parthenocissus vitacea*). Ground cover included wild oats, brome (*Bromus* spp.), barley (*Hordeum* spp.), ryegrass (*Lolium* spp.),

needlegrass (*Achnatherum* spp.), turkey tangle frogfruit (*Phyla nodiflora*), and many of the herbaceous species observed in mixed riparian communities. Giant reed (*Arundo donax*), a non-native and invasive plant, was also observed in isolated stands both along the channel and agricultural field margins in association with this community. Valley Oak Woodland is nearly continuous between Highway 33 and the San Joaquin River. The riparian corridor in this area is generally less than 25 feet wide on either side of the channel and is bordered by agricultural crops.

Valley Oak Woodland is recorded as occurring at between 6 and 20 viable locations and 2,000 to 10,000 acres throughout the state of California, and CNPS ranks the community as being very threatened (Sawyer and Keeler-Wolf, 1997). Although there are some areas on Orestimba Creek that are dominated by valley oaks, these areas are restricted to channel margins and have been substantially reduced in area by agricultural clearing, gravel mining, and other streambed alterations. The study area supports approximately 150 acres of Valley Oak Woodland.

Figure 2-11: Valley Oak Woodland

2.5 Wildlife and Fisheries

Although the Sycamore Alluvial Woodland in the study area is somewhat degraded, it provides important habitat for many wildlife species. Because most of the surrounding area is dominated by Non-native Annual Grassland, the Sycamore Alluvial Woodland provides cover, nesting, and foraging habitat that is rare in the region. Raptors, including Swainson's hawk (*Buteo swainsoni*), red-tailed hawk (*Buteo jamaicensis*), and great-horned owl (*Bubo virginianus*) were observed nesting in high densities. Migratory passerines, such as western kingbird (*Tyrannus verticalis*) and Bullock's oriole (*Icterus bullockii*), were also very abundant in this vegetation community. Other woodland birds such as woodpeckers, magpies, and owls are expected to use the Sycamore Alluvial Woodland year-round. Several species of medium-sized mammals were observed in this area, including Audubon's cottontail (*Sylvilagus audubonii*), raccoon (*Procyon lotor*), badger, bobcat (*Lynx rufus*), and coyote.

The multi-layered canopy of trees, shrubs, and herbaceous species found in Valley Oak Woodland community provides important habitat for a variety of wildlife. Because much of this community has been removed from the Central Valley, the habitat that remains provides an important source of food, water, and cover for many species. Red-shouldered hawk (*Buteo lineatus*), California quail (*Callipepla californica*), Nuttal's woodpecker (*Picoides nuttallii*), ash-throated flycatcher (*Myiarchus cinerascens*), tree swallow (*Tachycineta bicolor*), spotted towhee (*Pipilo maculatus*), and many other bird species are expected to nest in the Valley Oak Woodland on Orestimba Creek. In addition, this habitat provides a migratory and dispersal corridor for many species including coyotes, raccoons, and skunks.

Similar to the Valley Oak Woodland, the Mixed Riparian Woodland community provides forage and cover opportunities for a variety of wildlife. Areas containing pooled water, freshwater marsh, and other riparian vegetation provide important habitat for semi-aquatic species such as western pond turtles (*Actinemys marmorata*), Pacific treefrogs (*Hyla regilla*), and non-native bullfrogs (*Rana catesbeiana*). The presence of open water is also valuable to other wildlife such as bats, herons, egrets, and swallows. Mixed Riparian Shrubland provides habitat for species that prefer or tolerate more open habitats, including western kingbird, blue grosbeak (*Passerina caerulea*), and house finch (*Carpodacus mexicanus*).

Fisheries

The upper reach of Orestimba Creek is known to support several warm-water native and non-native fish species. Native fish species include Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento sucker (*Catostomus occidentalis occidentalis*), and California roach (*Hesperoleucus symmetricus*). Non-native fish species include green sunfish (*Lepomis cyanellus*) and mosquito fish (*Gambusia affinis*). In July 2001, EDAW biologists observed California roach, Sacramento sucker, mosquitofish, and green and other sunfish redds (fish nests) in the few isolated pools in the upper portion of the channel where water was still present. Sycamore root masses that protrude from the banks and large woody debris in these areas provide cover for fish; otherwise, the area generally lacks shade and cover for fish. Many of the isolated pools were very shallow (less than 12 inches deep) during biological surveys conducted in August

2008 by GSRC; however, fish populations were observed during biological surveys. These pools could persist through the summer, allowing juvenile and some adult fish to survive and reproduce when winter flows resume. Two amphibians were also observed in these isolated pools: American bullfrog (*Lithobates catesbeianus*) and American toad (*Anaxyrus americanus*).

Due to habitat modification, the reach of Orestimba Creek from downstream of the Delta-Mendota Canal to the San Joaquin River provides relatively poor habitat for native warm-water species, but may support a variety of introduced warm-water species. Habitat modification includes agricultural runoff or canal diversions to Orestimba Creek, which is likely the main source of water flow in the creek during the summer. The channel, except for isolated pools, was dry upstream of the Delta-Mendota Canal in July 2001 and August 2008. Agricultural runoff and diversions from canals modify the natural hydrology of the stream, lower dissolved oxygen content, increase sedimentation, and introduce harmful pesticides and herbicides, all of which adversely affect habitat conditions for native species.

No fish surveys have been conducted for the lower reaches of the creek. Native fish species that may be present include Sacramento sucker and Sacramento pikeminnow. Generally, a variety of introduced species can survive in this type of stream, including catfish, carp, mosquitofish, and members of the Centrarchidae family such as green sunfish, black crappie (*Pomoxis annularis*), and largemouth bass (*Micropterus salmoides*).

The San Joaquin River above and below Orestimba Creek is designated Essential Fish Habitat (EFH) for Pacific salmon under the Magnuson-Stevens Fisheries Conservation and Management Act (Pacific Fishery Management Council, 1999). EFH for Pacific salmon includes all streams, lakes, ponds, wetlands, and other currently viable water bodies historically accessible to salmon in Washington, Oregon, Idaho, and California. EFH includes habitat elements necessary for a sustainable salmon population, such as water quality, hydrology, channel morphology, and riparian vegetation. Although salmon do not use Orestimba Creek, actions on Orestimba Creek could affect habitat elements in the San Joaquin River. Broad categories of actions that can potentially affect EFH include agriculture, bank stabilization, construction/urbanization, dredging and dredged soil disposal, sand and gravel mining, waste water/pollutant discharge, and wetland and floodplain alteration.

2.6 Special Status Species

Certain special status species and their habitats are protected by Federal, State, or local laws and agency regulations. The Federal Endangered Species Act (ESA) of 1973 (50 CFR 17) provides legal protection for plant and animal species in danger of extinction. This act is administered by USFWS and NMFS. The California Endangered Species Act (CESA) of 1977 parallels the Federal ESA and is administered by CDFG. Other special status species lack legal protection, but have been characterized as “sensitive” based on policies and expertise of agencies or private organizations, or policies adopted by local government. Special-status species are those that meet any of the following criteria:

- Listed or candidate for listing under the Federal ESA (50 CFR 17).
- Listed or candidate for listing under CESA.
- Nesting bird species and active nests of birds listed under the Migratory Bird Treaty Act.
- Species listed in the Bald and Golden Eagle Protection Act.
- Essential Fish Habitat listed under the Magnuson-Stevens Act.
- Fully protected or protected species under stated CDFG code.
- Wildlife species of special concern listed by the CDFG.
- Plant species listed as Rare under the California Native Plant Protection Act.
- Plant species listed by the California Native Plant Society.
- Species protected by other local ordinances, goals, and policies.

In 2001, EDAW conducted surveys for sensitive species and their habitats. Focused surveys were conducted specifically for the San Joaquin kit fox (*Vulpes macrotis mutica*), nesting raptors, and California red-legged frog (*Rana aurora draytonii*).

Federally Listed Species, Critical Habitat, and Essential Fish Habitat (EFH)

There are 16 Federally listed or candidate species that could potentially occur in Stanislaus County (Table 2-1). Of these 16 species, eight have designated critical habitat within the county. The majority of these 16 species are associated with relatively large, deep vernal pools among the rolling hills, remnant alluvial fans, and depositional stream terraces at the base of the Sierra Nevada foothills and would not be found within the range of potential effects resulting from the project. Others are associated with grasslands surrounding Orestimba Creek in the Diablo Range upstream of the Delta-Mendota Canal. Three Federally listed species and one area of designated critical habitat could occur within the area potentially affected by the proposed project.

Table 2-1: Federally Listed Species and Critical Habitats

Species/Critical Habitat	Status	Potential to Occur*
INVERTEBRATES		
Conservancy fairy shrimp *Branchinecta conservatio*	Endangered	None; primarily occurs in vernal pools, which are located on the east side of the county
Critical Habitat	Final	None
Longhorn fairy shrimp *Branchinecta longiantenna*	Endangered	None; primarily occurs in vernal pools, which are located on the east side of the county
Vernal pool fairy shrimp *Branchiecta lynchi*	Threatened	None; primarily occurs in vernal pools, which are located on the east side of the county
Critical Habitat	Final	None
Vernal pool tadpole shrimp *Lepidurus packardi*	Endangered	None; primarily occurs in vernal pools, which are located on the east side of the county
Critical Habitat	Final	None
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	Threatened	Low; blue elderberry shrubs present, but habitat suitability limited by fragmentation and use of pesticides, and no species occurrences identified by Critical Habitat Portal or biological surveys
FISH		
Green sturgeon *Acipenser medirostris*	Threatened	None; spawns in rivers north of the San Francisco Bay
Delta smelt *Hypomesus transpacificus*	Threatened	None; occurs in the San Joaquin River about 50 miles downstream of Orestimba Creek
West Coast Steelhead, California Central Valley Distinct Population Segment (DPS) *Oncorhynchus mykiss*	Threatened	None; this anadromous fish is known to occur in the San Joaquin River above and below its confluence with Orestimba Creek; due to its flashy hydrology, suitability of Orestimba Creek is limited but could provide habitat in some years
Critical Habitat	Final	None; water quality of San Joaquin River above and below Orestimba Creek is a primary constituent element of critical habitat
AMPHIBIANS		
California tiger salamander, central population *Ambystoma californiense*	Threatened	None; suitability of habitats is limited by presence of predators such as bullfrogs and fish which were observed in standing pools of water during 2001 and 2008 biological surveys

Species/Critical Habitat	Status	Potential to Occur*
Critical Habitat	Final	None
California red-legged frog *Rana aurora draytonii*	Threatened	None; focused surveys of the upper portion of Orestimba Creek were conducted by EDAW in 2001, and the species was not detected; habitat suitability limited by predators such as bullfrogs and predatory fish observed in standing pools of water during 2008 biological surveys
REPTILES		
Giant garter snake *Thamnophis gigas*	Threatened	None; Orestimba Creek riparian area is somewhat limited in suitability due to a general lack of basking areas and upland refugia, and the species is not known to occur within Orestimba Creek but has been recently sighted in San Joaquin Valley
MAMMALS		
San Joaquin kit fox *Vulpes macrotis mutica*	Endangered	None; use of the foothills of the Diablo Range as a migratory pathway between existing populations is considered important for recovery of the species, and Orestimba Creek and adjacent agricultural fields downstream of Jorgenson Road do not provide suitable habitat
PLANTS		
Hoover's spurge *Chamaesyce hooveri* Critical Habitat	Threatened Final	None; primarily occurs in vernal pools, which are located on the east side of the county None
Colusa grass *Neostapfia colusana*	Threatened	None; primarily occurs in vernal pools, which are located on the east side of Stanislaus
Hairy Orcutt grass *Orcuttia pilosa* Critical Habitat	Endangered Final	None; primarily occurs in vernal pools, which are located on the east side of the county None
Hartweg's golden sunburst *Pseudobahia bahiifolia*	Endangered	None; remaining populations are concentrated in La Grange east of San Joaquin River
Greene's tuctoria *Tuctoria greenei* Critical Habitat	Endangered Final	None; extirpated from Stanislaus County None

Species/Critical Habitat	Status	Potential to Occur*
Fleshy owl's-clover *Castilleja campestris ssp. succulenta*	Threatened	None; occurs in beds of vernal pools in valley grasslands in the eastern San Joaquin Valley
Critical Habitat	Final	None

Source: CNDDB, 2011 and USFWS, 2010

* None = no suitable habitat or extirpated; Low = potentially suitable habitat, but no record of occurrence in potentially affected area; Confirmed = suitable habitat with known occurrence in potentially affected area

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle (VELB) is patchily distributed throughout the remaining riparian forests of the Central Valley from Redding to Bakersfield. The VELB appears to be only locally common (found in population clusters that are not evenly distributed across the Central Valley). Extensive loss of California's Central Valley riparian forests has occurred since 1900, declining by 80 to 96 percent depending on the region (USFWS, 2006). Low density and limited dispersal capability may cause the VELB to be particularly vulnerable to population isolation as a result of habitat fragmentation. Insecticide and herbicide use in agricultural areas and along road rights-of-way may be factors limiting the VELB's distribution. The age and quality of individual elderberry shrubs as a habitat for the VELB may be a factor in its limited distribution. Numerous blue elderberry shrubs were observed within the intact portions of the Orestimba Creek riparian zone. However, the fragmented nature of these habitats and the use of insecticides in adjacent agricultural fields likely limit the suitability of the study area for this species. The California Natural Diversity Database (CNDDB) records several occurrences of this species in Stanislaus County east of the San Joaquin River (CNDBB 2011).

USFWS released a 5-year status review for the VELB on October 2, 2006 (USFWS, 2006). This review reported an observed population increase and the concurrent protection and restoration of several thousand acres of riparian habitat suitable for VELB. The USFWS status review determined that this species is no longer in danger of extinction, and recommended that the species no longer be listed under the Federal ESA. This recommendation is not a guarantee that the species will be delisted, however, because formal changes in the classification of listed species require a separate USFWS rulemaking process distinct from the 5-year review. In August 2011, USFWS initiated a status review to determine if delisting is warranted (USFWS, 2011). On October 2, 2012, USFWS announced a proposed rule to remove the VELB from the Federal List of Endangered and Threatened Wildlife. This proposed rule is currently in public review.

Central Valley Steelhead

The California Central Valley steelhead, a distinct population segment (DPS) of the West Coast steelhead, includes all naturally spawned populations of steelhead in the Sacramento and

San Joaquin rivers and their tributaries, excluding steelhead from San Francisco and San Pablo bays and their tributaries (National Marine Fisheries Service [NMFS], 2006). Two artificial propagation programs, the Coleman National Fish Hatchery and Feather River Hatchery, are also considered part of this DPS. The abundance of this DPS has declined from an estimated one to two million adults prior to 1850 to an estimated 3,600 spawning female steelhead in 2000. Although the DPS remains widely distributed throughout the Sacramento River tributaries, an estimated 80 percent of historical spawning areas are currently above impassible dams. Numerous impacts, including the construction of impassible dams, water diversions, gravel mining, stream sedimentation, water pollution, introduction of non-native species, and the conversion of riparian zones to agricultural and urban land uses, are likely causes of population declines.

West Coast steelhead are anadromous, meaning they migrate as juveniles from fresh water to the ocean and then return to spawn in freshwater (NMFS, 1998). Juveniles typically spend 2 years in freshwater streams and spend 2 to 3 years in marine waters. West Coast steelhead can spawn more than once before they die, but rarely spawn more than twice. Their current distribution in the Central Valley likely extends upstream of the confluence of Orestimba Creek with the San Joaquin River; however, spawning in Orestimba Creek is not common due to its flashy hydrology and high volume of sediment. The CNDDB does not record any occurrences of this species in Stanislaus County (CNDBB 2011).

Giant Garter Snake

Giant garter snakes inhabit agricultural wetlands and other waterways such as irrigation and drainage canals, marshes, sloughs, ponds, small lakes, low gradient streams, and adjacent uplands in the Central Valley (USFWS, 1999). Due to the direct loss of habitat, populations are primarily restricted to rice fields in the Sacramento Valley and marsh areas on Federal- and State-managed lands. Recent sightings of the giant garter snake in the San Joaquin Valley are few and do not include the Orestimba Creek basin. Habitat loss and fragmentation, flood control activities, changes in agricultural and land management practices, predation from introduced species, parasites, and water pollution are the main causes for the decline of this species. They are primarily restricted to aquatic habitat and nearby basking areas during their active period (April 1 to October 1). Giant garter snakes retreat to small mammal burrows and other soil crevices above prevailing flood elevations during the winter dormancy period (November to mid-March), when they are particularly sensitive because of limited opportunities for escape from disturbance. The lack of basking areas and upland refugia likely limits the suitability of habitat for giant garter snakes within the study area. The CNDDB does not record any occurrences of this species in Stanislaus County (CNDBB 2011).

State-Listed Species

The CNDDB includes in its inventory all Federally and State-listed plants and animals, as well as species that are considered rare or sensitive by government agencies and the

conservation community. A search of the CNDDB for occurrences in Stanislaus County returned 85 species, 18 of which were found near Orestimba Creek in the Orestimba Peak, Newman, and Crows Landing USGS quadrangles (CNDBB, 2011) (Figure 2-12). Most of the 85 species found in Stanislaus County are associated with vernal pools found east of the San Joaquin River or with grassland habitats found upstream of the Delta-Mendota Canal. Several of these species were observed in the Orestimba Creek watershed above the Delta-Mendota Canal during biological surveys conducted in 2001. A review of occurrence records and species habitat requirements identified 2 species that could occur within the area potentially affected by the proposed project (Table 2-2).

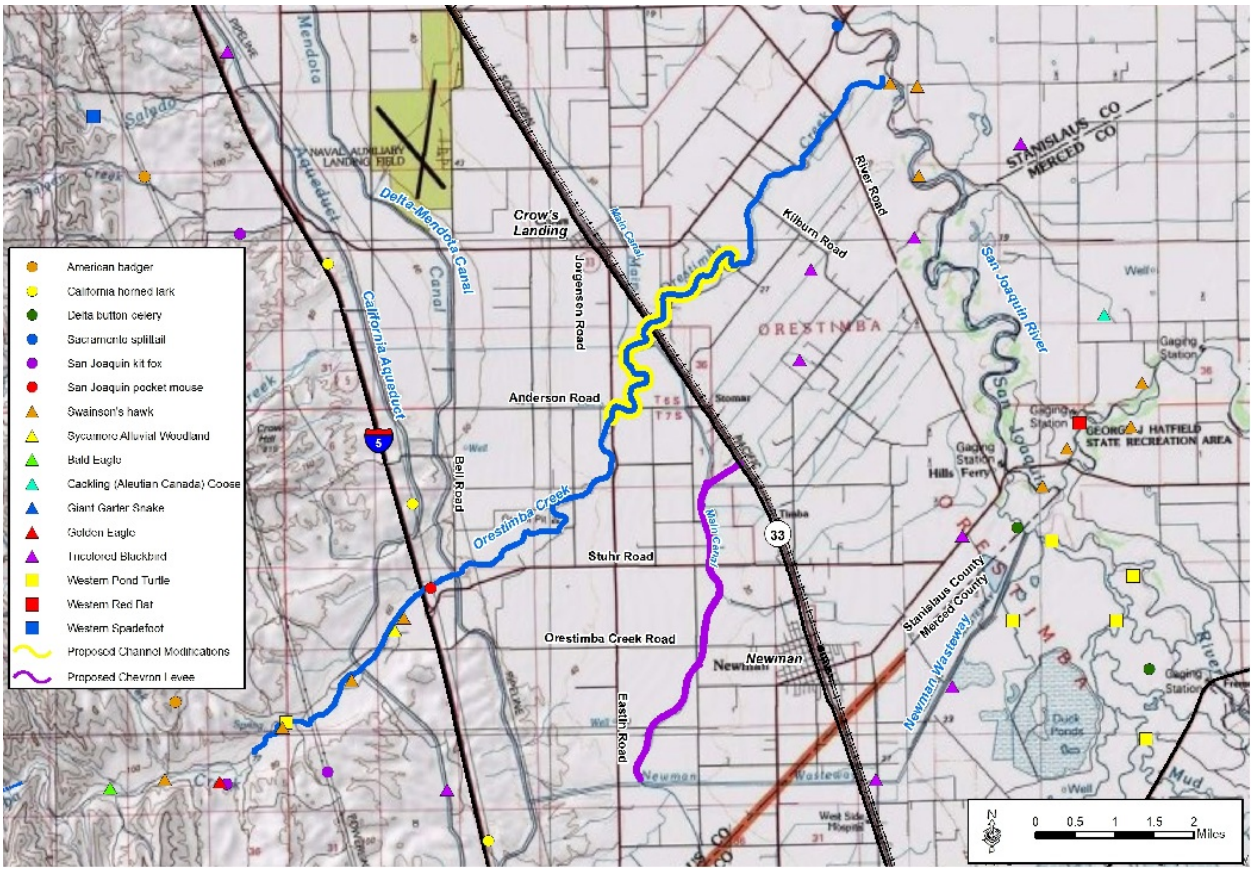


Figure 2-12: CNDDB Occurrences near the Proposed Levee and Channel Modifications

Table 2-2: State-Listed Species

Species	State/CNPS Status	Potential to Occur*

Species	State/CNPS Status	Potential to Occur*
REPTILES		
Western pond turtle *Clemmys marmorata*	SSC	None; occurs in isolated pools above the Delta-Mendota Canal
FISH		
San Joaquin roach *Lavinia symetricus*	SSC	None; occurs in isolated pools above the Delta-Mendota Canal
BIRDS		
Tricolored blackbird *Agelaius tricolor*	SSC	None; occurs in marshes above the Delta-Mendota Canal
Western burrowing owl *Athene cunicularia*	SSC	Low; occurs in grasslands above Delta-Mendota Canal, could use agricultural lands
Golden eagle *Aquila chrysaetos*	SSC	None; occurs in woodlands upstream of Delta-Mendota Canal
Swainson's hawk *Buteo swainsoni*	Threatened	Moderate; occurs in woodlands upstream of Delta-Mendota Canal
Mountain plover *Charadrius montanus*	SSC	Low; could occur in grasslands and plowed fields during winter
California horned lark *Eremophila alpestris actia*	SSC	None; occurs in grasslands upstream of Delta-Mendota Canal
Bald eagle *Haliaeetus leucocephalus*	Endangered	None; occurs in woodlands associated with Orestimba Creek and San Joaquin River
Loggerhead shrike *Lanius ludovicianus*	SSC	None; occurs in riparian scrub upstream of the Delta-Mendota Canal
MAMMALS		
Riparian woodrat *Neotoma fuscipes riparia*	SSC	None; can be found in riparian areas along the San Joaquin River
American Badger *Taxidea taxus*	SSC	None; occurs in open areas and brushlands with little ground cover

Species	State/CNPS Status	Potential to Occur*
PLANTS		
Delta Button Celery *Eryngium racemosum*	CE/1B	None; prefers clay depression in riparian

Source: CNDDB, 2011

Key: Low = occurs nearby, affected habitats of low to marginal suitability; Moderate - species occurs nearby, potentially affected habitats of moderate to high suitability; High - species and suitable habitat occur within potentially affected area

Western Pond Turtle

Western pond turtles can be found in slow-moving aquatic habitats such as ponds, marshes, streams, and irrigation ditches (Hays *et al.*, 1999). Suitable habitat provides emergent vegetation for cover and foraging, as well as logs or other basking opportunities. Western pond turtles are found in aquatic habitats year-round, but require adjacent upland habitats for nesting. Western pond turtles are recorded upstream of the Delta-Mendota Canal by CNDDB and were observed in the isolated pools and freshwater marsh areas during 2001 biological surveys (CNDBB, 2011). Freshwater Marsh communities found in Orestimba Creek between Jorgensen and Morris roads could provide suitable habitat; however, the species has not been observed in this area.

San Joaquin Roach

The San Joaquin roach is a subspecies of California roach generally found in small, warm intermittent streams flowing into the San Joaquin River from its confluence with the Cosumnes River south to its headwaters (Moyle, 1976; Moyle *et al.*, 1995). These fish are tolerant of relatively high water temperatures and low oxygen levels. The species is threatened by genetic isolation created by dams and artificial barriers, as well as water diversions and developments, which may cause water to dry up more frequently and more completely than usual. Introduced predatory fish such as green sunfish and bass are also a threat. San Joaquin roach were observed in dense populations in most of the isolated pools of Orestimba Creek upstream of the Delta-Mendota Canal. Green sunfish were also observed. The San Joaquin roach populations in the upper reaches of Orestimba Creek are isolated from lower reaches of the creek by a low water crossing at Bell Road and by the gravel mining operation. The low water crossing at Bell Road is armored on the downstream side, and the channel elevation drops several feet at this location. Although individuals could be carried downstream during high flows, survival in the low-flow channel of Orestimba Creek downstream of the Delta-Mendota Canal is unlikely.

Tricolored Blackbird

Tricolored blackbirds nest in dense emergent or riparian vegetation, especially where cattails and bulrush (*Scheonoplectus* spp.) are dominant (Beedy, 2008). The Freshwater Marsh, Mulefat, and Mixed Riparian Woodland communities upstream of the Delta-Mendota Canal are known to provide suitable nesting habitat. Similar habitats are found downstream but are not known to be occupied by tricolored blackbirds. This species was occasionally observed during 2001 biological surveys and numerous CNDDB records occur within Stanislaus County, with one record near the California Aqueduct southwest of Newman and three records located within agricultural fields east of Highway 33 (CNDBB, 2011).

Western Burrowing Owl

In California, the western burrowing owl can be found throughout the Central Valley, in the interior portion of the Coast Ranges, and along the coast (Howard, 1996). The population of burrowing owls has declined primarily because native grassland habitats have been converted for agricultural uses. Current threats to remaining populations include urban development and conversion from agricultural crop types that are compatible with burrowing owl occurrence to those that are incompatible. Optimal habitat conditions include open, dry, and nearly level grasslands or prairies. In the Central Valley, burrowing owls often nest along roadsides adjacent to agricultural fields, along field borders, in annual grasslands and dryland pastures, and along levee embankments that are open to adjacent fields. The species was observed above the Delta-Mendota Canal in the 2001 surveys, and CNDDB records also indicate occurrences near Salado Creek and Del Puerto Canyon (CNDBB, 2011). Although not observed near Orestimba Creek below the Delta Mendota Canal, surrounding agricultural fields could provide suitable habitat.

Golden Eagle

The golden eagle is a large raptor that lives throughout California (Johnsgard, 1990). Golden eagles are usually found in mountainous areas, canyons, shrub-land and grasslands, and their home ranges can be up to 35 square miles. The golden eagle prefers to nest in large trees or on cliffs or rock ledges. Mating pairs can have several alternate nests. CNDDB records indicate an occurrence near Orestimba Creek 2.2 miles southwest of the California Aqueduct (CNDBB, 2011).

Swainson's Hawk

Swainson's hawks prefer to nest in riparian areas with isolated trees bordered by suitable foraging habitat (grasslands, active agriculture, or fallow fields) (Johnsgard, 1990). Agricultural fields provide important foraging habitat for Swainson's hawks. Alfalfa, fallow fields, dry and irrigated pastures, and other low-growing row crops (including corn after harvest) are preferred foraging habitats for Swainson's hawks. Swainson's hawks are summer residents in the Central Valley, and typically arrive in April to breed. The species was observed

upstream of the Delta-Mendota Canal in 2001 and 2008. There are numerous CNDDB occurrences of Swainson's hawk throughout the Orestimba Creek riparian area (CNDBB, 2011) .

Mountain Plover

From September through March, mountain plovers spend the winters in northern California (Knopf and Rupert, 1995). In order of preference, habitats include alkali flats, heavily grazed native grasslands, and recently cultivated croplands. Alkali flats are virtually non-existent and were historically found in the eastern half of the San Joaquin Valley. Mountain plovers remain dependent upon alkali flats, especially in October and November, and the lack of these habitats near Orestimba Creek may limit the suitability of secondary habitats found in agricultural fields. CNDDB records indicate one occurrence near Turlock Lake approximately 10 miles east of the San Joaquin River (CNDBB, 2011).

Bald Eagle

Within California, bald eagles are permanent residents in the north and uncommon winter migrants, particularly in the south (Brown, 2009). In central California, bald eagles nest at Millerton Lake State Recreation Area. In the winter, bald eagles can be found at this lake, along the San Joaquin River downstream of Friant Dam, and along the Tuluomne and Stanislaus rivers, especially near their reservoirs located in the foothills of the Sierra Nevada. Although Orestimba Creek is not suitable foraging habitat, snags and mature trees within the riparian zone of the creek could provide nesting habitat for birds foraging in the nearby San Joaquin River and other nearby rivers and reservoirs. CNDDB records of bald eagles along Orestimba Creek are likely observations of individuals using the riparian woodlands as resting locations while foraging (CNDBB, 2011).

California Horned Lark and Loggerhead Shrike

The California horned lark and the loggerhead shrike both use grasslands for foraging and nest in shrubs (American Ornithologists Union, 1983). Both species were commonly observed during 2001 biological surveys in grasslands and riparian area surrounding Orestimba Creek upstream of the Delta-Mendota Canal. CNDDB records indicate a loggerhead shrike occurrence near Patterson and the Delta-Mendota Canal approximately 10 miles north of Orestimba Creek, and California horned lark occurrences in the vicinity of Orestimba Creek near the California Aqueduct and near the Newman Wasteway (CNDBB, 2011).

Riparian Woodrat

The riparian woodrat is a medium-sized rodent that prefers willow thickets in riparian areas (USFWS, 2008a). This species is mostly active at night when it forages for leaves, fruits, terminal shoots of twigs, flowers, nuts, and fungi. It is known to inhabit riparian communities along the lower portions of the San Joaquin and Stanislaus rivers. Threats to the riparian woodrat include habitat conversion to agriculture, wildfire, disease, predation, flooding, drought, use of rodenticides, and browsing and trampling by ungulates. The CNDDB did not contain any records of occurrence of riparian woodrat near the project (CNDBB, 2011).

American Badger

The American badger prefers open areas and may also frequent brushlands with little groundcover. During periods of inactivity, it occupies burrows. This animal is usually encountered in relatively dry grasslands and open forests. While this species may be active at any hour, it is predominantly nocturnal. It feeds primarily on rodents and ground squirrels, but will opportunistically devour arthropods, small reptiles, and birds. This species is widely distributed throughout southern and western California. Wild populations of American badger are decreasing due to land use change and its associated effects on prey availability, and trapping/killing for pelts or pest control (Reid and Helgen, 2008). The CNDDB did not contain any records of occurrence of American badger near the project (CNDBB, 2011).

3 EFFECTS DETERMINATION

3.1 Seismicity

Implementation of a project alternative would result in a significant seismic impact if it would expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

- Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
- Strong seismic ground shaking; or
- Seismic-related ground failure, including liquefaction, landslides, mudslides, or other similar hazards.

Alternative 1: No Action

Newman and surrounding areas are located in an area of low seismic risk. The nearest Alquist-Priolo Earthquake Fault Zone is located west of the Delta-Mendota Canal near the foothills of the Diablo Range. Development of lands within this zone is limited by Stanislaus County policies and regulations, as well as rugged terrain and lack of infrastructure. The San Joaquin Fault underlies the Orestimba Creek watershed and the southwest corner of Newman's SOI. Newman requires new development and substantial renovations to comply with current seismic standards for construction and requires geotechnical engineering studies for major new buildings or earthworks. The No Action Alternative would not result in development within areas of high seismic risk or expose people or structures to adverse effects of seismic activity. The No Action Alternative would not result in adverse effects due to seismic conditions.

Alternative 2: Channel Modifications

Alternative 2 could result in significant indirect effects, but these would be mitigated to less than significant through proper design and construction. The proposed channel modifications would not be located in the Alquist-Priolo Special Study Zone. Alternative 2

would not directly expose people to adverse effects of seismic activity since no people or structures would be located within the channel modification footprint.

Increased flood damage would be proportional to the seismic damage occurring and would not substantially affect the extent, depth, or duration of flooding occurring under design conditions. With a geotechnical study and implementation of appropriate design measures, the potential indirect impacts of seismic activity would be less than significant.

3.2 Geology

Implementation of a project alternative would have a significant geologic effect if it would:

- Substantially alter natural geologic processes resulting in hazards conditions;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in an on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse; or
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the State.

Alternative 1: No Action

Under the No Action Alternative, the geologic processes associated with flooding of Orestimba Creek would be minimally impacted. Gravel mining and the construction of levees, berms, and bridges have altered the patterns of sediment deposition on the alluvial fan and in the channel. Additionally, these factors have affected the patterns of channel scouring. These actions have largely had local effects on geologic processes. Flooding and the associated depositional process still occur throughout much of the historic alluvial fan. Flood waters upstream of the trestle overtop both the CCID Main Canal berms and the railroad track berm at multiple locations where flood flows typically follow east-west roads to the San Joaquin River. The metering of flows past the UPRR trestle has scoured the main channel of Orestimba Creek, which is expected to maintain its current capacity. Hazardous conditions arise during flood events; however, these conditions are largely the result of natural patterns of flooding, and geologic process would remain minimally impacted. The geomorphic processes affecting channel capacity and stability are discussed in detail in Section 2.1.

Because the study area is generally flat, the potentials for landslides, lateral spreading, and collapse of geologic features are low. The groundwater table can be near the surface throughout the study area, and these areas are subject to liquefaction. Due to the high expansion potential of most soils, local subsidence is common. To minimize the potential for hazardous conditions, Newman requires new development and substantial renovations to comply with current seismic standards for construction and requires geotechnical engineering studies for major new buildings or earthworks. Construction grade aggregate deposits occur throughout the study area and are currently being mined on Orestimba Creek. Mineral

resources would remain available for mining. The No Action alternative would result in less than significant effects on geologic processes and resources of the study area.

Alternative 2: Channel Modifications

Implementation of Alternative 2 would alter the pattern of geologic processes, but would not substantially affect hazardous conditions occurring as a result of deposition and erosion. Under Alternative 2, it is anticipated that channel capacity would continue to be maintained through the natural processes of deposition and scouring. The potential for in-stream deposition or scouring of the channel to cause substantial hazardous conditions would remain minimal. The effects of Alternative 2 on channel stability are discussed in greater detail in Section 3.4.

High quality aggregate is found in the subsurface materials throughout the Orestimba Creek basin. Channel modification would not remove or affect the availability of these mineral resources.

Mitigation

With a geotechnical study and implementation of appropriate design measures based on the study results, the potentially significant impacts resulting from underlying geologic conditions would be mitigated to less than significant.

3.3 Soils

Implementation of a project alternative would have a significant impact on soils if it would result in substantial soil erosion or the loss of topsoil.

Alternative 1: No Action

Due to the limited topography and depth of flooding on the alluvial plain, erosion processes are minimal. City and County regulations control soil erosion resulting from development, and the long-term potential for loss of top soil is discountable.

Alternative 2: Channel Modifications

The study area is generally flat, and the long-term potential for substantial erosion of soils to occur is minimal. The construction footprint of the channel modifications would be approximately 69 acres. Due to the large area of soils that would be temporarily exposed during construction, the short-term potential for erosion to occur would be significant, but would be mitigated to less than significant, as described below. Long-term soil erosion would be avoided through appropriate design measures, as described below.

Mitigation

A Stormwater Pollution Prevention Plan (SWPPP) incorporating site-specific measures to reduce erosion would be developed by the contractor prior to construction, and erosion protection measures would be monitored to ensure that soil loss is less than significant. A SWPPP would limit the downstream transport of sediments through such measures as silt

fencing and temporary retention ponds. Potentially, upstream flows may be temporarily obstructed. An encroachment permit would be obtained from the San Joaquin Valley Flood Control District (SJVFCD) prior to construction. The requirements of an encroachment permit would prevent construction from occurring during the flood season; thus, flows in the creek during construction would be minimal and the potential for soil loss would be further reduced. Design measures to minimize long-term erosion include use of rip-rap, geo-textile filters, erosion control seeding, and the installation of culverts. Additional design measures to prevent substantial long-term erosion of the modified channel include the replacement of two private bridges and a railroad trestle, as well as the armoring of sharp bends in the channel. Therefore, the potential for substantial erosion to occur as a result of the channel modifications would be mitigated less than significant.

3.4 Geomorphology

Implementation of a project alternative would have a significant geomorphic impact if it substantially destabilizes, or results in conditions leading to the substantial destabilization of the Orestimba Creek channel morphology such that hazardous conditions occur.

Alternative 1: No Action

The geomorphology of the upper reach of Orestimba Creek has remained relatively unaffected by development. However, the geomorphology of the middle and lower reaches has been substantially affected by gravel mining, efforts to control flood flows, the construction of bridges, and irrigation return flows. Minor shifting of the channel planform in the middle reach has occurred over the period of record and is likely to continue in the future. Hydraulic modeling of bed shear stresses indicate that, even under relatively infrequent flood conditions, channel boundary materials are not sufficiently large enough to prevent future gradient and planform changes along the channel. As the existing condition is expected to prevail in the future, continued downcutting and shifting of the channel in the middle reach may be expected. The lower reach has been effectively stabilized due to the limited flow volumes created by the channel restrictions in the middle reach. Continued modification of the channel in the middle reach may accelerate instability of the channel gradient and planform in the lower reach. Flows resulting from large storm events would continue to exceed channel capacity in the middle reach, resulting in flooding. Although channel morphology is not likely to change substantially without the project, the current channel capacity is unable to contain large flow volumes resulting in hazardous conditions which significantly affect the human environment. Without the project, these conditions are likely to continue in the future.

Alternative 2: Channel Modifications

Direct and indirect impacts resulting from the implementation of Alternative 2 would not result in hazardous conditions and would be less than significant. Channel modification would occur in the middle reach of Orestimba Creek. Channel modifications would include increasing the capacity through excavation of the channel and the construction of intermittent

segments of levees. These direct effects to geomorphology would meet the functional design of the modifications to increase the channel carrying capacity and reduce the frequency and volume of overland flood flows.

Channel modifications would indirectly increase the rate of flow in the lower reach during storm events that fill the channel with more than 1,300 cfs. Historically, flows in excess of this minimum overtopped the channel in the middle reach and were directed towards Newman by the UPRR embankment. The constriction of flows at Highway 33 Bridge and UPRR trestle have protected the lower reach from flooding and contributed to stabilization and downcutting of the channel. Proposed channel modifications and the replacement of the UPRR trestle were designed to create a sustainable creek channel that would optimize the conveyance of stormflows within the channel while working within the existing infrastructure constraints such as bridges and siphons.

Analysis of channel stability downstream of the proposed modifications was conducted to determine how the channel in the lower reach would react to changes in upstream channel dimensions. The analysis showed that removal of small-scale constrictions would not substantially affect downstream channel stability, while being effective at reducing overbank flow and the associated flood damages. Channel modifications may accelerate the instability of gradient and planform in the lower reach; however, this acceleration would not be substantial. Existing structures near the creek in the lower reach are currently protected by earthen levees and it is unlikely these structures would be affected. Implementation of Alternative 2 would not result in hazardous conditions, and the effects would be less than significant.

Mitigation

Through analysis of channel stability and project design, adverse impacts on geomorphology would be avoided. Design measures to improve channel stability include replacement of bridges and a railroad trestle, installation of culverts, armoring of sharp bends with rip-rap, and use of geotextile filters. Channel modifications are designed to maintain long-term stability and capacity of the Orestimba Creek channel.

3.5 Hydrology

Implementation of a project alternative would have a significant hydrologic impact if it would expose people or structures to a substantial risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam, or if it would substantially alter the existing drainage pattern of the site or area in a manner which would result in substantial erosion, siltation, or induced flooding on- or off-site.

Alternative 1: No Action

Under the No Action Alternative, the significant risk of loss, injury, and death involving flooding would continue. Flood frequency and the extent of flooding across the alluvial plain is primarily the result of natural processes and the general lack of control structures on Orestimba

Creek. Limited channel capacity and channel restrictions in the middle reach contribute to flooding in Newman and can result in loss, injury, and potentially death. Under Newman's General Plan, development within the next 10 years would primarily occur south of Stuhr Road within Newman's proposed primary SOI. This area is affected by the 1/100 AEP; however, Newman regulations require measures to reduce the impacts of flooding to less than significant. Small-scale flood risk reduction measures could be implemented by local interests in the middle reach to reduce flood risk within the primary SOI; however, these measures are likely to have very local effects. The overall risk of loss, injury, or death involving flooding would not be significantly reduced.

Alternative 2: Channel Modifications

Alternative 2 would have beneficial effects on hydrology. Alternative 2 would reduce the risk of loss, injury, and death involving flooding. Through project design, adverse erosion and siltation would be avoided. The extent of flooding would be substantially reduced overall; however, induced flooding would occur near the main channel of Orestimba Creek between Crows Landing Road and JT Crow Road. The depth of induced flooding in this area would generally be less than 0.5 feet during the 1/100 AEP.

Through implementation of a SWPPP and project design, erosion and siltation would be controlled and have minimal effects on hydrology and flooding (see sections 2.2 and 2.4). Although Alternative 2 would result in induced flooding, the area affected and the depth and duration of flooding would be minimal. The area of induced flooding would be located in a rural area outside Newman's SOI. The depth of induced flooding in this area would generally be less than 0.5 feet during the 1/100 AEP and would typically last less than 3 days. If not elevated or protected by local berms, several rural residences and agricultural buildings (located near Orestimba Creek and Kilburn Road) could be affected. However, flooding would be substantially reduced or eliminated along JT Crow, Stuhr, and Hills Ferry roads.

Mitigation

Implementation of a SWPPP, as described in Section 2.3, would reduce short-term impacts resulting from erosion and siltation to less than significant. Channel modifications, replacement of LWCs and bridges, and armoring of sharp bends in the channel would control erosion and siltation and provide for long-term stability and capacity of the Orestimba Creek channel.

3.6 Water Quality

Implementation of a project alternative would have a significant impact on water quality if it would violate any water quality standards or waste discharge requirements or otherwise substantially degrade water quality; or create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.

Alternative 1: No Action

Flooding of agricultural and urban lands results in pollution of both Orestimba Creek and the San Joaquin River and contributes to water quality which is not in attainment of designated uses. Flood flows which inundate agricultural fields are exposed to agricultural pesticides and nutrients, and flood flows in urban areas are exposed to petroleum products, solvents, pesticides, nutrients, and other pollutants. Polluted flood flows either return to Orestimba Creek via overland flow or are collected by agricultural and stormwater drainage systems and discharged to the San Joaquin River. Irrigation return waters, which can also contain pollutants, are collected by agricultural drains managed by the CCID or by Orestimba Creek and are discharged into the San Joaquin River. Measures to reuse irrigation waters reduce these impacts; however, they remain significant.

In addition to Newman maintained storm drains within the City Limits, CCID-maintained agricultural ditches that supply and collect water runoff are located within Newman's SOI. Some city storm drains collect CCID water. Stormwater runoff is collected in underground pipes and CCID ditches and flows to a pump station at Inyo Avenue and Canal School Road. There are five lift stations to pump stormwater which currently operate below capacity. Under current conditions, large storm events result in the collection of overland flood flows by the Newman Wasteway. Water quality is an issue because the population of Newman is growing quickly and because a large portion of Newman discharges runoff into the Newman Wasteway without water quality treatment. As Newman's population grows, it will become subject to NPDES Phase II Stormwater Program requirements, which would likely require treatment of stormwater including the six minimum control measures.

Additional development and related construction activities allowed by the proposed General Plan could affect the drainage system in the Newman area with increased runoff, resulting in the need for more drainage capacity and additional monitoring. As such, Newman plans to upgrade 750 to 1,000 feet of existing pipeline at Inyo Avenue to a 60-inch diameter pipe to increase drainage capacity for runoff. By increasing the drainage capacity and obtaining an NPDES stormwater discharge permit, Newman would reduce the potential for impacts associated with increased runoff to less than significant.

Alternative 2: Channel Modifications

Channel modifications could result in minimal discharge of excavated materials into Orestimba Creek. Due to the low volume and minimal velocity of flows in Orestimba Creek, any discharged sediment is likely to be deposited within the stream bed a short distance from the area of excavation. Sediments in the channel could contain agricultural pollutants, and sediment toxicity analysis would be required to determine the potential for adverse impacts of excavation. If substantial pollutant concentrations are detected, water quality could be substantially impacted during and after construction. Excavation of wetlands would result in a loss of wetland functions and would adversely affect water quality. Excavation within the channel would result in significant impacts on water quality, but would be mitigated to less than significant as described below.

The operation of construction equipment within the channel could potentially result in pollution as a result of leaks or spills. If a large spill were to occur, impacts on water quality would be significant, but would be mitigated to less than significant as described below.

Flood flows would ultimately be discharged to the San Joaquin River via Orestimba Creek, agricultural drains, or the Newman Wasteway. The replacement of the UPRR trestle and downstream channel modifications would allow a greater volume of flows to be carried into the lower reach of Orestimba Creek. During smaller events, most overland flood flows would return to Orestimba Creek prior to discharge into the San Joaquin River. During moderate events, flood flows could overtop the UPRR embankment and be collected by agricultural drains prior to discharge into the San Joaquin River. The capacity of agricultural drains is not likely to be sufficient to contain these flows, and these flows would be exposed to agricultural pollutants; however, flows would be reduced in comparison to existing conditions. Under current conditions, large storm events result in the collection of overland flood flows by the Newman Wasteway. With the implementation of Alternative 2, the volume and frequency of flood flows entering the Newman Wasteway would be reduced. Alternative 2 would reduce flood flows within Newman's proposed SOI and would have a beneficial effect on existing stormwater drainage systems.

Mitigation

Mitigation measures to avoid impacts on water quality would be developed through coordination with resource agencies. Stream flows would be diverted through pipes and around the area of channel modifications. Thus, excavation would occur in an effectively dry channel and the potential for adverse effects would be substantially minimized. To ensure that water quality impacts are less than significant, the Corps would obtain a Section 401 water quality certification from CVRWQCB and complete a water quality assessment compliant with Section 404(b)(1) of the CWA. Implementation of a SWPPP, as described in Section 2.3, would reduce short-term impacts of erosion to less than significant. Compliance with the terms of an SJVFCD encroachment permit, also described in Section 2.3, would further reduce the potential for substantial erosion to impact water quality. An NPDES general construction permit would be obtained from the State WQCB and approved by the CVRWQCB during the PED phase. The conditions of the NPDES permit would include measures to protect water quality and to ensure that impacts are less than significant. Restoration of wetland communities would be incorporated into a riparian zone restoration plan, as described below in section 2.11, and would mitigate the adverse impacts resulting from loss of wetland functions.

Mitigation measures to avoid or minimize impacts as a result of spills or leaks would be included in a Spill Prevention Control and Countermeasures Plan (SPCCP) to be developed prior to construction. Such measures include monitoring equipment and preventing the storage or refueling of equipment within the riparian zone. Implementation of these mitigation measures would reduce potential impacts on water quality to less than significant.

3.7 Groundwater

A project alternative would significantly impact groundwater if it would substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (if the production rate of preexisting nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted).

Alternative 1: No Action

Development within Newman and surrounding areas could reduce recharge rates as the area of impervious surfaces increases and a larger volume of surface flows are collected by surface drains. According to Newman, there is sufficient groundwater within the proposed SOI and the surrounding area to meet both the needs of the existing population, as well as growth anticipated in the Newman General Plan, without depleting the groundwater aquifer. The No Action Alternative would have a less than significant impact on groundwater availability.

Alternative 2: Channel Modifications

Channel modifications would widen the existing channel, allowing for greater recharge to occur during moderate to large storm events; however, minimization of flooding would reduce the area over which recharge occurs on the floodplain. As illustrated by the high water table in the Newman SOI and Newman's need to reduce water levels by providing and maintaining agricultural irrigation drainage systems, the future growth anticipated by the proposed General Plan would not substantially deplete groundwater supplies even if Newman continues to rely on groundwater as its primary source of water in the future. Alternative 2 would have a less than significant impact on groundwater recharge.

Mitigation

Impacts on groundwater would be less than significant, and no mitigation is required.

2.8 Waters of the U.S. and Wetlands

A project alternative would have a significant impact on waters of the U.S., including wetlands, if it would have a substantial adverse effect on Federally protected waters of the U.S. through direct removal, filling, hydrological interruption, or other means.

Alternative 1: No Action

Wetlands occurring in association with agricultural drains, margins, and depressions could be impacted as a result of anticipated growth in Newman and surrounding areas. These impacts would be mitigated by local, State, and Federal regulations and policies that require wetland functions and values to be preserved or replaced, and would be less than significant. The No Action Alternative would result in less than significant impacts on wetlands.

Alternative 2: Channel Modifications

Channel modifications would directly impact the channel, banks, floodplain, and riparian communities of Orestimba Creek. Orestimba Creek is a water of the U.S. and Freshwater Marsh communities found within the low-flow channel of the middle reach meet the definition of a vegetated shallow. Vegetated shallows are considered Special Aquatic Sites and are part of Orestimba Creek. Modification of the channel, banks, and floodplain would meet the functional design of reducing flood damage risk by increasing the channel's minimum capacity. Increasing the flow capacity of Orestimba Creek would not affect the navigability of waters of the U.S., including Orestimba Creek and the San Joaquin River.

Channel modification would also result in the removal of up to 5 acres of vegetated shallows. Water storage provided by vegetated shallows can beneficially affect hydrology by decreasing flow velocity, reducing flood peaks, extending distribution of storm flows, increasing groundwater recharge and decreasing groundwater discharge, helping to maintain water quality, and reduce erosion. The temporary loss of these wetland functions as a result of excavation would result in significant adverse impacts on the hydrology of Orestimba Creek, but would be mitigated to less than significant as described below.

Mitigation

A water quality analysis compliant with Section 404(b)(1) guidelines of the CWA and a water quality certification compliant with Section 401 would be completed. Compliance would require a determination of the precise extent of waters of the U.S. impacted by construction activities, including wetlands and special aquatic sites such as vegetated shallows. The restoration of wetlands within the footprint of the proposed channel modifications would be incorporated into a riparian zone restoration plan developed in coordination with resource agencies. Approximately 18.5 acres of land within the proposed channel modifications would be suitable for the establishment of side channels or backwaters that would support sustainable wetland communities. The restoration of wetlands in these areas would offset potential losses at a ratio greater than 1:1 and would result in no net loss of wetlands compliant with EO 11980, Protection of Wetlands. Herbaceous wetland communities would be established in suitable areas by planting and hydroseeding of emergent wetland species. Riparian communities supporting wetland shrubs may also be created along the channel through creation of wetland benches and planting with appropriate species. Plantings would be maintained for at least 5 years, and an annual monitoring report would be prepared for submittal to resource agencies. Success criteria would be established as indicators of plant health, community development, and invasive plant establishment. Successful establishment of wetland communities would offset the loss of wetland functions occurring as a result of excavation, reducing impacts to less than significant.

2.9 Air Quality

Implementation of a project alternative would have a significant air quality impact if it would:

- Directly or indirectly result in a substantial increase of air pollutants in areas in non-attainment of State or Federal air standards;
- Conflict with or obstruct implementation of the Valley Air District Air Quality Control Plan;
- Conflict with the Newman or Stanislaus County General Plan guidelines for control of air pollution; or
- Expose sensitive receptors to substantial pollutant concentrations.

Alternative 1: No Action

The San Joaquin Valley Airshed is currently in non-attainment of State and Federal air quality standards for 8-hour O_3 and PM-2.5. The Valley Air District has developed air pollution control measures under three California Air Resources Board (CARB)-approved Air Quality Control Plans: the Extreme Ozone Attainment Demonstration Plan, the Carbon Monoxide Maintenance Plan, and a PM-10 Maintenance Plan. Ozone control measures focus on eliminating precursors and placing restrictions on a wide range of emission sources. These emission sources include oil and gas producers and refineries, school bus fleets, residential development projects generating increased traffic, commercial fuel combustion, wineries, agricultural dryers, and numerous other sources. The control measures for CO are based on reformulation of gasoline, exhaust emission standards, and use of low-emission vehicles. Control measures for PM-10 are similar to those implemented for carbon monoxide, and extend emission standards to larger vehicles such as trucks and buses. A PM-2.5 Plan was submitted to CARB in 2008 and is still under development. The PM-2.5 Plan demonstrates the effectiveness of control measures adopted under previous plans, and anticipates attainment of PM-2.5 air quality standards by 2012. Newman and Stanislaus County have adopted policies and regulations to improve air quality conditions in the San Joaquin Valley Airshed. These policies and regulations:

- Endorse implementation of mixed-use land uses that promote alternative modes of transportation;
- Call for a reduction of air pollution associated with energy usage;
- Encourage compliance with Federal and State air quality standards;
- Enact expansion of employment opportunities to reduce commuting times and increase ridesharing and transit use;
- Require installation of cleaner, gas-burning fireplaces in new developments;
- Encourage construction of bicycle, pedestrian and transit facilities;

- Require features in new developments to reduce reliance of gas-powered landscape equipment;
- Regulate emissions from residential fireplaces and wood-burning heaters and provide educational information to reduce wood smoke emissions; and
- Enact measures to reduce ambient concentrations of PM-10 by requiring actions to prevent, reduce, or mitigate anthropogenic fugitive dust emissions.

Despite these measures, the Newman General Plan would exceed transportation assumptions required to meet attainment under the current plans. Due to increases in vehicle use beyond those anticipated in the Air Quality Control Plan, the No Action Alternative would have a significant impact on air quality.

Alternative 2: Channel Modifications

Emissions resulting from implementation of Alternative 2 would not exceed Federal and State *de minimis* thresholds, and a conformity determination would not be required (Table 1, Appendix E). Impacts to air quality would be short-term and limited to the construction period. All applicable Valley Air District control measures and local guidelines for controlling emissions would be implemented. There are no sensitive receptors, such as schools, near the construction footprint and construction activities would not result in high concentrations of pollutants. Alternative 2 would result in less than significant impacts on air quality.

TABLE 1. CONSTRUCTION EMISSIONS FOR ALTERNATIVE 2

Construction Activity	Construction Emissions for Criteria Pollutants and GHG (tons per year)						
	VOC	CO	NO_x	PM-10	PM-2.5	SO_2	CO_2
Levee and Channel Modifications	3.45	15.99	38.86	42.95	5.89	2.78	15,101
de minimis Thresholds	50.00	NA	50.00	50.00	100.00	NA	27,557

Mitigation

In compliance with Valley Air District control measures, all construction equipment would meet current exhaust emission standards. In compliance with City of Newman and Stanislaus County guidelines, measures to reduce anthropogenic emissions of PM-10 would include minimization of the construction footprint and wetting of soils when beneficial for the suppression of windborne dust. To further reduce air emissions resulting from the transport of materials, suitable excavated materials would be used in the construction of levees or would be

spread on adjacent agricultural fields. With these and other Best Management Practices in place, effects on Air Quality would be less than significant.

2.10 Vegetation

Implementation of a project alternative would result in significant impacts on vegetation if it would have a substantial adverse effect on any riparian habitat or other sensitive natural community type identified by the CDFG.

Alternative 1: No Action

Growth of Newman and surrounding areas could result in impacts on agricultural fields and riparian areas of Orestimba Creek and the San Joaquin River. Although grazing lands are dominated by non-native annual grasses, some native species are likely to occur in these areas. Other agricultural fields support native and non-native species around their margins. The loss of common native plants would not be substantial due to the prevalence of similar communities throughout the Central Valley. Much of the riparian habitat within the study area has been removed or substantially degraded by past agricultural and urban development. The removal or degradation of remaining patches of riparian habitat could occur as a result of local efforts to control the hydrology of Orestimba Creek. Due to the limited area of remaining riparian habitat, even a modest loss or degradation would be a significant impact on this sensitive natural community. However, local agencies would be required to receive a Streambed Alteration Agreement from CDFG for any work to the Orestimba Creek bed and banks, and implement mitigation measures for loss of riparian habitat as part of the permit activity.

Alternative 2: Channel Modifications

Proposed channel modifications would result in the loss or degradation of sensitive natural communities within the riparian zone of Orestimba Creek, including approximately 17.0 acres of Valley Oak Woodland, 2.2 acres of Mixed Riparian Woodland, 23.7 acres of Mixed Riparian Scrubland, and up to 5 acres of Freshwater Marsh within the channel. Up to 26.2 acres of agricultural fields would also be removed; however, none of these lands are used for grazing and none would be considered a natural community. Within the study area, Valley Oak Woodland, Freshwater Marsh, and other natural communities occurring in riparian zones have been substantially affected by agricultural encroachment and are relatively uncommon. The loss or degradation of remaining riparian communities along Orestimba Creek would be a significant impact, but would be mitigated to less than significant as described below.

Mitigation

Mitigation of impacts on vegetation communities to less than significant would be achieved through avoidance and restoration. Existing Valley Oak Woodland and other woodland communities within the riparian zone would be conserved to the maximum extent practicable through design of the channel modifications. Where feasible, channel modifications would be restricted to one side of the creek. Upon completion of channel modifications, the

riparian zone would be substantially wider and would allow for restoration of up to 20.3 acres of Valley Oak Woodland and 18.5 acres of Freshwater Marsh. Native plant communities would be established within the footprint of proposed channel modifications through implementation of a riparian zone restoration plan. The riparian zone restoration plan would be developed during the PED phase through coordination with wildlife managing agencies. The restoration plan would focus on the development of Valley Oak Woodland and Freshwater Marsh communities, including riparian scrub species such as willows. Other riparian woodland trees would be included where appropriate. During the first year of restoration, a hydroseed mix of native grasses would be applied and invasive plants would be spot treated with an herbicide approved for aquatic environments. Woodland communities would be established by planting seedlings in areas above the ordinary high-water mark and irrigating for up to 2 years. Where suitable, backwater area and side channels would be created for the establishment of herbaceous wetland plants. The health of plantings and establishment of invasive species would be monitored and maintained for up to 5 years. The establishment of success criteria through coordination with wildlife resource agencies would ensure adequate survival, growth, and recruitment for the long-term development of native communities. Alternative 2 would result in short-term loss of sensitive natural communities, but would result in a long-term net gain of these communities. With mitigation, Alternative 2 would have a less than significant impact on sensitive natural communities.

2.11 Wildlife and Fisheries

Implementation of a project alternative would have a significant impact on wildlife and fisheries if it would result in a substantial loss of habitat such that displacement of individuals threatens the long-term persistence of local populations; or have a substantial interference with the movement of any native resident or migratory fish or wildlife species, their wildlife corridors, or nursery sites.

Alternative 1: No Action

Wildlife habitats would be impacted by the No Action Alternative. Anticipated growth would result in loss of alfalfa fields and grazing lands, which provide habitat for insects and small mammals. These areas also provide foraging habitat for raptors nesting in woodland habitat along Orestimba Creek and the San Joaquin River. However, the area of similar habitat within foraging distance of suitable nesting habitats is extensive, and the number of raptors that forage in agricultural fields surrounding Orestimba Creek is likely limited by nesting habitat availability rather than forage. Newman policies would serve to adequately protect existing tree and other important vegetation resources in Newman's SOI, as well as provide additional plantings as part of new development and public improvements. With measures to avoid, minimize, and mitigate for potential impacts, future development would have a less than significant impact on wildlife and wildlife habitats.

As described under water quality, flooding would continue under the No Action Alternative. Under current conditions, flooding contributes to the discharge of agricultural and

urban pollutants into Orestimba Creek and the San Joaquin River. This source of pollution is minimal in relation to stormwater run-off discharged through agricultural drains during storm events of lower intensity and as a result of irrigation returns. Measures to improve existing drainage facilities and measures included in NPDES permit requirements would reduce impacts on water quality, and subsequently fishes and other aquatic organisms, to less than significant.

Alternative 2: Channel Modifications

Channel modifications would impact wildlife habitats. The majority of existing natural communities within the Orestimba Creek riparian zone occurs near the San Joaquin River and would not be lost or degraded. The temporary loss and degradation of up to 33 acres of natural communities, as described above in Section 2.10, would result in the displacement of some wildlife; however, long-term impacts on local populations would be minimal. Potential impacts on special-status birds known to use these habitats are discussed below in Section 2.12. Although the riparian corridor is nearly continuous in the lower reaches of Orestimba Creek, terrestrial habitats are highly fragmented in the middle reaches and absent in the reaches between the Delta-Mendota Canal and Highway 33. Due to the lack of cover and extensive gravel mining along the channel, the riparian corridor is not likely to serve as a migratory pathway, and wildlife migration would not be impacted.

Aquatic habitats would be temporarily degraded during construction of channel modifications. Earthwork in and near the channel and removal of the riparian canopy would result in increased turbidity and water temperature and decreased dissolved oxygen, and potentially suspend contaminated sediments. With implementation of mitigation measures, these potential temporary impacts on water quality would be minimal and would not extend downstream to EFH in the San Joaquin River. Potential impacts on fishes would be limited to common native and invasive species tolerant of the relatively poor aquatic habitats found within Orestimba Creek. Channel modifications would not substantially alter hydrology or water quality during normal flow conditions. Water quality could improve over the long term as a result of increased riparian buffer and reduced exposure to pollutants during flood events. The persistence of local fish populations would not be threatened by channel modifications, and impacts on fisheries would be less than significant.

Mitigation

Construction-related impacts on water quality would have short-term and less than significant impacts on local fish populations. All water quality impacts would be mitigated as described in Section 2.6. Mitigation measures would include a sediment toxicity analysis, obtaining a Section 401 water quality certification and NPDES general construction permit from CVRWQCB, and development of a SWPPP.

2.12 Special-Status Species

Implementation of a project alternative would significantly impact special-status species if it would:

- Harm or harass a special-status plant or animal;
- Directly or indirectly affect essential habitat of special-status species; or
- Prevent the migration of a special-status species between potentially occupied habitats.

Alternative 1: No Action

Potential habitat for three special-status species occurs within Newman's SOI: Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*) (VELB), the San Joaquin Kit Fox (*Vulpes macroitis mutica*), Swainson's hawk **(***Buteo swainsoni*), and burrowing owl (*Athene cunicularia*). Newman and Stanislaus County regulations and policies require pre-construction surveys of projects located in potentially suitable habitats for special-status species, and mitigation of any habitat loss. With mitigation, impacts from future growth and development to special-status species would be less than significant.

Alternative 2: Channel Modifications

Special-status species are known to occur within the study area, and potential habitat for these species would be impacted both directly and indirectly by channel modifications. The riparian zone has been removed or degraded along Orestimba Creek from Morris Road to Jorgenson Road, where channel modifications are proposed. Extending upstream from the San Joaquin River the riparian zone is narrow but continuous for approximately 3,000 feet past Morris Road. The riparian zone is generally cleared to the stream bank upstream of this point to Anderson Road and consists of scattered trees and shrubland upstream of Anderson Road to Jorgenson Road. In total, approximately 42.9 acres of riparian habitat, including 17.0 acres of Valley Oak Woodland, would be removed or degraded. Freshwater marsh, occurring intermittently along approximately 1.8 miles of riparian zone would also be directly impacted.

Valley Oak Woodland and scattered trees in the Orestimba Creek riparian zone east of Highway 33 likely provide perching habitat for the population of bald eagles known to occur in association with the San Joaquin River, including its eastern tributaries and impoundments. The golden eagle, Swainson's hawk, and loggerhead shrike, although not recorded downstream of the Delta-Mendota Canal, could also use these habitats for foraging and nesting. The suitability of Freshwater Marsh communities for tricolored blackbirds in the area of proposed channel modifications is generally limited by low flows and the general lack of dense, willow-dominated scrub/shrub communities. However, these birds have been observed in nearby wetlands associated with agricultural margins. Migratory birds are also likely to use shrub and woodland habitats along the riparian zone. The disturbance and loss of riparian habitats would have a significant impact on special-status raptors and migratory birds through direct take and displacement, but would be mitigated to less than significant as described below.

Channel modifications would also impact approximately 26.2 acres of agricultural fields. Alfalfa fields, fallow fields, and grazing lands within 10 miles of Orestimba Creek or the San Joaquin River provide suitable foraging habitat for golden eagle, Swainson's hawk, loggerhead shrike, and other raptors. Agricultural fields along the margin of Orestimba Creek consist

primarily of row crops and the loss of a minimal amount of potentially suitable foraging habitats would be a less than significant impact.

The margins of agricultural fields, especially drains, berms, and levees, also provide suitable nesting habitat for burrowing owls, which forage in adjacent agricultural fields. If occupied burrows or other nesting locations are located within the limits of construction, activities such as grading, grubbing, and excavation could result in the removal of occupied burrows during both the breeding and wintering seasons. Loss of occupied burrows or individual owls, including young or eggs, would be a significant impact on a special-status species, but would be mitigated to less than significant as described below.

Blue elderberry is a necessary component of VELB habitat and exists in patches within the Orestimba Creek riparian zone. No blue elderberry shrubs were observed in the vicinity of proposed channel modifications where most woody plants have been removed. However, right-of-entry to the project area has not been granted, and blue elderberry shrubs could occur north of Morris Road where vegetation could not be observed from the road. The disturbance of vegetation within 100 feet of any blue elderberry would be a potentially significant impact on VELB, but would be mitigated to less than significant as described below.

Aquatic habitats in Orestimba Creek below Eastin Road and downstream habitats in the San Joaquin River could be impacted by channel modifications. Substantial erosion and suspension of sediments and other pollutants in the channel could result from channel modifications, and could significantly affect the suitability of downstream aquatic habitats. The West Coast steelhead is known to occur in the San Joaquin River above and below its confluence with Orestimba Creek. Orestimba Creek does not provide sufficient flows during normal flow conditions to provide suitable spawning or rearing habitat. The San Joaquin River serves as a freshwater migration corridor, provides the primary constituent elements essential to conservation of West Coast steelhead, and has been designated as critical habitat under the Federal ESA. Construction-related activities could result in substantial degradation of water quality and result in significant short-term impacts on West Coast steelhead and their critical habitat, but would be mitigated to less than significant as described below.

By increasing the capacity of Orestimba Creek, the volume and frequency of flood flows exposed to agricultural and urban pollutants (petroleum products, solvents, and pesticides) and ultimately discharged into the San Joaquin River would be substantially reduced. Improved water quality resulting from channel modification would result in long-term beneficial impacts on West Coast steelhead and their critical habitat.

No special-status species are known to use Orestimba Creek as a migratory pathway, and migratory pathways for special-status species would not be impacted. Species such as the golden eagle, Swainson's hawk, loggerhead shrike, and tricolored blackbird, are known to occur in the study area and could occupy newly created habitats. Other special-status species which have historically occurred within the watershed or which are known to occur in remnant riparian habitats nearby, such as delta button celery, giant garter snake, and riparian woodrat, could also benefit from restoration efforts.

Mitigation

The impact of degrading and removing essential habitat would be mitigated to less than significant through avoidance and restoration of riparian communities as described in Section 2.11.

Potential impacts on Swainson's hawks would be reduced to less than significant through avoidance. A qualified biologist would survey the project area and all areas within one-half mile of the project prior to construction. If the survey determines that a nesting pair is present, the City of Newman would coordinate with CDFG, and the proper avoidance and minimization measures would be implemented. To avoid potential effects on nesting Swainson's hawks, CDFG typically requires the avoidance of nesting sites during construction activities. These measures include avoiding construction during the breeding season and monitoring of any discovered nest site by a qualified biologist.

Potential impacts on burrowing owls would be reduced to less than significant through avoidance and, if necessary, through mitigation. A burrowing owl survey would be conducted prior to any construction activities. Avoidance would be achieved by restricting construction activities within 160 feet of occupied burrows during the non-breeding season and within 250 feet of occupied burrows during the breeding season. Avoidance measures also require that a minimum of 6.5 acres of foraging habitat be permanently preserved contiguous with occupied burrows for each pair of breeding burrowing owls. If destruction of active burrows is unavoidable, burrowing owls would be passively relocated from active burrows during the non-breeding season, existing unsuitable burrows would be enhanced, and new burrows created at a ratio of 2:1. All burrowing owl mitigation measures would be conducted in coordination with the CDFG.

Potential impacts on the San Joaquin Kit Fox would be reduced to less than significant through avoidance and, if necessary, through mitigation. A kit fox survey would be conducted prior to any construction activities. Avoidance would be achieved by restricting construction activities within 50 feet of potential dens and within 100 feet of known dens. Additional avoidance or mitigation measures would be coordinated with USFWS.

Potential impacts on VELB would be reduced to less than significant through avoidance, and if necessary, through mitigation. A pedestrian survey of the construction footprint for blue elderberry shrubs would be conducted prior to any ground-disturbing activities. If any elderberry shrubs are observed, the City of Newman would enter Section 10 consultation with USFWS. If possible, the area would be avoided through design of the channel modifications. Unavoidable impacts on blue elderberry shrubs would be mitigated through the creation of new habitat within the footprint of proposed channel modifications per USFWS mitigation requirements. Creation of VELB habitat would be incorporated into the riparian zone restoration plan. Although no VELB populations are known to occur in the vicinity, their range is poorly described and improving habitat conditions could reduce the impacts of habitat fragmentation and benefit the species.

Potentially significant impacts on water quality would be avoided through implementation of mitigation measures described in Section 2.6, and potential adverse effects on critical habitat would be minimal.

2.13 Invasive Plants and Noxious Weeds

Implementation of a project alternative would result in significant invasive plant or noxious weed impacts if it would promote the establishment of invasive plants or noxious weeds in native plant communities or agricultural fields.

Alternative 1: No Action

Several invasive plants and noxious weeds were observed along Orestimba Creek and in association with field margins and ditches. These populations are likely to remain established, and the seeds and propagules of these plants are likely to colonize areas where soil disturbance occurs. Soil disturbance is likely to continue to occur as a result of agricultural practices and land development including road improvements and other linear projects. Because invasive plants and noxious weeds are currently present along agricultural margins throughout the study area, continued soil disturbance would not promote further establishment of these plants. The impact of invasive plants and noxious weeds on native plant communities and agricultural fields would be less than significant.

Alternative 2: Channel Modifications

Channel modifications would result in approximately 69 acres of disturbed soils suitable for the establishment of invasive plant pests, including noxious weeds. Although some invasive plants currently exist within patches of native vegetation, the removal of native plants would reduce competition and promote the spread of noxious weeds within the construction footprint. The establishment and spread of noxious weeds would be a significant impact, but would be mitigated to less than significant as described below.

Mitigation

To mitigate the impacts of noxious weeds to less than significant, a control plan would be developed through coordination with resource agencies during the PED phase. A noxious weed control plan would include removal of whole plants prior to construction and spot treatment with USEPA - approved herbicides prior to establishment of native plants. Noxious weeds would be controlled through hand removal where appropriate, and spot treatment with herbicide for 5 years following construction. The establishment of native plant communities, as described in Section 2.10, would prevent the long-term establishment and spread of noxious weeds.

2.14 Socioeconomics

Implementation of a project alternative would have a significant impact with regard to population, housing, and employment if it would induce substantial unplanned population growth in an area, either directly or indirectly, or if it would physically divide an established community.

Implementation of a project alternative would have a significant impact with regard to environmental justice if it would have substantial and disproportionate adverse effects on the social and economic welfare of minority or low-income populations.

Alternative 1: No Action

The No Action Alternative would not result in unplanned growth, either directly or indirectly. The Newman General Plan anticipates continued growth within Newman's SOI and planning area and establishes guidelines and regulations to minimize the impacts of growth on human and environmental resources. Flooding would continue to result in short-term and minor restrictions of connectivity between rural and urban areas; however, the limited duration and depth of flooding does not substantially isolate or divide communities. The Newman General Plan would encourage development of a mixture of commercial, residential, and public spaces suitable for local residents through planned zoning and extension of services.

Under the No Action Alternative, flooding would continue to result in substantial damage to private and public property, loss of personal income, and loss of public tax revenue. Because Newman is primarily populated by minorities, adverse effects on the economic welfare of the community essentially affect a minority population. Thus, the No Action Alternative would continue to have significant adverse impacts on the economic welfare of a minority population.

Alternative 2: Channel Modifications

Alternative 2 would not result in unplanned growth and would reduce the adverse effects of flooding on economic welfare to a less than significant level. Minimal induced flooding would occur outside of Newman's Planning Area in rural areas. This flooding could temporarily restrict access to rural residences or agricultural fields, but would not divide communities. The overall reduction in duration, depth, and extent of flooding and the replacement or improvement LWCs and bridges would result in beneficial effects on overall connectivity during flood conditions.

The reduction of flood damage risk would have beneficial effects on the economic welfare of individuals and the community. Furthermore, Alternative 2 could temporarily increase job availability resulting in short-term beneficial effects on local income as a result of construction-related jobs and investment, but it would not substantially affect population size, diversity, household size, or housing availability. There are between three and five rural residences within 100 feet of the existing channel of Orestimba Creek. Impacts on residences and agricultural structures would be avoided through design measures where possible. If impacts are unavoidable, property owners would be compensated.

Mitigation

Impacts on socioeconomic conditions would be less than significant and no mitigation is required. If impacts on residential or agricultural structures are unavoidable, property owners would be compensated for any loss.

2.15 Land Use

A project alternative would create a significant land use impact if it would:

- Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project and adopted for the purpose of avoiding or mitigating an environmental effect;
- Result in unnecessary and unavoidable conversion of substantial areas of Prime Farmland, Unique Farmland, or Farmland of Local Importance to nonagricultural use; or
- Involve other changes in the existing environment which, due to their location or nature, could result in substantial conversion of farmland to non-agricultural use.

Alternative 1: No Action

The No Action Alternative would have no effect on land use. Lands outside of Newman's City Limits are under the jurisdiction of Stanislaus County, which designates these lands as agricultural. Newman's General Plan, which designates lands outside of its City Limits as non-agricultural, is in conflict with the Stanislaus County Plan and represents a significant impact. However, as plans for development are proposed within the County, these projects would be evaluated for compliance with existing City and County regulations and guidelines, and the County would support incorporation by Newman of lands for approved developments. The vast majority of these lands are designated Prime Farmlands under the Farmland Protection Policy Act (FPPA) and would be converted to non-agricultural use. Any growth beyond existing development would result in impacts on Prime Farmland; however, Newman and Stanislaus County implement numerous measures to limit the effects of growth on farmland conversion and on the daily operation of farmland.

Alternative 2: Channel Modifications

The channel modifications would be located on lands under the jurisdiction of Stanislaus County, and the Stanislaus General Plan designates these lands as agricultural. Although the channel modifications would not be classified as agricultural use, Stanislaus County would revise its zoning designation upon approval of this project, and no conflicts would occur. Growth within the Planning Area is not anticipated to occur until after 2030, and Newman would have adequate time and space to redirect future plans towards development of equally suitable lands within and adjacent to unaffected portions of its Planning Area. Thus, the proposed channel modifications would not conflict with any land use plans or zoning.

The channel modification project area is located on Prime Farmlands. The FPPA ensures that Federal actions do not cause farmland to be irreversibly converted to nonagricultural uses in cases in which other national interest do not override the importance of the protection of farmland or otherwise outweigh the benefits of maintaining farmland resources. Impacts on Prime Farmland were evaluated using the California Land Evaluation and Site Assessment (LESA) model. LESA has been approved as an alternative to the FPPA model for quantifying impacts on Prime Farmlands and other important soils (7 CFR 658.4 (f)). Scoring thresholds are based upon both the total LESA score as well as the component LE and SA scores (Table 2). A total LESA score of 80 to 100 points is considered significant. Due to the overall size of the project and the high value of surrounding farmlands, the footprint of the channel modifications would be considered significant under LESA. Section 1548 of the FPPA states that the FPPA shall not be deemed to provide basis for any action challenging a Federal project that may affect farmland. However, as further discussed in Section 1548, a state can challenge a Federal action affecting farmland where a state policy or program exists to protect farmland.

TABLE 2. LESA SCORE FOR LPP LEVEE

Factor	Score	Weight	Weighted Factor Score
Land Evaluation (LE)			
Land Capability Classification	99	0.25	24.71
Storie Index	80	0.25	20.00
LE Subtotal		**0.50**	**44.71**
Site Assessment (SA)			
Project Size	100	0.15	15.00
Water Resource Availability	100	0.15	15.00
Surrounding Agricultural Land	100	0.15	15.00
Protected Resource Land	60	0.05	3.00
SA Subtotal		**0.50**	**48.00**
Final Score			**92.71**

Table 3. California LESA Model Scoring Thresholds

Total LESA Score	Scoring Decision
0 to 39	Not Considered Significant
40 to 59	Considered Significant only if LE and SA subscores are each greater than or equal to 20
60 to 79	Considered Significant unless either LE or SA subscore is less than 20 points
80 to 100	Considered Significant

In California, farmlands are protected under the California Farmland Conservancy Program (CFCP). The CFCP seeks to encourage the long-term, private stewardship of agricultural lands through the voluntary use of agricultural conservation easements. There are no CFCP conservation easements on potentially affected lands. Additionally, the California Land Conservation Act, commonly referred to as the Williamson Act, enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural use. In return, landowners receive property tax assessments which are much lower than normal because they are based on farming and open space uses as opposed to full market value. The majority of lands within the area of flood damage risk reduction, especially within the Primary SOI and SOI, are not held under Williamson Act contracts or are held under Williamson Act contracts set to expire by 2014. The channel modifications would not remove any lands from FEMA-designated flood zones; and therefore would not induce development or result in indirect conversion of Prime Farmlands.

Although the direct impacts of channel modification would remove a substantial area of Prime Farmlands from agricultural production, Alternative 2 would not induce growth, conflict with a CFCP conservation easement, directly remove lands from Williamson Act contracts, or induce removal of lands from Williamson Act contracts. The area of the impacts has been minimized to the maximum extent practicable through engineering design. The policies and ordinances of both the city of Newman and Stanislaus County work together to ensure that the planned development of lands for non-agricultural use minimize conflicts between land uses. Therefore, impacts on land use would be less than significant.

Mitigation

Impacts on land use would be less than significant and no mitigation is required.

2.16 Transportation

A project alternative would have a significant impact on traffic or transportation if it would:

- Degrade traffic flow and safety to conditions below thresholds established on Newman roadways, or LOS C, except for Merced Street downtown and Highway 33 where Newman has established less stringent thresholds due to existing constraints and the desire to maintain the community character;
- Substantially increase hazards due to a design feature (such as sharp curves or dangerous intersections) or incompatible uses (such as farm equipment);
- Result in inadequate emergency access; or
- Conflict with adopted policies, plans, or programs supporting alternative transportation.

Alternative 1: No Action

Current transportation infrastructure is sufficient to provide a LOS of C or better for Newman and Stanislaus County managed roadways and intersections in the study area. Continuing growth within and around Newman would increase traffic volumes on roadways in the study area. Existing development limits improvement of many roads within the City Limits, and LOS on these road segments is anticipated to be unacceptable as a result of continued growth. The LOS of intersections within Newman's City Limits would be similarly affected but can be improved to a LOS lower than C with installation of traffic signals. Newman has implemented plans and policies to minimize the impact of projected growth on traffic within the City Limits.

Flooding can result in temporary road closures; however, access to lands on either side of Highway 33 is provided by arterial roadways, and emergency access is not significantly impacted. Impacts on transportation resulting from the No Action Alternative would be less than significant.

Alternative 2: Channel Modifications

Alternative 2 would result in minimal, short-term impacts on traffic, but would not substantially increase hazards due to design features, would not substantially restrict emergency access, and would not conflict with alternative transportation policies, plans, or programs. Construction activities would require moving large quantities of soil, construction materials, and heavy equipment into and out of the study area. The number of trips to and from construction activities would likely be less than 100 per day, including commute of workers and movement of materials. This volume is less than 10 percent of the total anticipated volume for any given road managed by Newman. Worker commutes, approximately half of the resulting increase, would likely occur during peak traffic hours. However, LOS is currently A on most city- and county-managed roads, and these roads are capable of accommodating a moderate, temporary increase in traffic without substantial change to LOS. During construction of channel modifications, truck traffic is likely to increase

on Fink, Bell, Anderson, Jorgenson, and Morris roads. The LOS of these roadways is not anticipated to be lower than C with implementation of Newman's General Plan. Alternative 2 would not substantially affect LOS of impacted roadways, and impacts on traffic would be less than significant.

Induced flooding is expected to be minimal; however, inundated roadways would result in hazardous conditions and would significantly impact transportation safety. Impacts would be mitigated to less than significant. Alternative southbound and northbound routes to I-5 would remain accessible from Highway 33. Emergency access to areas within the City Limits would not be affected. Eastin Road would remain accessible for emergency response in rural areas and would not substantially add to response times. Replacement of LWCs and bridges would result in long-term beneficial impacts on emergency access.

Mitigation

Where induced flooding results in hazardous conditions, installation of temporary barriers and signage to prevent motorists from entering inundated roadways would mitigate transportation safety impacts to less than significant.

2.17 Utilities and Public Services

A project alternative would have a significant impact related to utilities and public services if it would:

- Result in substantial adverse physical impacts associated with the provision of new or physically altered public service or facilities, including police service, fire protection, school, library, drinking water, wastewater, and stormwater collection facilities;
- Substantially increase need for new or physically altered public service or facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objective;
- Require or result in the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects; or
- Be served by a landfill with insufficient permitted capacity to accommodate the buildout of Newman's General Plan solid waste disposal needs.

Alternative 1: No Action

With implementation of Newman's General Plan, future growth would not exceed the capabilities or capacity of Newman to provide utilities and public services, including police service, fire protection, schools, libraries, and drinking water, wastewater, and stormwater collection facilities. Although anticipated growth would require improvement of public services and facilities, these improvements would not result directly in adverse environmental impacts. The impacts of induced development resulting from improved utilities and services would be

mitigated to less than significant through implementation of City of Newman policies and regulations.

Alternative 2: Channel Modifications

Flood risk reduction measures would not require the expansion of utilities or public services. The Stuhr Road alignment would not extend flood damage risk reduction to substantial areas outside of Newman's proposed SOI. Channel modifications would alter existing drainage patterns, resulting in a reduced demand on City facilities during flood events, and no new stormwater drainage systems would be required as a result of Alternative 2. The integrity of the CCID Main Canal, its capacity to deliver irrigation water, and the quality of irrigation waters in the canal would not be affected. Soils excavated from the channel suitable for agricultural use may be disposed of in adjacent agricultural fields, as approved in writing by the Corps and the affected landowner. Any material unsuitable for disposal on agricultural fields would be disposed of in the Fink Road Landfill. The Fink Road Landfill has a permitted capacity until 2022 or 2023, depending on the type of permitted waste generated by the cogeneration versus municipal solid waste. In order to accommodate waste after 2023, the Fink Road Landfill has applied for a permit with Stanislaus County to expand its site westward onto adjacent property owned by the county. A recycling center would also be included in this expansion in order to reduce the total amount of landfill waste. The Fink Road Landfill is currently permitted to accept up to 2,400 tons of waste per day. Impacts on utilities and public services from the implementation of Alternative 2 would be less than significant.

Mitigation

Impacts on utilities and public services would be less than significant and no mitigation is required.

2.18 Recreation

The proposed project would have a significant impact on recreational resources if it would increase the use of existing neighborhood and regional parks or other recreational facilities, such that substantial physical deterioration of the facility would occur or be accelerated, or if it would result in substantial adverse physical impacts associated with the provision of new or physically altered parks or recreational facilities, need for new or physically altered parks or recreational facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable performance objectives for parks or recreational facilities.

Alternative 1: No Action

Newman offers sufficient recreational opportunities through public parks and would be able to maintain sufficient recreational area to population ratios meeting future needs for recreational opportunities without adversely impacting other resources. Following the Newman General Plan, a bicycle path north of the CCID Main Canal would be developed over

the next 10 years. Therefore, the No Action Alternative would have a less than significant impact on recreation.

Alternative 2: Channel Modifications

With the implementation of Alternative 2, no adverse effects would occur to recreation resources in the area. Downstream of the California Aqueduct, the Orestimba Creek channel is primarily located on private property and is generally only accessible from road crossings. Due to the inaccessible nature of the creek with respect to the general public, opportunities to develop recreation opportunities are substantially limited. Alternative 2 would not impact existing and future recreation opportunities.

Mitigation

Recreational impacts would not occur and no mitigation is required.

2.19 Aesthetics

The implementation of the proposed project would have a significant impact on visual and aesthetic quality if it would:

- Substantially or demonstrably result in a negative aesthetic alteration to the existing character of the area. A substantial alteration is characterized by a negative "sense of loss" of character or unique resources;
- Have a substantial adverse effect on a scenic vista; or
- Create a new source of substantial light or glare which would adversely affect daytime or nighttime views in the area.

Alternative 1: No Action

Features that define the character of the area identified by the Newman (2007) General Plan include its distinct neighborhoods and areas, gateways, its primary corridor Highway 33, and its trees and landscaping. As Newman grows, development is likely to impact some of these features. The General Plan contains policies that work in conjunction with current City design and development regulations to ensure that new development complements the existing aesthetic fabric of City of Newman and its surrounding environment, and does not threaten scenic corridors or exacerbate issues of light and glare. Because each of the characteristic features is susceptible to flood damage, the No Action Alternative would have a significant effect on the character of the area**.**

Future flooding would not degrade the physical appearance of features which contribute to scenic vistas, including farmlands, the Diablo Range, and riparian habitats along Orestimba Creek and the San Joaquin River. Although farmlands are functionally impacted following flooding, they remain open spaces and continue to contribute to the rural quality of views. Similarly, riparian habitats may be damaged but would retain the undeveloped appearance which contributes to the scenic views. Flooding does not affect light or glare.

Alternative 2: Channel Modifications

Although construction would temporarily detract from aesthetic values, long-term aesthetic values could improve as a result of restoration of riparian habitats in rural areas. If construction occurs at night, the use of lighting would have a significant short-term impact; however, the channel modifications would not have a long-term impact on light or glare. If construction activities affect the Newman Gateway at Stuhr Road, aesthetics would be significantly impacted, but would be mitigated to less than significant as described below.

Mitigation

Nighttime construction would be avoided to the extent practicable. If nighttime construction is unavoidable, shielding would be used to direct light away from residential areas and onto the construction area. Restoration of the creek bed would improve the aesthetic quality of Orestimba Creek. These mitigation measures would reduce potential aesthetic impacts to less than significant.

2.20 Noise

Implementation of a project alternative would result in a significant noise impact if it would:

- Expose people to or generate noise levels in excess of standards established in the local general plan, noise ordinance, or applicable standards of other agencies;
- Expose people to or generate excessive groundborne vibration or groundborne noise levels;
- Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
- Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project; or
- Result in the encroachment of incompatible land uses near known noise producing industries, railroads, airports, and other sources.

Alternative 1: No Action

Development occurring as a result of implementing the Newman General Plan would result in an increase of traffic on city-, county-, and state-maintained roadways. Of these roadways, Highway 33, Upper Road, Prince Street, Barrington Avenue, Merced Street, Hills Ferry Road, Canyon Creek Drive, Kern Street, Driskell Avenue, and Inyo Avenue are adjacent to existing residences within Newman, and would experience a substantial permanent increase in ambient noise levels. Residences located adjacent to roadways with low existing traffic volumes would also experience a substantial permanent increase in ambient noise levels, including Fig Lane, Main Street, Balsam Drive, Eucalyptus Avenue, Orestimba Road, and Hoyer Road. Although the proposed General Plan includes policies and actions that would serve to

reduce the identified noise increases in Newman, it does not eliminate the significant unavoidable impact with regard to noise.

Newman and Stanislaus County regulations would reduce any construction-related groundborne vibrations to less than significant. Periodic increases in ambient noise levels resulting from construction associated with new development or infrastructure maintenance would be similarly mitigated. City and County policy and regulation would prevent encroachment of incompatible land uses. However, as a result of increased traffic near residential areas, the No Action Alternative would have a significant impact on noise.

Alternative 2: Channel Modifications

Stanislaus County (2008) has established land use compatibility guidelines, which promote the development of new land uses within areas of compatible exterior noise exposure (Table 4).

TABLE 4. STANISLAUS COUNTY LAND USE COMPATIBILITY GUIDELINES

Land Use Category	Exterior Noise Exposure (DNL, dBA)		
	Acceptable	Conditional	Unacceptable
Residential – Low-Density-Single Family, Duplex, and Mobile Homes	50 - 60	60 - 70	> 70
Industrial, Manufacturing, Utilities, and Agriculture	50 - 75		> 75

Source: Stanislaus County, 2008

The State of California General Plan guidelines require the following noise-sensitive areas be considered in the development of each community's General Plan: schools, hospitals, convalescent homes, churches, sensitive wildlife habitats, and use deemed noise-sensitive by the local jurisdiction. Neither Stanislaus County nor Newman identifies locally specific noise-sensitive receptors. Stanislaus County requires the evaluation of mitigation measures for construction projects that would cause the DNL at sensitive uses to increase by 3 dBA or more and exceed the "normally acceptable" level, or cause the DNL at noise-sensitive uses to increase 5 dBA or more and remain "normally acceptable." Newman further requires evaluation of mitigation for construction activities lasting more than one construction season that cause noise levels to exceed an hourly average of 60 dBA and exceed existing ambient noise levels by 5 dBA or more at a sensitive receiver.

No pile-driving or earth compaction would be required; thus, earthmoving equipment such as dump trucks and bulldozers would be the loudest source of noise during construction. Operation of typical earth-moving equipment produces noise emissions up to 81 dBA at the source and is typically attenuated to less than 60 dBA within approximately 700 feet. Noise

receptors within 700 feet of the construction footprint include rural residences on agricultural lands and noise-sensitive riparian habitats along Orestimba Creek. DNL at any given location near construction would be less than 60 dBA for several reasons. Because the project is linear, construction activities are not expected to occur at one location for more than several weeks. Because DNL averages noise over an entire year, intermittent peaks of 81 dBA for short periods would not substantially affect DNL values. The impact of construction activities on long-term ambient noise levels would be less than significant.

Noise levels could exceed an hourly average of 60 dBA at noise receptors within 700 feet of construction. Rural residences are typically located within or near clusters of agricultural facilities and ambient noise levels are likely to be affected by intermittent noise caused by equipment maintenance and by seasonal harvesting and field operations. Ambient noise levels at residences and commercial operations along Stuhr Road are affected by traffic along Stuhr Road, Highway 33, and the UPRR. Because existing sources of intermittent and long-term noise affects ambient noise levels near residences potentially affected by construction, construction activities are not likely to increase DNL by more than 5 dBA. The impact of construction activities on intermittent ambient noise levels near residences would be less than significant. Ambient noise levels near riparian habitats are likely to be much lower than other potentially affected areas, and the increase of intermittent ambient noise levels could have a significant impact on these noise-sensitive receptors but would be mitigated to less than significant as described below.

Mitigation

Pre-construction surveys of riparian habitats within 700 feet of construction activities would be conducted during the active nesting season (April through August) to identify the presence of migratory and other special-status bird nests. If recommended by wildlife resource agencies, additional mitigation measures such as the use of “quiet” equipment or construction of temporary noise barriers may be required. Increases in intermittent noise levels near riparian habitat would be mitigated to less than significant.

Measures to further minimize noise emissions would include restriction of nighttime construction near residences, location of staging areas at least 700 feet from residential areas and riparian habitats, design of construction and detour routes that avoid noise-sensitive receptors to the extent practicable, and proper maintenance of equipment.

2.21 Hazardous, Toxic, and Radiological Materials and Wastes

A project alternative would have an impact related to hazards or hazardous materials if it would:

- Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials;

- Emit hazardous emissions or handle hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school;
- Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment; or
- Be located on a site that is included on a list of hazardous material sites compiled pursuant to Government Code Section 65962.5 and, as a result, create a significant hazard to the public or the environment.

Alternative 1: No Action

Many of the commercial and industrial operations in Newman utilize and generate hazardous materials as part of their daily operations, including gasoline stations, dry cleaners, and automotive repair shops. Additionally, hazardous materials are utilized by agricultural operations in the form of pesticides, herbicides, and fertilizers, and by residential households, including cleaning supplies and paints. The potential increase in development permitted under the Newman General Plan could result in more hazardous materials being used, stored, or transported through and discarded within Newman, which would increase the potential risk associated with hazardous materials and waste. To address these issues, the Newman General Plan includes policies and actions that are intended to limit the impact hazardous materials could have on the population and environment, and the potential impacts would be less than significant.

Alternative 2: Channel Modifications

The operation of construction equipment during channel modification could potentially result in release of hazardous materials as a result of leaks or spills. If a large spill were to occur, impacts on water quality and agricultural resources may be significant, but would be mitigated to less than significant as described below. There are no sensitive receptors within 0.25 mile of the construction footprint. Excavated channel sediments could contain agricultural pollutants and hazardous materials or wastes which could result in significant impacts if released into the watershed. The extension of flood risk reduction measures to developed areas within Newman would reduce the risk of flooding in commercial and industrial facilities utilizing hazardous materials, thereby reducing potential negative impacts associated with flood waters.

USTs were identified within 1,000 feet of the construction footprint. The current status of these USTs is unknown; however, no leaks were reported from these USTs during a search of Federal, state, local, and tribal databases.

Mitigation

Mitigation measures to avoid or minimize impacts as a result of spills or leaks would be included in a SWPPP, as described in Section 2.3, and SPCCP to be developed prior to construction. An SPCCP would include best management practices, such as the use of drip pans

and containment berms, to limit the potential release of hazardous materials and toxic substances. A sediment toxicity analysis would be conducted during the PED phase to identify hazardous materials or toxic substances in the channel sediments, and appropriate measures to prevent significant impacts would be developed in coordination with resource agencies. If substantial concentrations of hazardous materials or toxic substances are identified, excavated materials would be disposed of in an approved upland disposal facility. Trucks carrying hazardous materials or waste to and from construction sites would use existing truck routes to minimize potential exposure to sensitive areas. No staging areas would be established within 0.25 mile of a sensitive receptor. The appropriate handling, transport, and disposal of hazardous materials would result in less than significant impacts.

A Phase I Environmental Site Assessment to identify potential hazardous materials and wastes within the project area would be conducted during the PED phase. Subsequent assessments would be conducted to analytically quantify any potential contaminants detected and to delineate the range of contamination, if necessary. Remedial actions would be taken to clean up all contaminants where necessary.

2.22 Cultural Resources

A project alternative would have a significant impact with regard to cultural resources if it would:

- Cause a substantial adverse change in the significance of a historical resource;
- Cause a substantial adverse change in the significance of an archaeological resource; or
- Disturb any human remains, including those interred outside of formal cemeteries.

Alternative 1: No Action

Newman contains numerous buildings that are over 50 years of age and may be historically significant. Although the majority of new development under the proposed General Plan would take place on land without existing structures, redevelopment within the historic downtown or in-fill development in older residential areas could result in the demolition, destruction, relocation, or alteration of buildings that are historically significant and eligible for listing on the NRHP. In addition, there are a number of rural buildings that are located outside Newman but within the proposed SOI that may be subjected to substantial adverse change as a result of new development allowed by the proposed General Plan. Development allowed under the proposed General Plan would also involve construction activities that could result in the disturbance of undiscovered archaeological and paleontological resources during grading or other on-site excavation activities. City policy includes measures to mitigate potential impacts on cultural resources to less than significant.

Currently, flooding impacts historic downtown Newman, and potentially impacts historic buildings in residential and rural areas. Remediation of flood damage could result in adverse impacts on these buildings if repairs are not compatible with the historic building in

design, materials, details, and character-defining features of historic buildings. Flooding could result in an adverse change in the significance of historic buildings resulting in significant impacts on cultural resources.

There are no known archaeological resources or human remains identified within the floodplain. Due to the generally shallow depth of flooding, such resources would likely remain undiscovered and are not likely to be adversely affected.

Alternative 2: Channel Modifications

The UPRR trestle, which is located along the historic route of the Southern Pacific Westside Railroad, is the only potentially historic resource that would be directly impacted by construction activities. The UPRR trestle would be replaced with an open span trestle. The trestle is potentially eligible under Criterion A of the NRHP for its association with the Southern Pacific Westside Railroad, and its former association with the San Pablo and Tulare Railroad. If the trestle is determined to be a contributing element of the Southern Pacific Westside Railroad, then mitigation measures would be needed to address the impacts of the removal of the trestle. The trestle is a modern structure constructed using modern design and materials, and only its location contributes to the historic district. Thus, replacement of the trestle is not likely to affect the historic district.

No adverse impacts are anticipated to occur on the potentially eligible CCID Main Canal as a result of construction activities. The CCID Main Canal is potentially eligible under Criterion A for the NRHP based on its association with the San Joaquin and Kings River canals, a valley-wide system for water distribution. The CCID Main Canal would not be directly impacted by construction activities.

Because the entire construction footprint has not been surveyed, there is a moderate potential for unidentified and subsurface cultural resources to be disturbed within the construction footprint. Any loss of such resources would be significant, but would be mitigated to less than significant as described below.

There are no known historic resources that would be adversely affected by induced flooding. The implementation of flood risk reduction measures would benefit historic homes and other structures in the developed areas of Newman. Newman regulations and policies would prevent any significant impact on existing structures resulting from renovation or nearby development.

There are no known archaeological resources or human remains identified within the floodplain. Due to the generally shallow depth of flooding, resources that remain undiscovered are not likely to be adversely affected by induced flooding.

Mitigation

Potential mitigation measures for removal of the railroad trestle would include the recording and archiving of the trestle structure before demolition and replacement in order to preserve a record of the original structure. Such mitigation measures, if necessary, would be

done in consultation with the California SHPO, and potential impacts would be reduced to less than significant.

The City of Newman would enter a Programmatic Agreement with the SHPO to avoid and minimize potentially significant resources within the construction footprint. The Programmatic Agreement would include requirements for pre-construction surveys and monitoring of construction activities. If any cultural resources are identified during surveys or by a monitor, all construction would be halted immediately and would not continue until the potential eligibility of the resources is assessed through coordination with the California SHPO.

2.23 Cumulative Effects

Programs with measures being planned or implemented in the study area include those listed in Section 1.6 of this Feasibility Report/IS/EA. These include three programs aimed at improving the biological environment: the California Bay-Delta Program (CALFED) to restore ecological health and improve water management of the Bay-Delta; the Central Valley Project (CVP) Improvement Act, which amends previous authorizations of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with power generation; and the NRCS Wetland Reserve Program, which focuses on the restoration of a variety of wetland types and has been used to restore flood-damaged wetlands along the San Joaquin River. Projects identified in Section 1.6 include the Nature Conservancy Mount Hamilton project, which seeks to ensure permanent conservation management of nearly 500,000 acres within the Diablo Range west of Newman; and the Nature Conservancy Simon Newman Ranch project, which would prevent future subdivision and development of 33,000 acres in the upper watershed of Orestimba Creek.

A review of the Caltrans District 10 homepage identified several projects planned within the County, most of which would occur along Highway 99 and east of the San Joaquin River in the vicinity of Turlock and Modesto. Two currently programmed projects were identified in the Newman area. The Newman Downtown Plaza Improvement project is in the planning phase and includes the replacement of sidewalks, curbs, gutters, and addition of parking spaces along Highway 33 from Fresno Street to Tulare Street. Rehabilitation of Highway 33 from Jenson Road in Newman to near Patterson is in the construction phase.

The Stanislaus County Planning Department maintains a database of current projects being planned within the county. An online search of the database identified one project planned in the Newman area. California Transplants proposes to expand their greenhouse facility at the west end of Stuhr Road, adjacent to the Delta-Mendota Canal. The expansion project would be extended over a 3-year period and the company would employ 14 people during the planting season each year (January to June).

Newman has two specific plans within its proposed SOI, the Downtown Development Plan and the Highway 33 Plan, each of which promotes controlled development and renewal of lands according to Newman's Adopted Vision Statement through preserving the historic fabric

of downtown and surrounding neighborhoods, creating a walkable community providing a range of activities connected by pedestrian trails and bike paths, providing a range of housing types and a variety of employment options, and maintaining a sufficient level of infrastructure.

Alternative 1: No Action

The Newman General Plan identifies several cumulative effects resulting from implementation of its general plan and other projects and plans. As a result of anticipated growth and development, the following cumulative impacts would be less than significant with implementation of mitigation measures:

- Degradation of the rural and agricultural setting of Newman and Stanislaus County;
- Loss or degradation of cultural resources as a result of grading and other construction activities;
- Increase in runoff affecting water quality;
- Location of additional population and structures within areas subject to flooding;
- Exposure of people to risk as a result of seismic activity;
- Loss of mineral resources;
- Exposure of people to hazardous materials and wastes; and
- Potential conflicts with other applicable plans, policies and regulations, including the County's General Plan.

As a result of anticipated growth and development, the following cumulative impacts would be significant even with implementation of mitigation measures:

- Loss of agricultural resources;
- General reduction in habitat values for existing resident and migratory species and cumulative loss of habitat for common and possible special-status species; and
- Exceedance of Valley Air District's regional clean air planning assumptions.

Under the No Action Alternative, cumulative impacts as described under Newman's General Plan would likely occur in the future. All of these impacts are associated with growth and development and would likely occur without the implementation of any risk reduction measures.

Alternative 2: Channel Modifications

With the proposed mitigation measures described for each resource, Alternative 2 would not adversely contribute to those cumulative effects identified as less than significant under the Newman General Plan EIR. Alternative 2 would result in minimal loss of agricultural resources within areas currently planned for development under the Newman General Plan. Furthermore, the reduction of flooding in the surrounding areas would be a beneficial impact on existing and future agricultural resources. Alternative 2 would have a less than significant

cumulative impact on wildlife and wildlife habitats. Alternative 2 would include the development of a riparian zone restoration plan that would ultimately benefit wildlife, including special-status species, through the recreation of riparian habitats that have been negatively impacted from historic development. Alternative 2 would not result in cumulative impacts on air quality. Alternative 2 would result in short-term increases in emission of air pollutants, but would not contribute to the development or traffic impacts which result in cumulative impacts of the General Plan and are not anticipated to occur until near full build out of the General Plan in 2030.

Geomorphology

As discussed in Section 5.2.4, the implementation of Alternative 2 would not lead to the destabilization of the floodplain. This feasibility study is the only known past, present, or reasonably foreseeable future project to consider modifications to the floodplain. As a result, there is not a potential for an incremental cumulative impact.

Mitigation

Alternative 2 would not result in significant cumulative impacts, and no mitigation, other than measures to mitigate impacts of the action itself as previously described, would be required.

2.24 Unavoidable Significant Effects

Alternative 1: No Action

As a result of anticipated growth and development proposed under the Newman General Plan and other actions in the region, Newman anticipates unavoidable significant cumulative impacts on agriculture, air quality, transportation, noise, and wildlife habitat.

Alternative 2: Channel Modifications

With the implementation of measures to mitigate direct and indirect impacts of the action itself, as described under each resource assessment, all significant or potentially significant impacts would be avoided.

2.25 Irreversible and Irretrievable Commitment of Resources

Section 15126.2(c) of the CEQA Guidelines requires a discussion of the extent to which a proposed project would commit nonrenewable resources to uses those future generations would probably be unable to reverse. A project alternative would generally result in a significant irreversible impact if the irreversible commitment of resources, including direct and indirect commitments, is not justified.

Alternative 1: No Action

Development under the Newman General Plan would result in the conversion of agricultural lands to commercial, residential uses, and public uses. This development would constitute a long-term commitment 226 acres of land that were not previously designated for development to urban uses.

Development allowed under the Newman General Plan would also irretrievably commit nonrenewable resources to the construction and maintenance of buildings, infrastructure, and roadways. These include mining resources such as sand, gravel, steel, lead, copper, and other metals. Development also represents a long-term commitment to the consumption of fossil fuels, natural gas, and gasoline. Increased energy demands would be used for construction, lighting, heating, and cooling of new buildings, and transportation of people within, to, and from the planning area. The Newman General Plan policies and actions promoting energy conservation would result in some savings in nonrenewable energy supplies. Implementation of the Newman General Plan would also result in an irreversible commitment of limited, renewable resources such as lumber and water. Policies and actions contained in the Newman General Plan that promote resource and water conservation and green building would result in some savings of renewable resources.

Irreversible changes to the physical environment could occur from accidental release of hazardous materials associated with development activities. However, compliance with State and Federal hazardous materials regulations and Newman General Plan policies is expected to maintain this potential impact at a less than significant level.

The irreversible commitment of resources occurring under the Newman General Plan would provide beneficial impacts to the socioeconomic conditions of Newman and Stanislaus County. Commitment of resources associated with all new development would be regulated by both Newman and Stanislaus County; thereby, ensuring the efficient and productive use of limited lands and resources and that these commitments are justified.

Alternative 2: Channel Modifications

Approximately 26.2 acres of agricultural land occurring within the construction footprint would be affected. Although future generations would be committed to maintaining the hydrological protection features (such as riprap) as a flood risk reduction measure, this irreversible commitment of resources would be beneficial to both urban areas within Newman and surrounding agricultural land. Future development would occur primarily as a result of implementing Newman's General Plan, and Alternative 2 would not substantially influence future growth or contribute to the irretrievable commitment of resources occurring under the No Action Alternative.

Mitigation

The irreversible and irretrievable commitment of resources would be less than significant and no mitigation is required.

Orestimba Creek
West Stanislaus County, California
Draft Interim Feasibility Study and EA/IS

Mitigation Monitoring Plan
August 2012

1.0 Introduction

Section 15097 of the California Environmental Quality Act (CEQA) requires all state and local agencies to establish monitoring or reporting programs for projects approved by a public agency whenever approval involves the adoption of either a "mitigated negative declaration" or specified environmental findings related to environmental impact reports. The following checklist provides a means for implementing the mitigation measures as identified within the Environmental Assessment/Initial Study for the Orestimba Creek project.

2.0 Compliance Checklist

The attached checklist identifies all mitigation measures, corresponding monitoring, the verifying agency, and the timing of the action. As the CEQA lead agency, Stanislaus County will be responsible for verifying compliance.

MITIGATION MONITORING PLAN ORESTIMBA CREEK PROJECT				
Impact	**Mitigation Measure**	**Verifying Agency**	**Implementation Schedule**	**Sign-off**
WILDLIFE AND FISHERIES				
Short-term loss of wildlife habitat associated with agricultural margins, and impacts on water quality could impact local fish populations	1 - Hydroseed levee slopes and staging areas with native grasses	Stanislaus County	Following completion of ground disturbance	
	2 - Development and implementation of a Storm Water Pollution Prevention Plan	Stanislaus County	Prior to construction	
SPECIAL STATUS SPECIES				
Loss or degradation of wildlife habitat and displacement of common wildlife	1 – Pre-construction bird surveys (Swainson's hawk and burrowing owl) and coordination with USFWS	Stanislaus County	Prior to construction	
	2 – Pre-constructin kit fox survey and coordination with USFWS	Stanislaus County	Prior to construction	
	3 – Pre-construction elderberry survey and coordination with USFWS	Stanislaus County	Prior to construction	
TRANSPORTATION				
Increased flood depths on roadways	1 - Install temporary barriers and signage to prevent motorists from entering roadways	Stanislaus County	During high water events	
AESTHETICS				
Short-term impacts from night lighting	1 - Avoid nighttime construction to the extent practicable	Stanislaus County	During construction	
	2 - Shield lighting away from residential areas	Stanislaus County	During construction	
	3 - Avoid the Newman Gateway	Stanislaus County	During construction	
NOISE				
	1 - Restrict night-time construction near residences and riparian habitats	Stanislaus County	During construction	

	2 - Locate staging areas at least 700 feet from residential areas	Stanislaus County	During project design	
	3 - Design construction and detour routes that avoid noise-sensitive receptors to the extent practicable	Stanislaus County	During project design	
HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTES				
Accident leaks or spills during construction	1 - Development and implementation of a Storm Water Pollution Prevention Plan	Stanislaus County	Prior to construction	
	2 - Develop a SPCCP that would limit the potential for hazardous materials and toxic substances to impact soils or water bodies during construction	Stanislaus County	Prior to construction	
	3 – Conduct Phase I Environmental Site Assessment prior to construction	Stanislaus County	Prior to construction	

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In Reply Refer To
08ESMF00-2012-CPA-0111

JUL 11 2012

Alicia E. Kirchner
Chief, Planning Division
U.S. Army Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95814-2922

Dear Ms. Kirchner:

Please find enclosed for your review and comment the Fish and Wildlife Service's (Service) draft detailed report on the Corps of Engineer's Orestimba Creek Feasibility Study.

If you have any questions, please contact Steven Schoenberg, at (916) 414-6600.

Sincerely,

Daniel Welsh
Assistant Field Supervisor

Enclosure

cc:
Robin Rosenau, COE, Sacramento, CA
Josh Garcia, COE, Sacramento, CA
Diane Waller, USDA, NRCS, Modesto, CA
Julie Vance, CDFG, Fresno, CA
Robert Scarborough, DWR, Sacramento, CA
Ed Katen, City of Newman, Newman, CA
Garner Reynolds, City of Newman Public Works, Newman, CA
Matt Machado, Stanislaus County Public Works, Modesto, CA
David Jones, Legislative Affairs, Stanislaus County, Modesto, CA
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UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

DRAFT
FISH AND WILDLIFE COORDINATION ACT REPORT

FOR THE

ORESTIMBA CREEK FEASIBILITY STUDY, STANISLAUS COUNTY, CALIFORNIA

PREPARED BY:

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U.S. Fish and Wildlife Service
Sacramento Fish and Wildlife Office
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Sacramento, California

PREPARED FOR:

U.S. Army Corps of Engineers
Sacramento District
Sacramento, California

July 2012

SUMMARY

Orestimba Creek is an intermittent stream that flows east out of the coast range across the Central Valley to the San Joaquin River just north of the City of Newman. The U.S. Army Corps of Engineers and Stanislaus County propose to construct a 4.7-mile-long chevron levee parallel to the Central California Irrigation District main canal embankment from the Newman Wasteway to State Highway 33, and associated structures (partial seepage berm, 2 miles of railroad embankment protection, raising of a 1,000-foot-long portion of State Highway 33, stoplogs), to prevent flooding of the city. This design completely avoids environmental issues of other previously-considered alternatives or project elements, such as impacts to high-value Central California Sycamore Alluvial Woodland (CCSAW) to the west of Interstate Highway 5 (I-5) that would have resulted from construction of a detention dam, and impacts to the creek, wetland, and other riparian vegetation east of I-5 that would have resulted from channel excavation. The Fish and Wildlife Service (Service) has reviewed project plans and Corps communications, and conducted several site visits to examine the project area. Based on this information, we find that the project as designed would affect a minimal area of agricultural fields (crops, orchards) or already-disturbed lands (bare ground) that are of low value to fish and wildlife resources. The project design meets the Service's Resource Category 4 goal to minimize loss of habitat value. The Service has no recommendations for design refinement or mitigation for the project as currently proposed. However, should the project be amended, or supplemented by separate future action (federal or non-federal) to involve other work such as channel improvements, we recommend that the Corps and/or sponsoring agency consider measures to preserve and enhance habitat along the creek corridor. Impacts to CCSAW should continue to be completely avoided in any potential future action. We also recommend that the Corps evaluate the need for technical assistance or consultation, as appropriate, for listed species.

INTRODUCTION

This document constitutes the Fish and Wildlife Service's (Service) draft detailed report under the Fish and Wildlife Coordination Act (FWCA) on the U.S. Army Corps of Engineers' (Corps) Orestimba Creek Feasibility Study. Orestimba Creek is a seasonally-flowing tributary of the San Joaquin River, which drains a 134 square mile watershed of the coast range north and west of the City of Newman (City). The creek has flooded 14 times over the last 41 years, affecting the city as well as agricultural lands. To address flooding of the City only, the Corps and Stanislaus County (County, the local sponsor) propose to construct a 4.7 mile long chevron levee parallel to the Central California Irrigation District (CCID) main canal embankment from the Newman Wasteway to State Highway 33 (Hwy 33), and associated structures (partial seepage berm, 2 miles of railroad embankment protection, raising of a 1,000-foot portion of Hwy 33, stoplogs). No work would be done in the creek channel.

BACKGROUND

The Service has coordinated with the Corps on this project since 1998 as part of the West Stanislaus Feasibility Study that included Orestimba, Salado, and Del Puerto Creeks. Previously, there had been considerable interest by the County to construct a dry dam upstream of Interstate Highway 5 (I-5), which would temporarily inundate one of the largest and highest quality groves of sycamore alluvial woodland in the State. The Service has participated in numerous meetings and site visits to the project area, and coordinated with other agencies including the California Department of Fish and Game (CDFG), and Department of Water Resources (DWR). In prior letters to the Corps, the Service, together with CDFG, identified major concerns with the dry dam approach and its potential effects on sycamore woodland, and on endangered species, particularly the endangered San Joaquin kit fox and California red-legged frog (Service 2002a, 2002b; Service and CDFG 2004). The Service has long emphasized the need to pursue other project approaches which would avoid and minimize impacts and take advantage of restoration and enhancement opportunities (Service 2002c). The DWR has expressed concern about effects on both habitat and water supply, due to risks created by the proximity of the proposed dry dam to the California Aqueduct (Corps 2010a).

At a public meeting on November 26, 2007, the Corps presented an alternative which did not involve any form of a dry dam, but instead a combination of a chevron levee along the CCID main canal and channel improvements (primarily excavation, some levees and riprap) along portions of Orestimba Creek. This alternative was the basis for the locally preferred plan discussed in the Corps' F4 conference report (Corps 2010a). In late 2011, the Corps informed the Service that the channel improvements were no longer being considered, and the project would consist only of a chevron levee element modestly refined from that described in Corps (2010a) (December 19, 2011, electronic mail [email] from Robin Rosenau, Sacramento District).

Information considered in this report includes: (1) a project description received February 6, 2012, by email; (2) plan sheets dated January 20, 2012, received February 14, 2012, by email; (3) Orestimba Creek flood Risk Management Feasibility Report. Appendix C6. Civil Design, dated December 2011 and received January 24, 2012, by email; (4) the F4 conference report (Corps 2010a); (5) observations by Service staff during site visits, most recently on

September 27, 2011 and April 14, 2012; and (6) other prior communications, reports, and site visits and meeting notes in Service files.

PROPOSED PROJECT

The proposed project consists of a single primary feature, a chevron levee that would provide flood protection to the urban area of Newman and nearby agricultural lands. The project evaluated in this draft FWCA report is the Locally Preferred Plan, which differs slightly from the National Economic Development Plan, because of its 1-to-2 foot higher levee and slightly larger footprint. The chevron levee (a total distance of 4.7 miles) would be constructed parallel to the east bank of the CCID Main Canal from the Newman Wasteway to Lundy Road, where it would continue east to Hwy 33. This chevron levee would be a new levee, set back a minimum of 20 feet from an existing short berm, or embankment, on the east bank of the canal. The levee would be about 4-to-6 feet tall, have 3:1 (horizontal:vertical) sideslopes, and a 16-foot-wide crown with an asphalt surface. The portion of the levee between Orestimba Creek Road and Stuhr Road would also have a seepage berm. The width of the levee cross-section would be about 64 feet, with an additional 28 feet for the seepage berm section.

At each of the Shiells, Draper, Orestimba Creek, and Stuhr Road crossings, there would be a stop log closure structure consisting of a slotted abutment on each side of the roadway in which logs could be placed during potentially-damaging flood events. Hwy 33 would be raised up to 1.5 feet over a distance of 1,080 feet where it meets the levee. At the intersection of the levee and Hwy 33, a swing gate would be constructed hinged to abutments on each side of the road. During large flood events, floodwaters would be held behind (west) the chevron levee and be discharged either into the Newman Wasteway to the south, or over the railroad embankment to the north. Specifically, from the north end of the chevron levee where it meets Hwy 33 to the Orestimba Creek undercrossing, railroad embankment erosion protection would be installed to mitigate the potential erosional effect of railroad overtopping. This embankment work will have a 5:1 sideslope (flatter than existing) consisting of sand and gravel topped with rock. Existing culverts would be extended through the embankment.

There will be three staging areas: near JT Crow Road (1.9 acres), Lundy Road (10.6 acres), and Orestimba Creek Road (11.7 acres). The 24 existing CCID gravity diversion pipes would be extended through the new chevron levee and fitted with closure structures. Several existing groundwater wells in the area that may be affected during flood events will be floodproofed. There will be assorted other relocations or demolitions of buildings, power poles, and several ditches. The levee work will create about 41 acres of isolated drainage between the CCID berm and the new levee toe. Any residual ponding between the berm and new levee after large floods would be drained by portable pumps.

BIOLOGICAL RESOURCES

Currently-proposed project footprint: A detailed site visit was conducted on April 12, 2012, and consistent with earlier information (Corps 2010a; EDAW 2001), the footprint of the currently-proposed project consists primarily of agricultural lands (row crops, orchards) and developed lands (bare ground or gravel on road or embankment surfaces; some residences), with a very

minimal area of herbaceous cover associated with fallowed agricultural fields. The following describes the land uses and cover-types in the project footprint, beginning at the north end of the site, during this most recent site visit:

Railroad Embankment Erosion Protection, Staging Area 1: Nearly all of this 2-mile portion of the project consists of bare ground or slag gravel from the existing railroad bed. The terminus at Orestimba Creek was not examined, but is expected to be limited in extent of impact to the creek (~60 feet of creek), if any, largely encompassing the existing bridge abutment, which is already disturbed/developed bank.

Lundy segment, Staging Area 2: This portion of the levee, from Hwy 33 to the CCID main canal north of Stuhr Road, is intensively managed agricultural fields, either row crops or bare ground (i.e., when plowed).

CCID main canal segment, from end of Lundy segment continuing past Stuhr Road to Orestimba Creek Road, seepage berm, Staging Area 3: This is mainly agricultural fields, row crops, with some alfalfa and sparse weeds. Some very young orchards are present near Orestimba Creek Road.

CCID main canal segment, from Orestimba Creek Road to Draper Road: This section includes a few structures, agriculture planted in wheat (or fallow), and some flooded fields.

CCID main canal segment, from Draper Road to Shiells Road: This section consists of orchard.

CCID main canal segment, from Shiells Road to Newman Wasteway: This section includes some winter wheat, limited light residential with urban plantings, fallowed fields with common herbaceous plants, and young orchard.

CCID main canal embankment: The embankment was found to be exclusively bare ground and appeared rigorously maintained free of any vegetation (woody or herbaceous) on both site visits.

Wildlife use in the project footprint area is likely to be limited to common bird and mammal species that use agricultural fields and disturbed ground. Avian wildlife seen during our site visit were red-tailed and other (unidentified) hawks, Brewer's blackbird, yellow-billed magpie, and crows. Waterbirds seen only in the flooded field area were great egret, mallard duck, ibis, and black-necked stilt. A number of 4-to-6 inch diameter small mammal burrows were seen in portions of the CCID main canal, and were suspected to be California ground squirrel.

Previously, qualitative field surveys of a much larger study area that included the project footprint and nearby areas, were conducted by EDAW in 2001, and by "GSRC" in 2008 (EDAW 2001; Corps 2010a). Except for the waterbirds we observed, these studies revealed a similar common array of vegetation and wildlife species typical of agricultural areas as was seen during our site visit. Orchards were planted with walnut, almond, apricot, or cherry trees, and were devoid of native vegetation. Row and field crops included alfalfa, beans, broccoli, cantaloupe, oats, sugarbeet, tomato, and others. Besides these crops, vegetation fence lines, roads, and other ruderal or fallow areas, included mustard, common cocklebur, common sunflower, and yellow

starthistle. Wildlife use was found to vary with crop type and time of year, and included Audubon's cottontail, California vole, western scrub-jay, American crow, barn owl, and yellow-billed magpie. Other species in more urban areas were the rock pigeon, European starling, house sparrow, house mouse, and brown rat. These field surveys recorded additional species, including hawks, songbirds, and other mammals such as coyote, raccoon, badger, skunk and bobcat, in other parts of the study area outside of the agricultural areas. However, this wildlife may occasionally forage in nearby agricultural lands including the footprint of the project now currently proposed.

For the purpose of this draft FWCA report, only preliminary information is provided on listed species. The area that had been studied previously by the Corps included much of Orestimba Creek including sycamore alluvial woodland west of I-5 to the San Joaquin River, due to alternatives that included detention dam and/or channel excavation elements. Listed species in this larger area that could be affected include: (1) the California red-legged frog (CRLF), which has known records in the Simon-Newman ranch upstream of that study area, and two, 1990s sightings near the Delta Mendota Canal and California Aqueduct near the project area; (2) the valley elderberry longhorn beetle (VELB), whose host plant occurs sporadically - at least one shrub at Morris Road and others downstream to the San Joaquin River; and (3) the San Joaquin kit fox (SJKF) - which has at least four records on the California Natural Diversity Data Base in or within 10 miles of this study area. Although no specific habitat assessment has been done for the project footprint (or adjacent CCID main canal), the presence of CRLF is unlikely there due to likely presence of bullfrogs, lack of marsh vegetation, and separation distance from known records. The VELB in the current project footprint is unlikely due to the absence of elderberry. The SJKF however, cannot be completely ruled out from the current project footprint, which is in a general region considered important to this species as a link between core and satellite populations in the area. The SJKF may travel along waterways such as the CCID main canal, and may use ground squirrel burrows such as were observed in the CCID embankment.

Nearby habitat: As discussed in Corps (2010a), there are a variety of other cover-types, including some higher value biological resources near, but not within, the footprint of the currently proposed project along Orestimba Creek. These include the following, none of which would be impacted by the project as proposed (descriptions based on Service staff site visits; general descriptions in Ayres (2007) and Corps (2010a); and other references, cited below). Other project alternatives previously examined or additional future work beyond the currently-proposed project could affect these resources.

Sycamore Alluvial Woodland: A 249-acre stand of Central California Sycamore Alluvial Woodland (CCSAW) is present, located from just east of I-5 extending west about 4 miles along Orestimba Creek. The CCSAW is a rare habitat type characterized by overwhelming dominance by sycamore trees and is limited to 2,032 acres in 17 locations in the State (CDFG 1997). The CDFG (1997) determined the Orestimba Creek stand to be the second largest and highest quality CCSAW stand in existence. The Orestimba Creek CCSAW supports high densities of nesting raptors including Swainson's hawk, red-tailed hawk, and great horned owl, migratory passerine birds during the breeding season, and other woodland birds such as woodpeckers and magpies (EDAW 2001). Studies by EDAW (2001) also documented use by mammals such as Audubon's cottontail, raccoon, badger, bobcat, and coyote. Earlier study also revealed a wide variety of

wildlife within this CCSAW stand, including waterbirds, raptors, numerous songbirds, and small and large mammals (DWR 1995).

Freshwater Marsh: This habitat includes cattails, knotweed, soft rush, and other common wetland plants. During site visits, Service staff observed freshwater marsh intermittently on Orestimba Creek from at least Eastin Road downstream to Morris Road where the Corps had previously considered channel improvements including excavation. Seasonality and permanence of the marsh appeared to vary, possibly due to variations in drainage and impoundment of irrigation water discharge into the creek. In the shallowest areas, numerous juvenile frogs (probably bullfrog) were noted during recent Service site visits.

Riparian Forest: Riparian habitat (other than CCSAW) occurs intermittently along Orestimba Creek in various forms, including young riparian, such as willows (e.g., downstream of Anderson Road to upstream of Lawer's Lane), or mixed or oak-dominated riparian woodland including cottonwood, oak, box elder, and other understory species (e.g., 0.25 mile upstream of Morris Road; Delta Mendota Canal vicinity; from about 0.25 mile east of Morris Road downstream to the San Joaquin River). Overall, riparian habitat is discontinuous, with some sections of the creek devoid of riparian trees (e.g., first 0.25 mile downstream of Morris Road, Lawer's Lane vicinity).

FUTURE WITHOUT THE PROJECT

Without the project, current habitat in the project footprint, and surrounding nearby areas, would remain essentially unchanged. This area would likely remain in agricultural use as row crops and orchards, and associated light residential structures. Urban growth would be limited as a consequence of the continuation of relatively high flood risk.

FUTURE WITH THE PROJECT

The project as currently proposed, involving only a chevron levee and associated elements, substantially avoids all impact to higher value riparian, CCSAW, and wetland habitats that are very limited in the region as a whole. The proposed project would impact a relatively small area of agriculture that is abundant to the region and of limited value to wildlife. When complete, the project may have an indirect, interrelated, and interdependent effect of inducing growth in the form of urban or residential development at the expense of agricultural land in the area protected by the chevron levee. The direct and indirect effects of the project on wildlife would be modest, consisting of a small, incremental loss of habitat for common small mammals and birds associated with agricultural lands. Foraging on these small mammals by raptors could be reduced by a slight amount compared to the abundance of remaining similar habitat. Some of this loss would be considered temporary, during the time of construction only, in that the area of the new chevron levee may possibly support herbaceous cover and associated wildlife after the project is complete.

RESOURCE CATEGORIES AND MITIGATION GOALS

The Service's Mitigation Policy (Policy) (FR 46:15 January 23, 1981) provides general guidance in making recommendations to conserve fish and wildlife resources. Under the Policy, resources are assigned to one of four Resource Categories, with a mitigation goal consistent with the values provided to fish and wildlife and the rarity of that habitat (cover-type). A mitigation goal is assigned ranging from "no loss of existing habitat value" (Resource Category 1) for the most valuable kinds of habitat, to "minimize loss of habitat value" (Resource Category 4) for the less valuable and most common kinds of habitat. Application of the policy involves designating cover-types which may be affected, and assigning evaluation species based on the sensitivity of those species to the project action, their role in the ecosystem, or association with Service-wide resource management issues such as anadromous fish and migratory birds. We then state the Resource Category, the rationale for that selection, and the corresponding mitigation goal.

The cover-types which occur within the project site or its influence are agriculture and developed/disturbed land.

Agriculture constitutes the majority of the footprint of the project, and dominates the landscape of the surrounding area. It is characterized by intensively managed row crops and tree orchards as described above (Biological Resources). Management involves frequent disturbance for plowing, weeding, and harvest, and treatment with chemical pesticides and fertilizers. Wildlife use can vary with the particular crop. Generally, these areas are utilized by common songbirds, blackbirds, and others, during the growing season, occasionally by waterbirds for flooded fields, by raptors under some circumstances (e.g., certain crops uses that permit foraging, fallow fields, fields after plowing), and by a variety of small mammals. This cover-type is common and of low to medium value to the evaluation species such as blackbirds and hawks. In the case of this project and where it occurs, we designate agriculture as Resource Category 4 ("minimize loss of habitat value").

Developed/disturbed land is a significant proportion of the project area. It includes bare road surfaces, residential dwellings and landscaping, and a railroad embankment. Although no quantitative mapping was done, we estimate it to be about 25% of the project footprint. These areas are of very limited value to wildlife in the project area, occasionally exhibiting burrows, or sightings of wildlife species. There is no evaluation species with a clear association with this cover-type. We designate developed/disturbed land as Resource Category 4 ("minimize loss of habitat value").

DISCUSSION

The project as proposed substantially avoids impacts to higher value habitats, and has limited foreseeable growth-inducing impacts, compared to other alternatives previously studied. Our mitigation goal for the agricultural habitat and other developed/disturbed lands that are affected (i.e., to "minimize loss of habitat value") is met by the proposed design. The Service has no recommendation for mitigation or project refinement. Of particular note is the lack of effect on CCSAW, a cover-type which is extremely limited in extent in the State, and threatened by water development projects, grazing, disease, groundwater pumping, gravel mining, and scarcity of

natural regeneration. Our review of available information suggests that conditions favoring the natural formation of CCSAW are very rare. Accordingly, we believe it is unlikely that CCSAW can be created by artificial means such as by mitigation efforts to compensate loss. The Service considers CCSAW to be a unique and irreplaceable habitat type. Selection of the chevron levee approach reduces the specific threat to CCSAW at this time, in one location. State-wide, however, CCSAW remains threatened over the long-term as demand increases in the future for flood protection, water supply, and water development projects to meet these demands. In order to protect CCSAW and to encourage project planning to avoid impacts State-wide, the Service has prepared a draft Resource Category 1 (i.e., "no loss of existing habitat value") proposal document for consideration by our Regional Office.

Although the reduced extent of the project avoids habitat impacts currently, it also limits the flood protection to the City and surrounding areas east of the chevron levee. Previously, the local sponsor has expressed a desire to achieve flood protection in a larger area (i.e., east to I-5) through other alternatives or additional elements, such as channel improvement (summarized in Corps 2010a). It is possible that additional elements could be constructed after this currently-proposed project. The effect of such future work would depend on the design. Some designs could have further direct impacts on higher value riparian habitat such as through channel excavation, riprap revetment, and channel maintenance, as well as indirect impacts if the provision of flood control induced conversion due to growth. The Corps estimated that the channel modification element (not currently proposed), would have directly affected 17 acres of valley oak woodland, 2.2 acres of mixed riparian woodland, 23.7 acres of riparian scrub, and 65 acres of freshwater marshland would require significant mitigation (Corps 2010a). Other designs, incorporating strategically located bypass, setback levee, and/or floodplain bench excavation elements, might allow for some protection and enhancement of riparian habitat, greater habitat continuity, and relaxed disturbance from maintenance operations. For example, Ayres (2007) discussed creating an inset floodplain in a formerly mined area upstream of Jorgensen Road, that could be revegetated, and a bypass channel between the Eastin/Anderson Road intersection and the CCID main canal. Earlier, the Corps identified a bypass in a "horseshoe bend" location, which could potentially support a broad riparian zone (Corps 2001). Service and CDFG (2004) also recommended that the Corps investigate small incremental projects throughout the Orestimba Creek waterway, such as bypass features, that could jointly alleviate flooding and restore habitat. The Service continues to recommend that any future flood control work incorporate features which would enhance the quality and quantity of habitat consistent with flood protection objectives.

The region in which the project occurs does include records of listed species that should be considered. Recently, at the Service's recommendation, the Corps conducted pre-construction surveys for SJKF prior to borings required for design of the chevron levee (Corps 2010b), and made a determination that the dens present were not occupied by SJKF, to which the Service concurred (October 6, 2010, email from Michael Welsh, Sacramento Fish and Wildlife Office, to Lindsay Dembosz, Sacramento District). However, the spatial extent and duration of construction for the currently-proposed project is greater than that of the boring activity, and this construction period may limit the ability to entirely avoid impacts such as working outside of SJKF breeding/pupping periods. Therefore, the Service recommends that the Corps proceed with its normal evaluation and determination of the need for consultation for SJKF and other

listed species in the project area. This determination process typically includes requesting a species list, reviewing current survey protocol guidance for each species available on our website (http://www.fws.gov/sacramento/es/Survey-Protocols-Guidelines/es_survey.htm), and the compilation of information on habitat, vicinity records, and/or conduct of habitat assessment for submission to the Service for review. Contact with the Service for technical assistance and, as appropriate, consultation, would provide the best assurance for take coverage and timely project completion should any such species be encountered during construction.

RECOMMENDATIONS

The Service recommends that the Corps:

1. Implement the project (chevron levee, no channel modifications) as proposed.

2. Evaluate the effect of the proposed project on listed species, and contact the Service for technical assistance and consultation, as appropriate.

3. If any future additional flood control work, by separate federal or non-federal action, is proposed that could affect more valuable cover-types (riparian woodland or scrub, wetland), investigate and promote measures which would maximally preserve, enhance, and/or restore habitat along the Orestimba Creek corridor.

4. In the consideration and planning of future flood control work, continue to completely avoid impacts to CCSAW.

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GETECHNICAL ENGINEERING EVALUATION

ORESTIMBA FEASIBILITY STUDY

NEWMAN, CALINFORNIA

FINAL

Prepared By:

U.S. Army Corps of Engineers

Sacramento District

Geotechnical Branch

QUALITY CONTROL CERTIFICATE FOR GEOTECHNICAL PRODUCTS

Project Name: Orestimba Creek Feasibility Study Project Manager: Michelle Williams

Organization: CE SPK ED GS B (Sacramento District, Soil Design Section B)

Geotechnical Product: Geotechnical Appendix Actual Completion Date: 01/26/2012

PREPARER – I have prepared the above products in accordance with the Quality Management Plan.

Preparer: _____ date: 01/26/12
Signature / Glen A. Johnson

REVIEWERS – I have reviewed the product noted above and find it to be in accordance with the Quality Management Plan meeting project requirements, and the profession and Corps of Engineers policies and standards.

Lead QC Reviewer: _____ date: 1-26-2012
Signature / Joseph Sciandrone

Lead AT Reviewer: _____ P.G. date: 1/26/2012
Signature / Eugene Lenhardt

PREPARER – I have incorporated or resolved all review issues in accordance with the Quality Management Plan.

Preparer: _____ date: 01/26/12
Signature / Glen A. Johnson

Resource Providers– I have reviewed, and all critical and technical issues have been resolved. I agree that all project requirements and standards of the profession and Corps of Engineers' policies and standards have been met.

Section Chief: _____ date: 9FEB12
Signature / Kevin Hazleton

Branch Chief: _____ date: 9Feb2012
Signature / Edward Ketchum

QUALITY CONTROL PLAN FOR GEOTECHNICAL PRODUCTS

Lead Geotechnical Organization: CE SPK ED GS B (Sacramento District, Soil Design Section B)

PROJECT AND TECHNICAL PRODUCT INFORMATION

Project Name: Orestimba Creek Feasibility Study Project Manager: Michelle Williams

Geotechnical Product(s): Geotechnical Appendix Scheduled Completion Date: 01/24/2012

Project Team

Name	Function	Office	Phone Ext.
Glen A. Johnson	Geotechnical Lead	SPK Soils Design	X6681
Michelle Williams	PM	SPK PM	X7098
Sara Schultz	Planning	SPK Planning	X7368

Product Quality Objectives

1. Product meets Corps of Engineers Technical Design Standards.
2. Product meets requirements of Scope of Service.

Review Team

Name	Function	Office	Phone Ext.
Glen A. Johnson	Geotechnical Lead	SPK Soil Design	X6681
Joseph Sciandrone	Internal QC Reviewer	SPK Soil Design	X7184
Eugene Lenhardt	AT Review Team Lead	LRB Geotechnical	X4167
Jonathan Kolber	Other AT Reviewer	LRB Geotechnical	Retired

The preparer of the technical product will ensure that it meets the product quality objectives for the project.

The above Quality Control Review, including internal peer reviewer(s), will perform their review in accordance with SOP EDG-02: "Technical Product Review Policy and Procedures" developed for the Engineering Quality System.

The AT reviewer will provide a review of major assumptions, analytical approaches, significant calculations, recommendations and conclusions in accordance with the Engineering Division's Engineering Quality System.

The preparer will assure that all comments are either incorporated into the product or comments are resolved with the reviewer. In event that the comment is not resolved it will be elevated to the Chief, Organization Lead to mediate.

Geotechnical Lead: Glen A. Johnson date: 01/26/12
Signature / Glen A. Johnson

QC Review Lead: Joseph Sciandrone date: 1-26-2012
Signature / Joseph Sciandrone

AT Review Lead: Eugene N. Lenhardt P.E. date: 1/26/2012
Signature / Eugene Lenhardt

Section Chief: date: 9 Feb 2012
Signature / Kevin Hazleton

Branch Chief: date: 8 Feb 2012
Signature / Edward Ketchum

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1.0 INTRODUCTION

The purpose of this report is to provide further geotechnical evaluation of the eastern levee alignment near the Central California Irrigation District canal system (CCID Canal). Both the eastern and western levee alignments have been evaluated under a separate study that determined the most favorable geotechnical alignment to be the eastern alignment driven mostly by seepage considerations. This report also recommends future geotechnical investigations relating to the eastern levee alignment and other project features.

1.1 PROJECT DESCRIPTION

This report summarizes the geotechnical investigation of the proposed CCID Canal levee alignment located near the city of Newman, California. The geotechnical investigation study area of the proposed alignment is shown on a site map in ***Plate 1***.

The city of Newman, California is located in southwestern Stanislaus County near the border of Merced County. It is bounded on the west by the coastal Diablo Mountain Range, the east by the San Joaquin River, the north by Crows Landing, and the south by the Merced County line. The watershed consists of approximately 185 square miles of mountain rangeland and irrigated farmland. Orestimba Creek is an ephemeral stream that runs through an alluvial fan and receives its flows from storm runoff from the Diablo Range and farmland irrigation (***Figure 1.1***). Orestimba Creek is traversed by Interstate 5, the California Aqueduct, Delta Mendota Canal, CCID Canal, Highway 33, and the California Northern Railroad Company. Orestimba Creek flows from the west towards the northeast through an alluvial fan as it drains its watershed in the Diablo Range to the San Joaquin River.

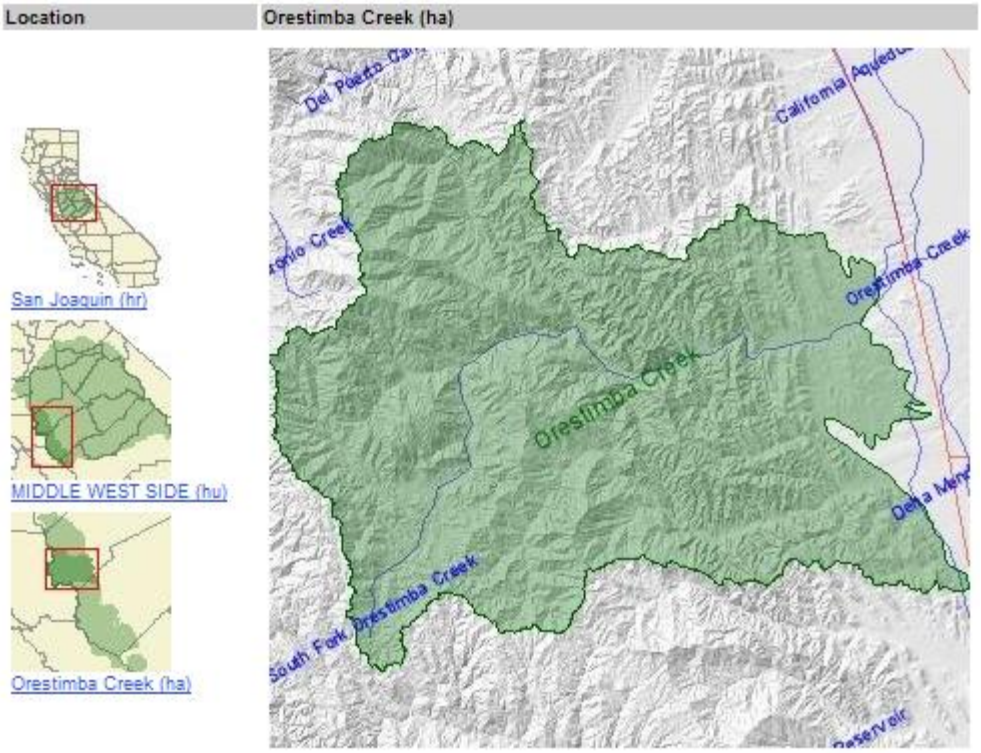

Figure 1.1: State of California Department of Conservation, Orestimba Creek Watershed

Orestimba Creek is prone to flash flooding due to winding low-flow channels and most notably the constriction caused by the California Northern Railroad trestle and railroad berm that maintains a north/south alignment through the city of Newman. As Orestimba Creek becomes constricted due to debris deposited at the California Northern Railroad trestle, water breaks out of the channel and sheet flows along the railroad berm into the city of Newman.

The proposed levee alignment would be located approximately 1.5 miles west of the city of Newman and would parallel the CCID Canal. The alignment would be offset a minimum of 20-feet from the CCID Canal and begin in the south at Newman Wasteway. The alignment would then continue north offset and adjacent to the CCID Canal to approximately Farm Road (directly west of Lundy Road); the alignment would then turn north-east and cross Highway 33 and tie in perpendicular to the California Northern Railroad (***Plate 2***). This would intercept the water that sheet flows toward the city.

Two alternatives were examined for the proposed levee alignment; the first alternative located the levee alignment along the west side of the CCID Canal; the other alternative located the alignment along the east side of the CCID Canal. The alignment along the west side of the canal was rejected due to geotechnical conditions which would lead to exceedance of hydraulic exit gradient criteria landside of the levee. These results have been documented in a geotechnical memorandum entitled, ***Geotechnical Analysis for Orestimba Creek Project Located near Newman, Stanislaus County, CA***, dated 10 May 2011. A copy of this memorandum is included in **Appendix A** of this report.

Information provided in this report includes: logs of geotechnical explorations used to develop the soil profile along the proposed alignment, analysis cross-sections, results of deterministic analysis for seepage and stability of levee cross-sections, and the results of the analysis.

1.2 DATUM AND TOPOGRAPHY

No topographic survey data was available for this project. The location of borings referenced in this report were determined using a handheld GPS unit with an accuracy of plus (+) or minus (-) 9-feet.

Topographic LIDAR imaging data (Light Detection and Ranging) was obtained from HDR, Inc. and converted by USACE Hydraulic Design. This data was tested and confirmed not to exceed 3.5-feet horizontal accuracy at 95% confidence level, and 0.6-feet vertical accuracy at 95% confidence level. LIDAR imaging data was used to generate the elevations needed to generate cross-sections for seepage and stability analysis.

1.3 HORIZONTAL AND VERTICAL DATUM

The horizontal datum used for this project is the North American Datum of 1983. The vertical datum used is NAVD 88.

1.3.1 COORDINATE SYSTEM

This report uses the State Plane coordinate system, California Zone 3.

2.0 REGIONAL AND SITE GEOLOGY

2.1 REGIONAL GEOLOGIC SETTING

The general geology of the site described herein is based on excerpts of a U.S. Geologic Survey Professional Paper by Hosford Scheirer and Magoon (2008) of the San Joaquin Valley into North Central and South Sub-Provinces. This work describes in detail the three dimensional composition of the San Joaquin Valley. The site location falls within the North sub-province.

This area of California was part of the early Cretaceous to Paleocene convergent tectonic margin and associated Sierran magmatism. The basement rock in this area consists of Sierran granite or granitoid rocks on the eastern side of the basin and the Coast Range ophiolite to the west. Age-dated profiles suggest a migration of plutonism from west to east with the oldest rocks occurring on the margin of the San Joaquin Valley and the youngest appearing on the eastern flank of the Sierra Nevada (Hosford Scheirer and Magoon, 2008). With the end of plutonism came the beginning of the flat slab subduction mega-sequence about 5 Ma (million years) subsequent. During the late Cretaceous through the beginning of the Paleocene, the Panoche and Moreno formations indicate dominantly marine conditions with periods of scattered and non-aerially extensive terrestrial deposition. The geologic record is incomplete from the late Paleocene to the early Eocene in the Northern Sub-province during which time the Lodo (marine) and Yokut (near shore fluvial deltaic) formations were deposited. The Yokut deposition was followed (conformably) in the north sub-province by the Domengine sand (shallow marine transgressive). Deposition of the Kreyenhagen formation (marine) began concurrently with the Domengine formation and continued long after into the middle Eocene (37 Ma). The geologic record is incomplete in the north sub-province until the deposition of the late Oligocene to early Miocene Zilch formation (terrestrial - period of worldwide regression) which lies unconformably above the Kreyenhagen. The Zilch is unconformably overlain by the upper Miocene Santa Margarita Sandstone (shallow marine clastic). The remaining sequence of sediments are generally Pliocene and Pleistocene terrestrial deposits derived from the uplift of the Sierra Nevada and Coast Range. These younger sediments include the Pliocene Mehrten formation (terrestrial fluvial - derived from volcanic sources), the Pliocene China Hat formation (terrestrial fluvial – Sierran origin). These are overlain by the Pleistocene Merced, Turlock Lake, Riverbank, and Modesto formations all of which thin to the west of the basin and interfinger with sediments derived from the coast range to the west. These are in turn incised by Holocene alluvial channels and covered by Holocene fan deposits.

2.2 SITE GEOLOGY

The surface geology of the site consists of Holocene fan deposits derived from the basins of the Orestimba and Garzas Creeks which drain from the Diablo Range eastward. According to Taliafero (1943) “Eocene and Miocene sediments are exposed about 6 miles west of Patterson and Newman, and the Jurassic-Franciscan group comprises the summit of the Diablo Range, the western boundary of Stanislaus County. The Franciscan formation is composed of many varieties of sedimentary, igneous, and metamorphic rocks. The sediments include arkose sandstone, argillaceous shale, chert, siliceous shale, some conglomerate, and metamorphosed arenaceous and argillaceous materials. Igneous occurrences are principally basic, but stone acidic porphyrites are found. In general, the intrusives have been altered to serpentine. The Franciscan

formation is differentiated from the overlying cretaceous strata mainly by its intense alteration. The Tejon formation of upper Eocene age is exposed from west of Patterson to the south beyond the Stanislaus County line. The Tejon is composed of fine-grained gray clayey sandstone with interstratified beds of fine-grained light-brown shale and gray clay. Layers of coal occur in the lower portion of these marine sediments. Upper Miocene marine sediments of the San Pablo formation can be traced along the base of the Diablo Range. The Kreyenhagen shale (upper Eocene) overlies the Tejon formation west of Crows Landing and extends southward to the Stanislaus County line." These source rocks are the materials from which the fan deposits and channel overbank deposits of the Orestimba and Garzas Basins are derived (Rogers, 1966). These deposits have been mapped as the late Pleistocene to early Holocene San Luis Ranch alluvium overlain by the early Holocene to modern Patterson alluvium (Lettis, 1982).

The CCID Main Canal project site is underlain in most areas by the coarse grained upper fan deposits of the San Luis Ranch formation. Where the canal passes Jensen Road (to the east) the site is underlain by younger deposits of the Patterson alluvium consisting of coarse grained fan deposits. This sequence only covers about 1700 feet of the canal project.

2.3 REGIONAL SEISMICITY

The project lies within the San Joaquin Valley and is consequently exposed to less seismic response during a maximum credible earthquake on the nearest active fault than sites in the San Andreas, Hayward or Calaveras fault zones for example. However, Petersen et al. (1996) have mapped this area as having a 10 percent chance in 50 years to exceed peak horizontal ground accelerations of 30-50% the force of gravity. In addition, Branum et al. (2008) have categorized the site vicinity as a low to intermediate level Seismic Hazard area (***Figure 2.1***).

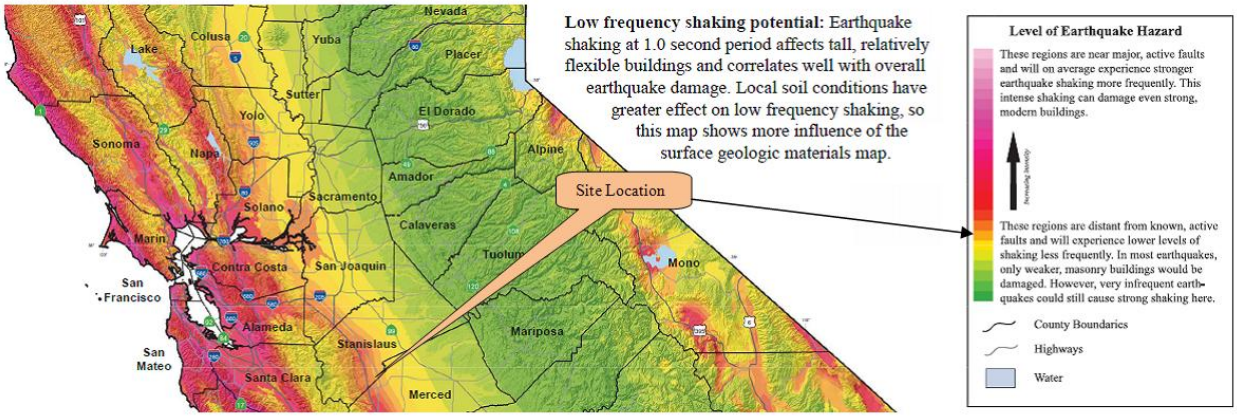

Figure 2.1: Branum, et al. 2008

The site is approximately 35 miles east of the Calaveras fault system (***Figure 2.2***). The Calaveras fault is 75 miles long and capable of generating a M_w (moment magnitude) 7.5 maximum credible earthquake (MCE). The Holocene Ortigalita fault is 41 miles long and is located approximately 13 miles southwest of the site. The Ortigalita fault is capable of generating a M_w 7.0 maximum credible earthquake (Mualchin, 1996). The site is less than two miles from the Quaternary San Joaquin fault (Unruh & Krug, 2007). The San Joaquin fault marks the physiographic boundary between the Diablo Range and the Central Valley (Unruh & Krug

2007). The San Joaquin fault parallels the range front from the Corral Hollow creek outlet in the north to the Garzas creek outlet in south. Estimates of motion for this fault are in the range of 60 meters of west-side-uplift over the last 200 to 300 thousand years. Maulchin (1996) has estimated a M_w 6.5 MCE for this fault. However, there is little evidence that this fault has moved in Holocene time.

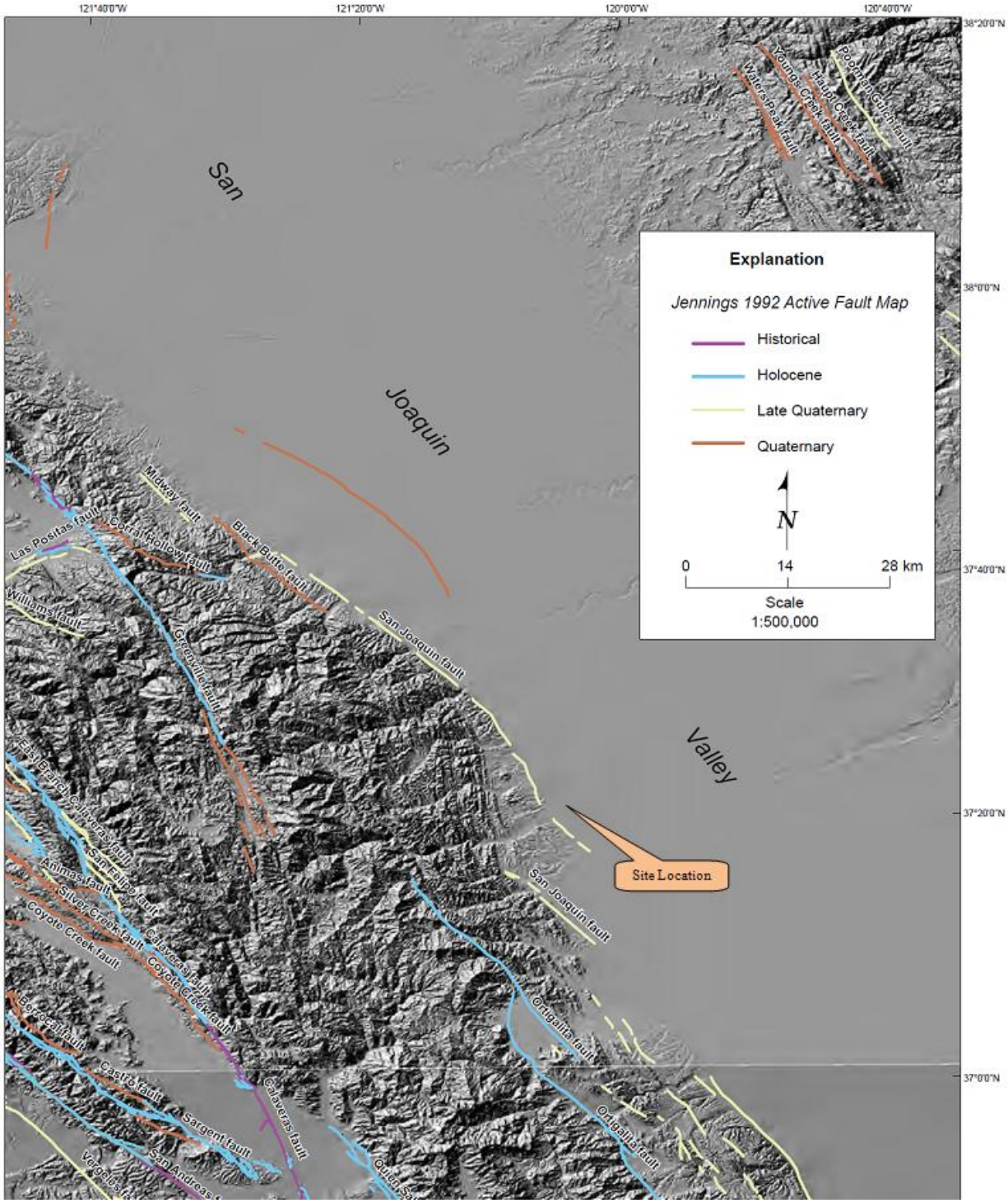

Figure 2.2: Unruh & Krug (2007), from Figure 4

3.0 SUBSURFACE EXPLORATIONS

At the initiation of this study, no previous geotechnical borings had been completed along or near the proposed alignment. Boring locations were determined by a representative of the USACE and the CCID. In November of 2010, twenty-one (21) borings were completed along the west side of the CCID Canal alignment by Moore Twining Associates under a contract by the city of Newman. The borings were completed using 6 to 8-inch hollow-stem auger or mud-rotary drilling methods. Of these twenty-one borings, one boring was stopped at a depth of 6-feet due to drilling mechanical problems, fifteen borings reached a depth of 40 feet, one boring reached a depth of 53.5 feet, three borings reached a depth of 60 feet, and one boring reached a depth of 81.5 feet bgs (below ground surface). Due to funding constraints, the lower extent of the pervious foundation material could not be determined for some of the boring locations. Standard penetration blow counts were performed using an automatic trip hammer at specific intervals using a split-barrel sampler with an inside diameter of 1-3/8 inches and an outside diameter of 2 inches. Where standard penetration blow counts were preformed, disturbed samples were obtained. No undisturbed samples were taken. The explorations were located approximately 20-30 feet west of the canal berm toe along the west side of the CCID Canal. The explorations were spaced approximately 1,350 feet apart and started just north of the Newman Wasteway (***Plate 3***).

The borings completed by Moore Twining Associates, and the subsequent laboratory testing, are the basis of developing the geotechnical cross-sections and selection of the soil parameters for the geotechnical analysis.

3.1 MOORE TWINING ASSOCIATES, INC.

Moore Twining Associates, Inc. completed their report, ***Summary of Drilling and Geotechnical Services, dated January 24, 2011***. This report includes a brief summary of the work completed, a boring location map, boring logs, laboratory testing, and energy measurement for the automatic hammer. This Moore Twining Report is included as **Appendix B**.

3.2 LABORATORY TESTING

Preliminary laboratory testing, including moisture content (ASTM D2216), sieve analysis (ASTM D422), and Atterberg Limits (ASTM D4318) were performed to aid in soil classification and to establish soil properties used in the seepage and stability analysis. The laboratory testing results are available in the Moore Twining Report listed in Section 3.1.

4.0 STUDY AREA DESCRIPTION

4.1 SURFACE AND SUBSURFACE CONDITIONS

The study area is covered mostly by agricultural land. Subsurface investigation and laboratory test results show an upper soil layer of soft to hard, medium-to-highly plastic lean clay (CL) to a highly plastic fat clay (CH) varying in thickness from 2.5 to 23 feet. The fines content of this material varied from 58 to 95 percent; the blow counts (N-value) were from 2 to 40; the N_{60} blow counts were from 3 to 53 and the consistency of the cohesive material varied from soft to hard. The lower foundation material consisted of clean poorly-graded sands (SP) to poorly-graded

sand with silt and gravel (SP-SM); this material varied in thickness from 16 to 64.5 feet; the blow counts (N-value) were from 3 to 80; the N_{60} blow counts were between 4 and 106, and the relative density ranges from very loose to very dense. A confining impervious layer was encountered in some borings varying in thickness from 10 to 25 feet. The fines content of this material varied from 60 to 90 percent; the blow counts (N-value) were from 4 to 34; the N_{60} blow counts were from 7 to 41, and the consistency of the cohesive material varied from soft to hard. Ground water was encountered in 11 of the 21 borings and varied from 35.0 to 52.0 feet below ground surface (bgs).

Most of the sandy fat clay material tested had liquid limits ranging from 50 to 62, plasticity indices ranging from 29 to 40, and moisture contents ranging from 9 to 14 percent. The sandy lean clay material tested had liquid limits ranging from 28 to 36, plasticity indices ranging from 15 to 21, and moisture contents ranging from 9 to 21

4.2 REACH IDENTIFICATION

The proposed CCID Canal levee alignment is approximately 4.7 miles long. For this report, the proposed levee alignment has been divided into five general Reaches; Reaches A through E. Reach A is from Station 0+00 to 50+00, Reach B is from Station 50+00 to 100+00, Reach C is from Station 100+00 to 150+00, Reach D is from Station 150+00 to 200+00, and Reach E is from Station 200+00 to 245+00. ***Table 4.1*** lists each Reach by stationing with borings. Each Reach can also be seen in the attached ***Plan and Profile Sheets 1 through 5***.

Reach	Station		Borings
	Start	End	
A	0+00	50+00	2F-11-01 through 2F-11-05
B	50+00	100+00	2F-11-06 through 2F-11-09
C	100+00	150+00	2F-11-10 through 2F-11-13
D	150+00	200+00	2F-11-14 through 2F-11-17[1]
E	200+00	245+00	2F-11-19 through 2F-11-22

[1] Boring 2F-11-18 was not completed due to funding constraints.

Table 4.1: Levee Reaches

5.0 GEOTECHNICAL ANALYSIS

5.1 GENERAL

Geotechnical analyses were performed on a typical cross section considered representative for each Reach. The geotechnical analyses include underseepage and slope stability analyses. The soil layers used in the geotechnical models were developed by characterizing the subsurface data into layers of similar material properties. The soil layering used in the analyses are shown below in ***Figures 5.1 through 5.6***.

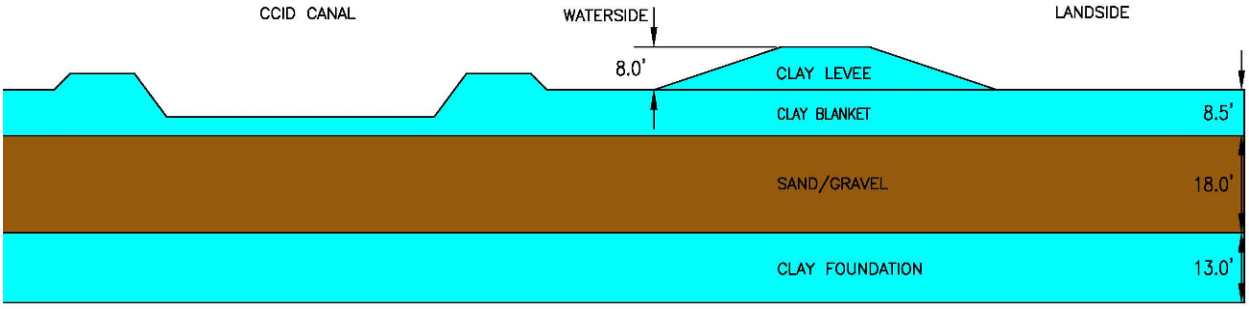

Figure 5.1: Reach A was modeled with an 8.5-foot blanket, an 18.0-foot pervious layer, and a 13.0-foot clay (CL) deep foundation.

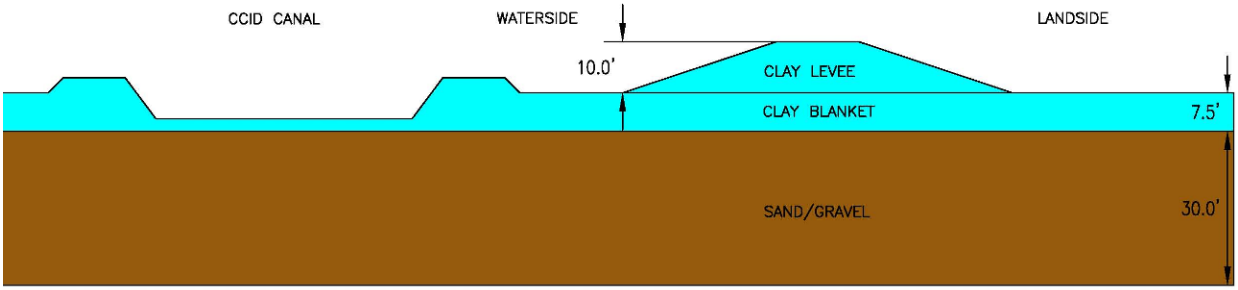

Figure 5.2: Reach B was modeled with a 7.5-foot blanket, and a 30.0-foot pervious layer.

Reach C was unique and had to be modeled for two separate cases.

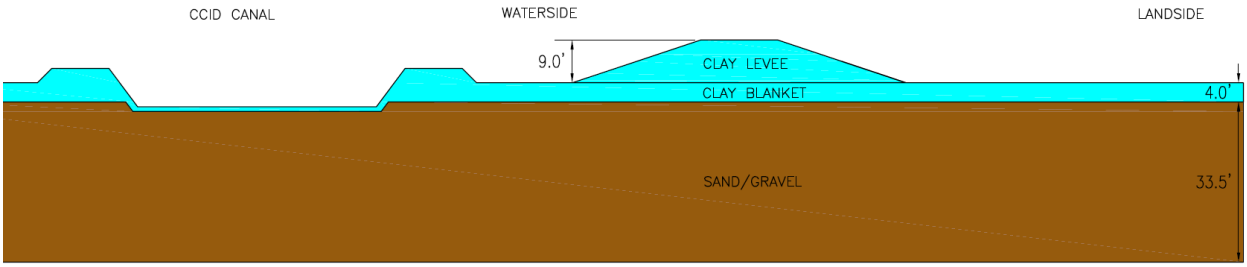

Figure 5.3: Reach C in the vicinity of 2F-11-11 (Sta. 125+00) was modeled with a 4.0-foot blanket, and a 33.5-foot pervious layer.

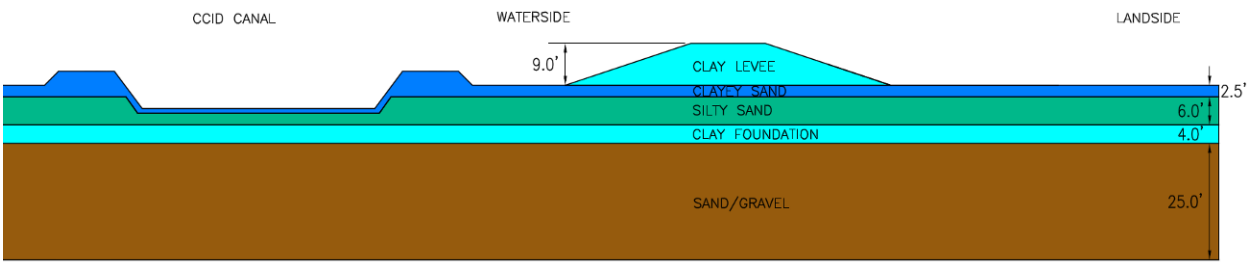

Figure 5.4: Reach C in the vicinity of 2F-11-13 (Sta. 151+00) was modeled with a 2.5-foot clayey sand blanket, a 6.0-foot semi-pervious silty-sand layer, a 4.0-foot clay foundation, and a 25.0-foot pervious layer.

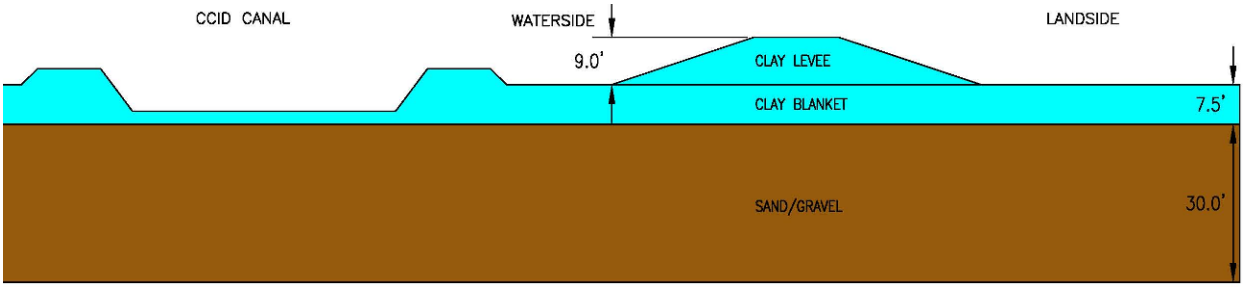

Figure 5.5: Reach D was modeled with a 7.5-foot blanket, and a 30-foot pervious layer.

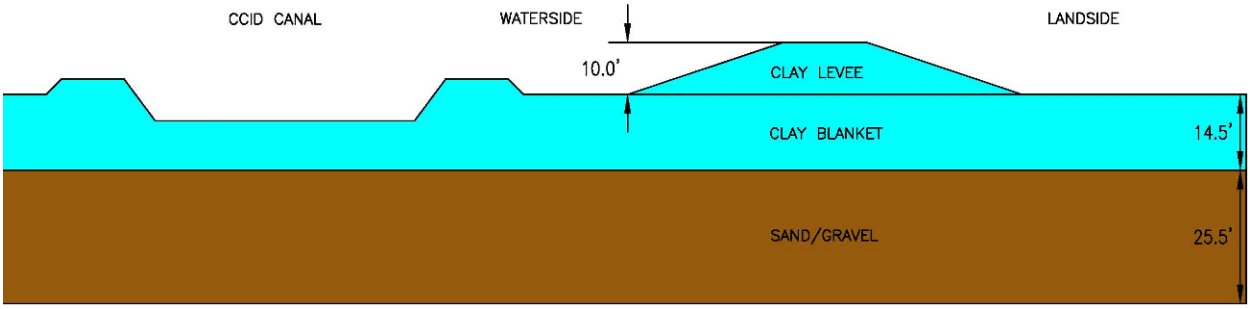

Figure 5.6: Reach E was modeled with a 14.5-foot blanket, and a 25.5-foot pervious layer.

Levee cross sections were proposed conforming to design guidance given in Engineering Manual, ***EM 1110-2-1913: Levee Design and Construction***. Both NED (National Economic Development Plan) and LPP (Locally Preferred Plan) plans were evaluated for seepage and stability. The subsurface conditions for both the NED and LPP Plans are the same; changes in levee geometry are based on NED and LPP elevations obtained by hydraulic and economic analyses. Available geometry of the CCID Canal was limited; information had to be

supplemented with field measurements and assumptions. ***Table 5.1*** summarizes levee design parameters over the different Reaches by NED and LPP Plans. All cross-sections modeled for seepage and stability are included in ***Appendices D and E***, respectively.

Reach	Plan	Station	Crest Width (ft)	Water Surface Elevation (ft)	Levee Height (ft)	Land/ Waterside Slope (ftH:ftV)	Levee Material
A	NED	38+00	16	6	6	3:1	CL
	LPP			5	8		
B	NED	86+00	16	8	8	3:1	CL
	LPP			7	10		
C	NED	125+00	16	7	7	3:1	CL
	LPP			6	9		
	NED	151+00	16	7	7	3:1	CL
	LPP			6	9		
D	NED	195+00	16	7	7	3:1	CL
	LPP			6	9		
E	NED	232+00	16	8	8	3:1	CL
	LPP			7	10		

Table 5.1: Levee Design Parameters at Different Reaches

The following sections also discuss levee material, seismic and liquefaction analyses, earthwork, proposed borrow sites, recommendations for construction, as well as the potential need for settlement analysis. Results of the geotechnical analyses are given in ***Tables 5.3***, ***5.4***, ***5.6***, and ***5.7***. Plan and profile sheets, seepage analysis, and stability analysis are attached as ***Plan and Profile Sheets 1 through 5*** and ***Appendices D and E***.

5.2 STEADY STATE SEEPAGE ANALYSIS

5.2.1 GENERAL

Seepage analyses were performed to evaluate underseepage through the levee foundation and seepage through the levee embankment. Due to the presence of the CCID Canal, a seepage evaluation was performed on the canal to determine if any adverse seepage conditions in the canal will affect the proposed levee. The location of the canal with respect to the levee influences the seepage evaluation. For example, if the canal is located on the waterside of the levee, the canal will create a shortened seepage entrance point into the pervious foundation under the levee. If the canal is located on the landside of the levee, as mentioned in Section 1.1, the canal can affect the seepage exiting out of the foundation of the levee. Both of these conditions affect mostly underseepage.

Pore pressures generated from the seepage analysis for the levee embankment and upper foundation are used to evaluate through seepage effects through the use of slope stability methods. High pore pressures produce de-stabilizing effects that result in lower factors of safety in the slope stability analyses.

Analyses were performed on twenty-two (22) cross-sections taken perpendicular to the levee profile utilizing SEEP 2D within GMS 6.5.6 (Groundwater Modeling System), a finite element program. Results from the seepage analyses were used to calculate exit gradients at the landside levee toe, and in some cases to calculate the average vertical exit gradients at the toe of seepage berms. An average vertical exit gradient is taken as the total head drop in the vertical direction across the levee's landside blanket, divided by the blanket's thickness. This is also referred to as the uplift gradient. This gradient controls a blowout type failure through a low hydraulic conductivity blanket. The pore pressures and phreatic surfaces were exported to UTEXAS 4.0 for use in slope stability analysis.

Analyses were performed at the NED design water surface, the LPP design water surface, and the LPP top-of-levee water surface. The NED and LPP design water surfaces correspond to a 100-year and 200-year level of protection, respectively. On the waterside, fixed total head conditions corresponding to the analysis water elevation are applied along the ground surface from the waterside levee slope to waterside extents of the model, approximately 500-feet from the waterside slope. On the landside, exit face boundary conditions are applied from the crest hinge point to landside extents of the model, approximately 1900-feet from the landside slope. All other boundaries not explicitly assigned a condition are assumed by the program to be a no-flow boundary which include both vertical faces of the model and the bottom nodes.

Soil parameters used for analyses were developed from empirical correlations using visual soil classification and description data, sieve analyses, and index property test data. Shear strength data was adopted from correlations using SPT blow counts, Atterberg limits, and moisture contents. Hydraulic conductivity data was developed using correlations with grain size distribution and soil plasticity. ***Table 5.2*** consists of hydraulic conductivities adopted for this project.

Material Type	Hydraulic Conductivity				
	K_H (cm/sec)	K_H (ft/day)	K_H/K_V	K_V (cm/sec)	K_V (ft/day)
Levee (CL)	$1x10^{-5}$	0.0284	4	$2.5x10^{-6}$	0.007
Blanket Material<5ft (CL, CH)	$1x10^{-5}$	0.0284	0.10	$1x10^{-4}$	0.284
5ft<Blanket Material<10ft (CL, CH)	$1x10^{-5}$	0.0284	1	$1x10^{-5}$	0.0284
Sand/Gravel Aquifer Material (SP-SM)	$1x10^{-2}$	28.0	10	$1x10^{-3}$	2.8
Berm Bedding (SP)	$5x10^{-3}$	14.0	10	$5x10^{-4}$	1.4
Berm Drain Rock (GW)	$2.5x10^{-2}$	71.0	10	$2.5x10^{-3}$	7.1
Seepage Berm (CL)	$1x10^{-5}$	0.0284	4	$2.5x10^{-6}$	0.007
Clayey Sand Blanket (SC)	$5x10^{-5}$	0.14	4	$1.3x10^{-4}$	0.035
Clay Foundation (CL)	$1x10^{-5}$	0.0284	4	$2.5x10^{-6}$	0.007
Silty Sand (SM)	$1x10^{-3}$	2.8	4	$2.5x10^{-4}$	0.71

Table 5.2: Hydraulic Conductivity Used in Seepage Analysis

Rapid drawdown analysis was not performed due to the absence of undisturbed samples suitable for triaxial compression tests. During the PED phase of the project, undisturbed samples will need to be obtained to develop the parameters needed to perform this analysis.

5.2.2 SEEPAGE RESULTS

The critical seepage criteria used in steady state seepage analyses was based on guidance provided in ***EM 1110-2-1913 "Design and Construction of Levees"***, the Sacramento District ***REFP10L0 "Geotechnical Levee Practice"***, and the ***California Department of Water Resources Urban Levee Design Criteria, dated November 15, 2011***. Steady-state seepage analysis for the design water surface elevation considered an allowable vertical exit gradient at the toe of the levee to be a maximum of 0.5 ($i_a \leq 0.5$). Where a seepage berm was needed, current USACE criteria states that exit gradients shall not exceed 0.5 at the levee toe and 0.8 at the toe of the seepage berm for a design water surface elevation; current State of California criteria for a hydraulic top-of-levee (HTOL) water surface also apply stating exit gradients shall not exceed 0.6 at the levee toe and 0.9 at the toe of the seepage berm.

The steady-state seepage analysis results are given in ***Table 5.3*** and ***Table 5.4***. Reach C will require a seepage berm to mitigate the exit gradients exceeding design criteria occurring along the landside toe for both the NED and LPP Plans. Section 5.4 gives the design parameters for the berms; the dimensions of the berms are also given below in ***Table 5.3*** and ***Table 5.4***.

Steady-State Seepage Analysis Results for NED Levee Height							
	Levee Height (ft)	Water Surface (ft)	Blanket Thickness (ft)	Seepage berm height (ft)	Seepage berm width (ft)	Average Vertical Exit Gradient at Landside Levee Toe	Exit Gradient at toe of berm
Reach A	6.0	6.0	8.5	N/A	N/A	0.33	N/A
Reach B	8	8	7.5	N/A	N/A	0.49	N/A
Reach C	2F-11-11						
	7.0	7.0	4.0	N/A	N/A	***0.70***	N/A
	7.0	7.0	4.0	4.5	28	0.42	0.54
	2F-11-13						
	7.0	7.0	2.5	N/A	N/A	***0.76***	N/A
	7.0	7.0	2.5	4.5	28	0.34	0.43
Reach D	7	7	7.5	N/A	N/A	0.43	N/A
Reach E	8	8	14.5	N/A	N/A	0.17	N/A

Table 5.3: Steady-State Seepage Results for NED Levee Height

Steady-State Seepage Analysis Results for LPP Levee Height							
	Levee Height (ft)	Water Surface (ft)	Blanket Thickness (ft)	Seepage berm height (ft)	Seepage berm width (ft)	Average Vertical Exit Gradient at Landside Levee Toe	Exit Gradient at toe of berm
Reach A	8.0	5.0	8.5	N/A	N/A	0.27	N/A
	8.0	8.0	8.5	N/A	N/A	0.44	N/A
Reach B	10.0	7.0	7.5	N/A	N/A	0.42	N/A
	10.0	10.0	7.5	N/A	N/A	0.59	N/A
Reach C	2F-11-11						
	9.0	6.0	4.0	N/A	N/A	***0.56***	N/A
	9.0	9.0	4.0	N/A	N/A	***0.84***	N/A
	9.0	6.0	4.0	4.5	36	0.36	0.43
	9.0	9.0	4.0	4.5	36	0.53	0.64
	2F-11-13						
	9.0	9.0	2.5	N/A	N/A	***0.88***	N/A
	9.0	9.0	2.5	4.5	36	0.38	0.46
Reach D	9.0	6.0	7.5	N/A	N/A	0.36	N/A
	9.0	9.0	7.5	N/A	N/A	0.54	N/A
Reach E	10.0	7.0	14.5	N/A	N/A	0.15	N/A
	10.0	10.0	14.5	N/A	N/A	0.22	N/A

Table 5.4: Steady-State Seepage Results for LPP Levee Height

5.3 SLOPE STABILITY ANALYSIS

5.3.1 GENERAL

Section II, titled "Stability Analyses" of ***EM 1110-2-1913*** summarizes various loading conditions to be analyzed for levees. These loadings conditions are (1) end of construction, (2) steady state seepage from full flood stage, and (3) sudden (rapid) drawdown. Each of these loading conditions require specific design shear strengths correlated to the loading condition being analyzed. Given the available soil data and available shear strength correlations, the only loading conditions that can be analyzed are the end of construction and steady state seepage condition. As the project progresses to PED phase, rapid drawdown analysis will need to be performed for the selected alternative.

Embankment stability against shear failure was analyzed using the UTEXAS 4.0 software package. Long-term conditions were analyzed with steady state seepage along the landside slope of the levee with pore pressures and waterside distributed loads imported from seepage analysis using SEEP 2D within GMS 6.5.6. Analysis to find factors of safety against sliding were conducted using a floating grid search routine to identify the critical failure surfaces using the Spencer Procedure with all sliding surfaces assumed to be a circular arc within the embankment and/or foundation. For purposes of determining the susceptibility of the levee to experience static shear failure, only landside slip surfaces were analyzed, with water surface elevations at the design water surface elevation and top of levee.

5.3.2 END OF CONSTRUCTION CONDITION

End of construction analyses requires undrained shear strengths for low permeability soils (e.g. clays, some silts, etc.) and effective shear strengths for free draining soils (e.g. poorly graded sands, gravels, etc.) that dissipate pore pressures relatively rapidly under loads. For the clay material the N_{60} blow count average was about 13 suggesting a stiff consistency. There was one N_{60} of 3 indicating a soft consistency. Computing the liquidity index for the clay material tested indicates mostly negative numbers which would suggest uncompressive strengths in the 2,000 to 10,000 pounds per square foot (psf) range or undrained shear strengths in the 1,000 to 5,000 psf range. Taking into consideration that clays with sieve analyses had over 20 percent sand, a lower undrained strength would be appropriate. An estimated undrained strength of 500 psf was adopted for the levee foundation clays. For a compacted material containing at least 25 percent, such as clayey sand, an estimated undrained strength was about 800 psf was adopted. Using the undrained strength parameters for fine fine-grained soil stated above, the unit weights and effective strength parameters for free draining soils from Table 5.5, and the stability charts and accompanying equations from Appendix E of ***EM 1110-2-1902***, the lowest factor of safety calculated was 2.31 occurring in Reach E.

5.3.3 STEADY STATE SEEPAGE CONDITION

The long-term evaluation was considered with steady-state seepage and is based on the assumption of a fully developed phreatic surface through the embankment. Saturated unit weights are used in the embankment and the pore water pressure is imported from SEEP 2D within GMS 6.5.6. External water pressures from the channel are applied as a distributed load against the waterside slope. Material properties were determined based on boring log description and laboratory test results and ***Figures 3-2 and 3-5*** of ***EM 1110-2-1913***. Effective friction angles were assigned to materials based on correlations with plasticity index for cohesive soil, and Standard Penetration Test values for cohesionless soils. Cohesion for lean clay material was assumed to be 50 psf and 0 psf for the poorly-graded-sand-with-gravel aquifer material. Typical effective strengths and unit weights by material classification are shown below in ***Table 5.5***.

Material Type	Effective Strength		Total Unit Weight (pcf)
	Angle of Internal Friction	Cohesion (psf)	
Levee (CL)	28	50	120
Blanket Material (CL, CH)	28	50	120
Aquifer Material (SP-SM)	33	0	130
Berm Bedding (SP)	33	0	125
Berm Drain Rock (GW)	35	0	135
Seepage Berm (CL)	28	50	120
Clayey Sand Blanket (SC)	28	0	120
Clay Foundation (CL)	28	50	120
Silty Sand (SM)	30	0	125

Table 5.5: Range of Material Properties Used for Stability Analysis

5.3.4 STABILITY RESULTS

A minimum critical factor of safety against sliding for long-term steady state seepage of 1.4 is given for a design water surface in ***Table 6-1b of EM 1110-2-1913***. To also meet current ***California Department of Water Resources*** criteria the factor of safety against sliding for long term steady state seepage for a HTOL water surface is 1.2. The slope stability analysis results are given in ***Table 5.6*** and ***5.7***.

Stability Analysis Results for NED Levee Height						
	Levee Height (ft)	Water Surface (ft)	Blanket Thickness (ft)	Seepage berm height (ft)	Seepage berm width (ft)	Landside Long-Term Slope Stability FOS
Reach A	6.0	6.0	8.5	N/A	N/A	1.8
Reach B	8	8	7.5	N/A	N/A	1.6
Reach C	2F-11-11					
	7.0	7.0	4.0	N/A	N/A	[1]N/A
	7.0	7.0	4.0	4.5	28	3.6
	2F-11-13					
	7.0	7.0	2.5	N/A	N/A	[1]N/A
	7.0	7.0	2.5	4.5	28	3.7
Reach D	7	7	7.5	N/A	N/A	1.7
Reach E	8	8	14.5	N/A	N/A	1.7

[1] The seepage model exceeds seepage criteria; no stability analysis was performed.

Table 5.6: Slope Stability Results for NED Levee Height

Stability Analysis Results for LPP Levee Height						
	Levee Height (ft)	Water Surface (ft)	Blanket Thickness (ft)	Seepage berm height (ft)	Seepage berm width (ft)	Landside Long-Term Slope Stability FOS
Reach A	8.0	5.0	8.5	N/A	N/A	1.8
	8.0	8.0	8.5	N/A	N/A	1.6
Reach B	10.0	7.0	7.5	N/A	N/A	2.3
	10.0	10.0	7.5	N/A	N/A	1.4
Reach C	2F-11-11					
	9.0	6.0	4.0	N/A	N/A	[1]N/A
	9.0	9.0	4.0	N/A	N/A	[1]N/A
	9.0	6.0	4.0	4.5	36	2.9
	9.0	9.0	4.0	4.5	36	2.6
	2F-11-13					
	9.0	9.0	2.5	N/A	N/A	[1]N/A
	9.0	9.0	2.5	4.5	36	2.9
Reach D	9.0	6.0	7.5	N/A	N/A	1.7
	9.0	9.0	7.5	N/A	N/A	1.5
Reach E	10.0	7.0	14.5	N/A	N/A	1.8
	10.0	10.0	14.5	N/A	N/A	1.6

[1] The seepage model exceeds seepage criteria; no stability analysis was performed.

Table 5.7: Slope Stability Results for LPP Levee Height

5.4 LANDSIDE SEEPAGE BERM

Due to exit gradients exceeding design criteria (***Tables 5.3 and 5.4***), Reach C will require a landside seepage berm from approximately Station 106+00 to Station 165+00. Seepage berm design requirements are presented below.

5.4.1 DIMENSIONS

The landside seepage berm should be constructed to a height of 5-feet above the landside toe elevation. The berm should extend landward from the landside toe at least 28-feet for the NED Plan, or 36-feet for the LPP Plan. The top of the berm should be constructed to drain toward the landward direction (typically 3%) maintaining a minimum height of 3-feet above the seepage berm toe elevation.

5.4.2 MATERIAL REQUIREMENTS

The landside seepage berm shall be composed of a sand bedding material, a gravel filter, earth fill berm material, and a geotextile separating the filter and earth fill berm material. The bedding material shall be a clean sand (SP) at least 0.5 feet in depth. The filter shall be a clean gravel (GW) at least 1.5-feet in depth. The earth fill berm material shall be a lean clay (CL), a silty clay (CL-ML), or a sandy silty clay (CL-ML) material.

5.5 LEVEE MATERIAL EARTHWORK

5.5.1 LEVEE EMBANKMENT BORROW MATERIAL REQUIREMENTS

The cells excavated for Fink landfill have been designated as a preliminary borrow source for the proposed levee alignment. In the event that this material is not available at the time of levee construction, levee embankment fill requirements are as follows in ***Table 5.8***:

Maximum Particle Size:	3 inches
Gravel Content:	Less than 30% by weight
Fines Content:	Greater than 25% by weight
Plasticity Index:	Greater than 8 and less than 40
Liquid Limit:	Greater than 30 and less than 45
Organic Content:	Less than 1% by volume

Table 5.8: Levee Embankment Fill Requirements

5.5.2 INSPECTION TRENCH

An inspection trench shall be excavated under the entire proposed levee alignment. The purpose of the inspection trench is to locate any underground features, animal burrows, pockets of unsuitable material, or other debris. The inspection trench shall be at least six (6) feet in depth, twelve (12) feet minimum bottom width of trench, and the side slopes must be one (1) foot horizontal to one (1) foot vertical. If a deeper inspection trench is necessary, slopes will need to be laid back to two (2) foot horizontal to one (1) foot vertical.

Based on the geotechnical borings, it is assumed that the majority of the material excavated for the inspection trench will be suitable material used for levee foundation.

5.5.3 RAILROAD EMBANKMENT

With the proposed levee alignment, the California Northern Railroad embankment will be exposed to periods of flood waters. A landside filter has been proposed to help mitigate through seepage conditions. The landside filter is composed of a clean sand (SP) material with a minimum depth of 0.5-feet, a fill material of sand and gravel up to 3-inch max. diameter, and a slope of 5-foot horizontal to 1-foot vertical; the slope will be covered in 12-inch max rip-rap stone protection (a drawing is available within the Civil Design Appendix).

5.5.4 STRIPPING AND GRUBBING

Areas within the proposed levee alignment, landside seepage berm, railroad tie-in, and railroad through seepage improvements are subject to stripping and grubbing. This would include stripping and removing the top 4 to 6 inches of soil containing shallow vegetation roots and other deleterious materials. This highly organic topsoil can be stockpiled on-site and used for surface landscaping, but should not be used for constructing compacted engineered fills. Grub the

underlying 6 to 8 inches of soil to remove any large vegetation roots or other deleterious material by first removing the in-situ soil and then replace the soil after grubbing.

Remove all large shrub and tree roots, tree root bulbs, and tree stumps. Excavate the remaining cavities or holes to a sufficient width so that an approved backfill soil can be placed and compacted in the cavity or holes. Sufficient backfill soil should be placed and compacted in order to match the surrounding elevations and grades.

Excessively large amounts of vegetation, other deleterious materials, and over sized rock materials greater than 3-inches should be removed from the site.

5.6 SITE SPECIFIC SEISMIC AND LIQUEFACTION ANALYSIS

5.6.1 SEISMIC ANALYSIS

A seismic site characterization was completed and is presented below. Because of the low probability of a seismic event causing catastrophic slope failure coinciding with a high water event, it is unlikely that inundation will result due to seismically induced levee failure. Improvements primarily for the purpose of seismic strengthening are generally not economically justifiable for intermittently-loaded levees. It should also be acknowledged that seismic degradation of levees consists primarily of cracking and lateral spreading, which can be repaired before becoming a threat to the overall stability of the levee. The post-seismic flood risk should be addressed through emergency response and interim and long-term repairs following an earthquake. To assess the extent of the post-earthquake damage, seismic analysis was performed.

There are three main parameters of the seismic action that should be defined in view of seismic analysis of levees:

- PHGA - Peak Horizontal Ground Acceleration, is the largest value of the acceleration at the free field ground surface in a specific direction during a specific event.
- M - Earthquake Magnitude is a measure of the earthquake size/energy. The currently preferred definition is the moment magnitude (M_w).
- Duration - Length of time during which ground motion at a site shows certain characteristics (sensing, violent shaking. etc.). It is sometimes defined through the number of equivalent uniform cycles of dynamic loading.

These three main parameters are inter-dependent: PHGA depends mainly on M and the distance from the site to the earthquake epicenter; this dependence is usually described through Attenuation Relationships. Duration (or number of equivalent uniform cycles) is generally directly related to M.

USGS recently developed the 2008 Interactive Deaggregations (Beta), although a preliminary version, it incorporates the changes in attenuation relationships for California in accordance with NGA (Next Generation Attenuation), Petersen et al., 2008. For the Western United States equal weight was assigned to three recently developed (NGA) attenuation relationships:

- Boore and Atkinson (2008)
- Campbell and Bozorgnia (2008)
- Chou and Youngs (2008)

Figure 5.7 presents an example of the interactive screen and ***Figures 5.8 and 5.9*** presents the obtained results for the CCID Canal alignment at Station 151+00 for 100 and 200 year events, respectively. The following data were input for 200-year results:

- Location, through latitude and longitude (up to three decimals each are considered);
- Exceedance probability of the seismic event;
- Desired spectral period;
- Shear wave velocity of the upper 30 meters (V_s30) of the site.

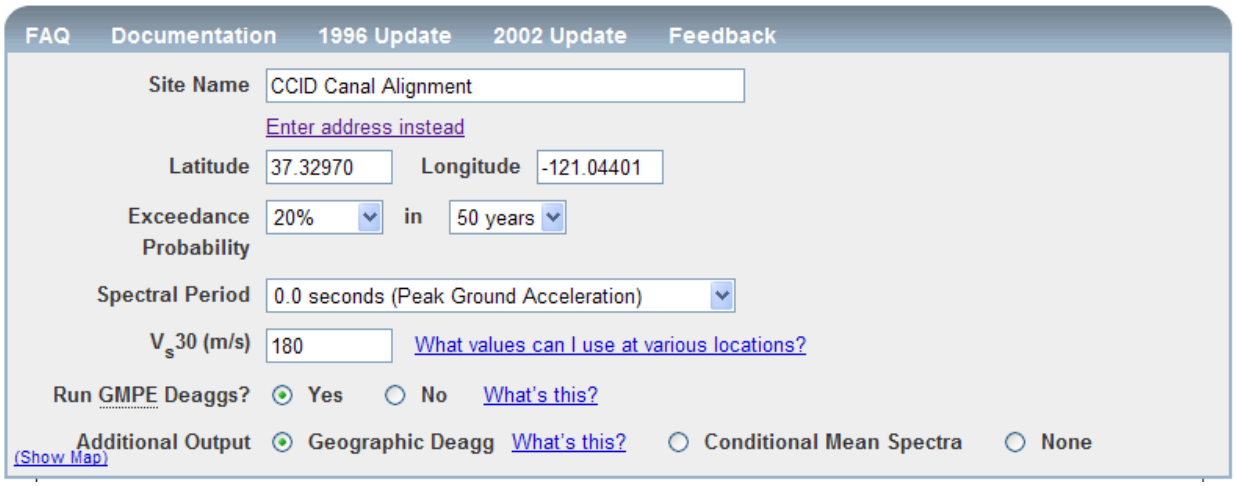

Figure 5.7: USGS 2008 Interactive Deaggregations (Beta)

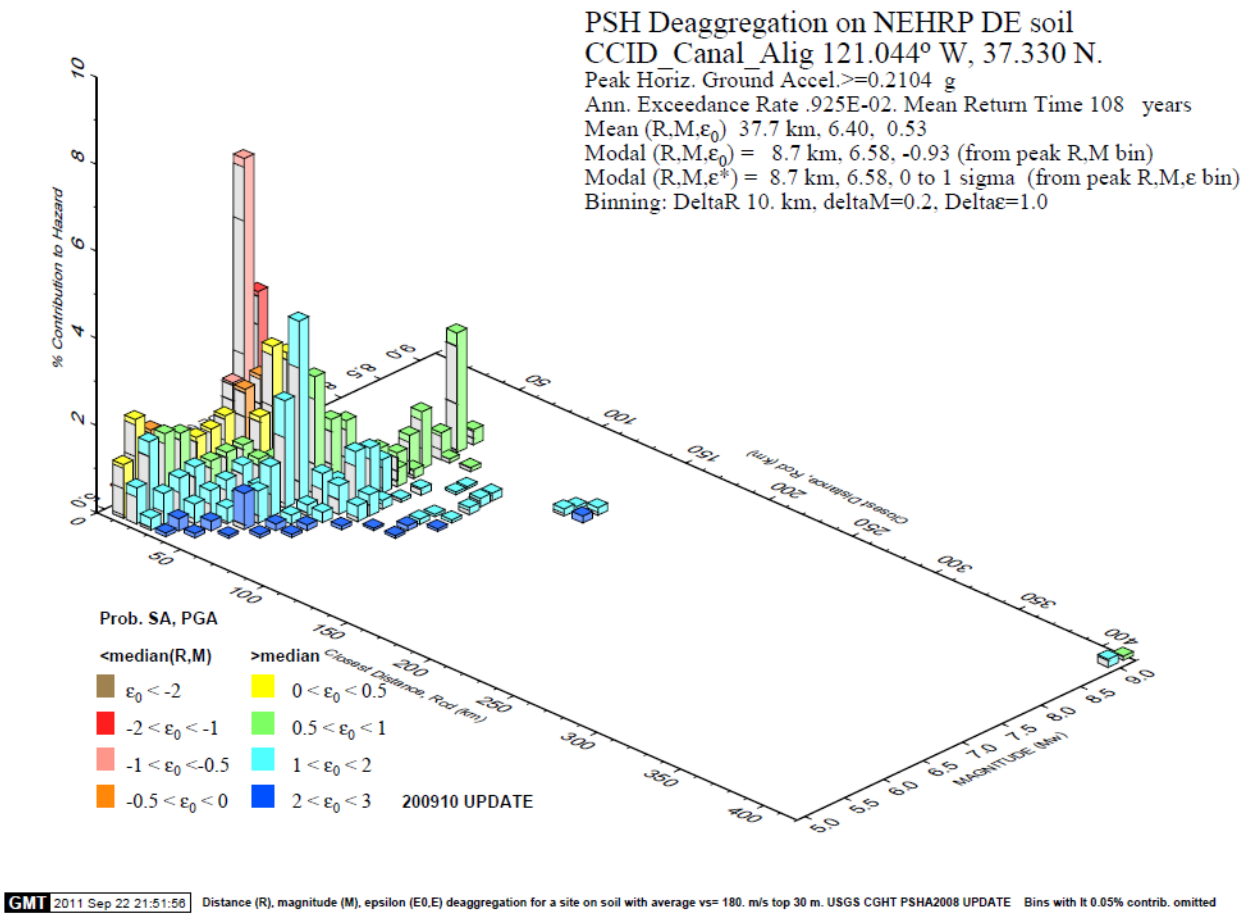

Figure 5.8: Deaggregation at CCID Canal Alignment, Station 151+00 for 108-year Return

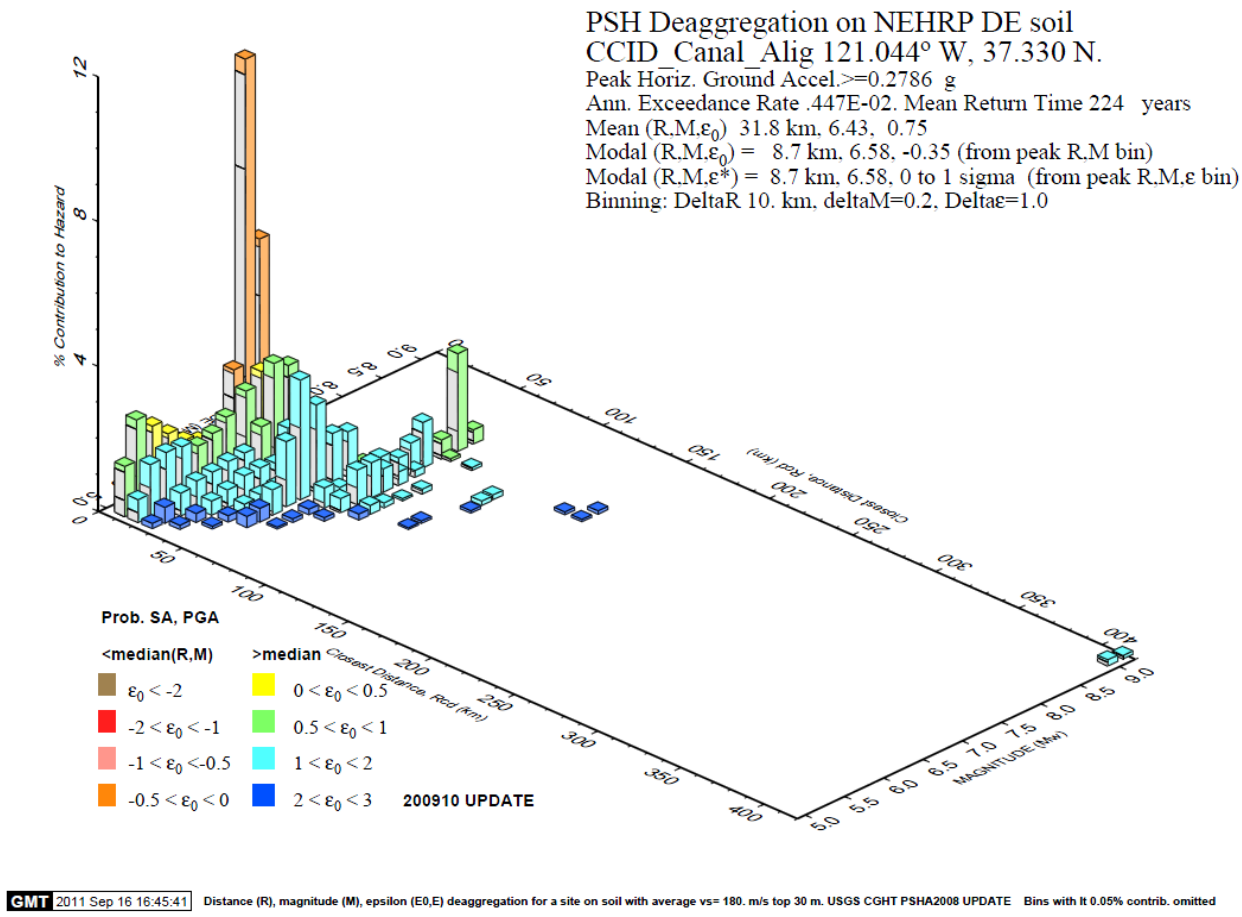

Figure 5.9: Deaggregation at CCID Canal Alignment, Station 151+00 for 224-year Return

Table 5.9 below presents the site specific seismic data at various points within the project area. Two exceedance probabilities were examined that coincide with typical levee design flood frequencies (100yr and 200yr), the 50 percent at time equals 75 years (108yr average return period [ARP]) and the 20 percent at time equals 50 years (224yr average return period [ARP]). The spectral period was chosen to be 0.0 seconds (Peak Ground Acceleration). The site classification was found to be bordering on NEHRP site class D and E, soft to stiff soil. Based on blow counts and un-drained shear strength derived from vertical effective stress and plasticity index, the corresponding shear wave velocity in the upper 30 meters was found to be V_s30=180 meters/second. The average PHGA for the project was found to be 0.21g for the 108-year event and 0.28g for the 224 year event.

Reach	Station	Latitude	Longitude	PHGA 50% t=75 (108 yr)	PHGA 20% t=50 (224 yr)
A	0+00 to 50+00	37.30059	-121.06106	0.2169	0.2873
B	50+00 to 100+00	37.31398	-121.05054	0.2130	0.2821
C	100+00 to 150+00	37.32970	-121.04401	0.2104	0.2786
D	150+00 to 200+00	37.34127	-121.04691	0.2093	0.2773
E	200+00 to 250+00	37.34753	-121.04009	0.2075	0.2750
			Average	**0.2114**	**0.2801**

Table 5.9: Seismic Hazard Assessment and Loading

The evaluated PHGA is the result of an equal hazard analysis; therefore, many events with different magnitudes and distances to the site contribute to the corresponding seismic event. It is reasonable to consider that the relevant magnitude is that that has the highest contribution to the site seismic hazard, which in the tri-dimensional graph of hazard deaggregation is represented by the highest column. ***Tables 5.10 and 5.11*** below correspond to the same data presented in ***Figures 5.8 and 5.9***.

Fault Hazard Details for 100-Year Event					
Fault ID	% Contribution	Rcd (km)	M	Epsilon 0	Site-to-src azimuth (d)
Great Valley 7 Char	4.79	18.7	6.69	-0.15	-45.8
Great Valley 8 Char	7.28	8.7	6.67	-0.98	-111.5
Great Valley 9 Char	3.19	26.6	6.68	0.28	168.6
Great Valley 7 GR	2.18	27.3	6.61	0.3	-45.8
Great Valley 8 GR	5.18	8.8	6.59	-0.93	-117.4
N. S. Andr. ;SAO+SAN+SAP+SAS	2.9	68.9	8.01	0.55	-138.1
Calaveras;CC aPriori	2.21	51.3	6.33	1.13	-118
Calaveras;CC MoBal	2.66	51.3	6.29	1.18	-118

Table 5.10: 100-year, Individual Fault Hazard Details if its Contribution to Mean Hazard >2%

+

For the 100 year event, the major contribution (7.28%) is induced by Great Valley 8 Char, capable of M = 6.67 and located 8.7 km from the site. The second major contribution (5.18%) is Great Valley 8 GR; with M = 6.59 located 8.8 km from the site. If a weighted average of M is calculated considering the data in ***Table 5.10*** and percent contribution as weight, M= 6.72 is obtained.

Fault Hazard Details for 200-Year Event					
Fault ID	% Contribution	Rcd (km)	M	Epsilon 0	Site-to-src azimuth (d)
Great Valley 7 Char	5.80	18.7	6.70	0.40	-45.8
Great Valley 8 Char	11.43	8.7	6.67	-0.40	-111.5
Great Valley 9 Char	3.32	26.6	6.68	0.80	168.6
Great Valley 7 GR	2.28	26.7	6.62	0.79	-45.8
Great Valley 8 GR	8.04	8.8	6.59	-0.35	-117.3
N. S. Andr. ;SAO+SAN+SAP+SAS	2.85	68.9	8.01	0.95	-138.1
Calaveras;CC MoBal	2.08	51.3	6.30	1.54	-118.0

Table 5.11: 200-year, Individual Fault Hazard Details if its Contribution to Mean Hazard >2%

For the 200-year event, the major contribution (11.43%) is induced by Great Valley 8 Char, capable of M = 6.67 and located 8.7 km from the site. The second major contribution (8.04%) is Great Valley 8 GR; with M = 6.59 located 8.8 km from the site. If a weighted average of M is calculated considering the data in ***Table 5.11*** and percent contribution as weight, M= 6.74 is obtained.

5.6.2 LIQUEFACTION TRIGGERING ANALYSIS

To evaluate the potential of liquefaction of soils, a liquefaction triggering analysis was performed based on the procedure from the summary report of the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, published as part of the Journal of Geotechnical and Geoenvironmental Engineering, dated October 2001 (Youd, et al., October 2001). The procedure was first developed and published by Seed and Idriss in 1964 and has since been modified and improved. It was developed from empirical evaluations of field observations and field and laboratory test data. Liquefaction is the phenomenon created by seismic shaking in which pore water pressures increase and effective stress is reduced, resulting in softening of granular soils. A brief summarization of the procedure is presented below.

Standard Penetration Test (SPT) was used as the primary index for liquefaction characteristics. SPT measures the number of blows for the SPT sampler to drive 12 inches (N). The blow count is corrected for hammer energy ratio (C_E), borehole diameter (C_B), rod length (C_R), and samplers with or without liners (C_S). The values for these correction factors can be found in the 2001 NCEER Summary Report referenced above. For this study, the hammer energy correction was 1.33 and the sampler correction was 1.1. Additionally, SPT blow counts are normalized to a common reference effective overburden stress (C_N). The effective overburden stress correction factor normalizes N to an effective overburden pressure of approximately 100 kPa or 1 atm. This study used the effective overburden stress correction factor suggested by Liao and Whitman (1986), which is recommended by Youd et. al. C_N is capped at 1.7.

$$(N_1)_{60} = N_m C_N C_E C_B C_R C_S$$

$$C_N = (P_a/\sigma'_{v0})^{0.5}$$

CORRECTION FOR FINES CONTENT

Resistance to liquefaction was found to increase with increased fines content, although $(N_1)_{60}$ decreases. To correct for the influence of fines content (FC) on the cyclic resistance ratio, the following correction factor is applied to $(N_1)_{60}$.

$$(N_1)_{60cs} = \alpha + \beta(N_1)_{60}$$

where, $\alpha = 0$ for $FC \leq 5\%$

$$\alpha = \exp[1.76 - (\frac{190}{FC^2})] \quad \text{for } 5\% < FC < 35\%$$

$\alpha = 5.0$ for $FC \geq 35\%$

$\beta = 1.0$ for $FC \leq 5\%$

$$\beta = \exp[0.99 - \frac{FC^{1.5}}{1000}] \quad \text{for } 5\% < FC < 35\%$$

$\beta = 1.2$ for $FC \geq 35\%$

SEISMIC LOADING CONDITIONS

The liquefaction susceptibility for two seismic loading conditions was assessed: 100-year and 200-year return period event. The peak horizontal ground acceleration (PHGA) values associated with a 100-year and 200-year return period event were estimated using the USGS Interactive Deaggregations website. ***Table 5.12*** summarizes the parameters used for this study.

Event	PHGA (g)	Magnitude (M)
100-Year Event	0.21	6.72
200-Year Event	0.28	6.74

Table 5.12: Seismic Loading Conditions (from ***Tables 5.9, 5.10, and 5.11***)

5.6.3 LIQUEFACTION-INDUCED LATERAL SPREADING AND POST-LIQUEFACTION SETTLEMENT

The consequences of triggering liquefaction include lateral spreading and vertical deformation. Lateral deformation can develop as a consequence of instability due to loss of shear strength or as accumulation of shear strains throughout the soil profile. Lateral spreading towards any open channel or face can occur in mildly sloping ground and extend to very large distances away from the open face. Vertical displacement can develop as a consequence of reconsolidation of the liquefied soil. Subsurface heterogeneity in soils has a strong influence on the magnitude and distribution of liquefaction-induced ground deformation.

The approach to estimate lateral spreading displacement and vertical displacement of the liquefied soil is presented in detail in Idriss and Boulanger (2008). A brief summarization of each approach is presented below.

5.6.3.1 PROCEDURE FOR ESTIMATING LATERAL DEFORMATION

The approach for estimating lateral displacement is based on a one-dimensional simplification of the strain potential procedure developed by Seed et. al. (1975). The maximum shear strains that are expected within the liquefied zones during undrained cyclic loading in laboratory tests are correlated against triggering of liquefaction. The potential maximum displacement, or lateral displacement index (LDI), can then calculated using the simplified strain potential procedure with maximum shear strains and depth. The actual lateral displacement depends on factors such as ground slope, spatial heterogeneity, distance from free face, and restrain from embedded structures.

The permanent lateral displacement at the ground surface is computed by numerically integrating the expected shear strains versus depth:

$$LD = \int_0^{z_{max}} \gamma \, dz$$

The shear strain at a depth is computed using the equation below:

$$F_\alpha = 0.032 + 0.69\sqrt{max(7,(N_1)_{60cs})} - 0.13\max\,(7,(N_1)_{60cs})$$

$$\gamma_{lim} = 1.859 * \left[1.1 - \sqrt{\frac{(N_1)_{60cs}}{46}}\right]^3$$

$$\gamma_{max} = \min\left[\gamma_{min}, 0.035\left(2 - FS_{liq}\right)\left(\frac{1-F_\alpha}{FS_{liq}-F_\alpha}\right)\right] \quad \text{if} \quad 2 > FS_{liq} > F_\alpha$$

$$\gamma_{max} = \gamma_{lim} \quad if \quad FS_{liq} \leq F_\alpha$$

5.6.3.2 PROCEDURE FOR ESTIMATING POST-LIQUEFACTION SETTLEMENT

The method to estimate post-liquefaction reconsolidation settlement is based on correlations derived from laboratory studies, which have been found to provide reasonably good agreement with field observations. The approach was developed by Ishihara and Yoshimine, who observed that the volumetric strains that occur during post-liquefaction reconsolidation of sand samples was directly related to the maximum shear strains that developed during undrained cyclic loading and to the initial relative density of the sand. The ground surface settlement for this method assumes one-dimensional reconsolidation, and therefore, assumes no lateral spreading movements. The consequences of one-dimensional post-liquefaction settlements are dependent on the spatial distribution of liquefied zones and may be mitigated by the presence of a thick non-liquefied layer above the liquefied layer.

The equation for volumetric strains that occur during post-liquefaction reconsolidation of sand samples is as follows:

$$\varepsilon_v = 1.5 * \exp\left(-0.369\sqrt{(N_1)_{60cs}}\right) * \min\left(0.08, \gamma_{max}\right)$$

The ground surface settlement for one-dimensional reconsolidation (no lateral spreading movements) is computed by equating the vertical strains to the volumetric strains and then integrating the vertical strains over the depth interval of concern. The equation is as follows.

$$S_{V-1D} = \int_0^{z_{max}} \varepsilon_v \, dz$$

The consequences of one-dimensional post-liquefaction reconsolidation settlements are dependent on the spatial distribution of liquefied zone.

5.6.4 FINDINGS

The findings of the liquefaction triggering analyses and liquefaction induced deformation and settlement analysis are presented below. The potential against liquefaction for a soil layer is classified using the following criteria:

If all factor of safety values (FS) at a particular layer are calculated higher than 1.4, then that soil layer is classified as non-liquefiable (FSliq > 1.4).

If the FS against liquefaction at a particular depth is calculated to be less than 1.0, then the soil layer is classified as liquefiable (FSliq < 1.0).

If the FS against liquefaction is between 1.0 and 1.4, but no portion of that layer has FS below 1.0, the layer is considered to be marginally liquefiable (1.0 < FSliq < 1.4).

For our analyses the proposed levee embankment is assumed to be unsaturated at the time of earthquake thus not liquefiable.

CCID Canal Alignment

Liquefaction triggering analysis was performed on Reaches A through E as defined in ***Table 4.1***. Reaches A, B, C, and E of the proposed alignment have at least one soil layer that is liquefiable, or liquefiable to marginally liquefiable. The analyses did not identify liquefiable layers within Reach D. All Reaches except Reach E of the proposed alignment are parallel to the CCID Canal. The free face condition created by the slope of the CCID Canal is typically in non-liquefiable cohesive fine grained soil; therefore, the lateral displacement due to liquefaction is not likely. However, with the canal bottom being only a few feet below the proposed levee toe, a free face condition might be possible in the vicinity of 2F-11-13 of Reach C. Reach E is located at least 1 mile south of the nearest free face (Orestimba Creek). Displacement varies with both distance and position parallel to the free face. Summarized below are the results of the Reaches with liquefiable and marginally liquefiable soil layers.

Reach A

For the 100 year event, the liquefaction triggering analysis found a Poorly Graded Sand (SP) soil layer from 14.5-feet to 20.5-feet below ground surface (bgs) that is liquefiable to marginally liquefiable (FS=0.37 to 1.11). The total lateral displacement index is 1.97-feet; the liquefaction-induced settlement is 0.20-feet.

For the 200 year event, the liquefaction triggering analysis found a Poorly Graded Sand (SP) soil layer from 12.5-feet to 20.5-feet bgs that is liquefiable to marginally liquefiable (FS=0.27 to 1.07). The total lateral displacement index is 2.11-feet; the liquefaction-induced settlement is 0.24-feet.

Reach B

For the 100 year event, the liquefaction triggering analysis found a Poorly Graded Sand (SP) soil layer from 10.5-feet to 12.5-feet bgs, a Poorly Graded Sand (SP) soil layer from 23.5-feet to 26.5-feet bgs, and a Poorly Graded Sand (SP) soil layer from 32.5-feet to 38.5-feet bgs that are liquefiable (FS=0.82, FS=0.60, and FS=0.46 to 0.96, respectively). The total lateral displacement index is 0.32-feet, 1.48-feet, and 1.62-feet, respectively; the liquefaction-induced settlement is 0.06-feet, 0.11-feet, and 0.18-feet, respectively.

For the 200 year event, the liquefaction triggering analysis found a Poorly Graded Sand (SP) soil layer from 10.5-feet to 12.5-feet bgs, a Poorly Graded Sand (SP) soil layer from 23.5-feet to 26.5-feet bgs, and a Poorly Graded Sand (SP) soil layer from 32.5-feet to 38.5-feet bgs that are liquefiable (FS=0.61, FS=0.44, and FS=0.34 to 0.72), respectively. The total lateral displacement index is 0.55-feet, 1.48-feet, and 2.21-feet, respectively; the liquefaction-induced settlement is 0.06-feet, 0.11-feet, and 0.22-feet, respectively.

Reach C

Vicinity of 2F-11-11

For the 100 year event, the liquefaction triggering analysis found a Poorly Graded Sand with Gravel (SP) soil layer from 8.5-feet to 10.5-feet below ground surface (bgs), and a Sand with Silt and Gravel (SP-SM) soil layer from 12.5-feet to 14.5-feet below ground surface (bgs) that are liquefiable (FS=0.47 and FS=0.79, respectively). The total lateral displacement index is 1.0-feet and 0.62-feet, respectively. The liquefaction-induced settlement is 0.09-feet and 0.06-feet, respectively.

For the 200 year event, the liquefaction triggering analysis found a Sand (SP) to Sand with Silt and Gravel (SP-SM) soil layer from 8.5-feet to 14.5-feet below ground surface (bgs) that is liquefiable to marginally liquefiable (FS=0.35 to 1.16). The total lateral displacement index is 1.66-feet. The liquefaction-induced settlement is 0.16-feet.

Vicinity of 2F-13-11

For the 100 year event, the liquefaction triggering analysis found a Silty Sand (SM) soil layer from 2.5-feet to 8.5-feet below ground surface (bgs), and a Poorly Graded Sand with Gravel (SP) soil layer from 29.5-feet to 35.5-feet below ground surface (bgs) that are liquefiable to marginally liquefiable (FS=0.74 to 1.04 and FS=0.91 to 1.16, respectively). The total lateral displacement index is 0.7-feet and 0.24-feet, respectively. The liquefaction-induced settlement is 0.08-feet and 0.08-feet, respectively.

For the 200 year event, the liquefaction triggering analysis found a Silty Sand (SM) soil layer from 2.5-feet to 8.5-feet below ground surface (bgs), and a Poorly Graded Sand with Gravel (SP) soil layer from 29.5 to 35.5 bgs that are liquefiable (FS=0.55 to 0.77 and FS=0.68 to 0.86, respectively). The total lateral displacement index is 0.82-feet and 0.96-feet, respectively. The liquefaction-induced settlement is 0.11-feet and 0.13-feet, respectively.

Reach D

No liquefiable layers were identified.

Reach E

For the 100 year event, the liquefaction triggering analysis found a Poorly Graded Sand with Gravel (SP) soil layer from 18.5-feet to 23.5-feet below ground surface (bgs) that is marginally liquefiable (FS=1.01 to 1.13). The total lateral displacement index is 0.12-feet; the liquefaction-induced settlement is 0.03-feet.

For the 200 year event, the liquefaction triggering analysis found a Poorly Graded Sand with Gravel (SP) soil layer from 18.5-feet to 23.5-feet bgs that is liquefiable (FS=0.75 to 0.84). The total lateral displacement index is 0.36-feet; the liquefaction-induced settlement is 0.09-feet.

5.7 SETTLEMENT

Due to the lack of appropriate data, a detailed settlement analysis has not been performed on the Reaches of the proposed levee alignment. Subsurface investigations show a thin CL/CH blanket underlain by a deep SP-SM foundation. It is expected that minimal settlement will occur. When this project moves forward into PED phase, undisturbed soil samples and laboratory testing will be collected and a detailed settlement analysis will be completed.

6.0 RISK AND UNCERTAINTY ANALYSIS

In practice, Risk and Uncertainty Analysis are performed, and fragility curves are produced, on existing levees to show benefits of the existing conditions. The same analyses are then performed on the proposed project to produce fragility curves for benefits of the 'with project' conditions. For the existing conditions of this project, there is no existing levee; therefore, geotechnical risk based analysis was not performed. For the proposed flood protection, the levee will be designed such that the risk of failure is minimal.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

The study area consisted of two proposed alignment alternatives. The first proposed alignment was located on the west side of the CCID Canal; therefore, boring locations were established and completed on the west side of the canal. After geotechnical analyses were performed, the western alignment was rejected due to high exit gradients that exceeded USACE and California Department of Resources design criteria. Due to funding limitations, it was decided that the subsurface investigations that took place on the west side of the canal would be used to establish subsurface conditions and soil parameters for an alignment offset from the east side of the canal a few hundred feet away. The eastern alignment yielded acceptable results for both seepage and stability throughout all Reaches of the proposed alignment; the only caveat to this would be that Reach C would require the addition of a seepage berm (28-feet for the NED Plan, or 36-feet for the LPP Plan) to mitigate exit gradients slightly higher than design criteria.

7.2 RECOMMENDATIONS

A geomorphologic study is recommended for the design phase of the project. A more extensive boring and laboratory testing program will need to be completed and should include borings spaced approximately 300-500 feet apart along the proposed centerline, waterside, and landside of the centerline to determine the extent of the alluvial fan. The additional borings should consider the geomorphic formation shown by the geomorphologic study. To establish the soil parameters necessary for design, the drilling program shall include the collection of both disturbed and undisturbed samples, and the testing program shall include laboratory testing on both the disturbed and undisturbed samples.

During the design phase, it is recommended that geotechnical analyses be performed along the centerline, waterside, and landside of the California Northern Railroad (from the proposed levee tie-in, proceeding north to Orestimba Creek). This structure has been incorporated into this project to resist flood waters and has not been designed as a flood control structure, therefore may be prone to failure due to seepage or overtopping.

During the design phase, it is recommended that a complete survey of the proposed alignment (including CCID Canal) be performed in both the NAD83 and NAVD 88 datum. If significant changes are found, the geotechnical analysis may require re-evaluation during the PED Phase.

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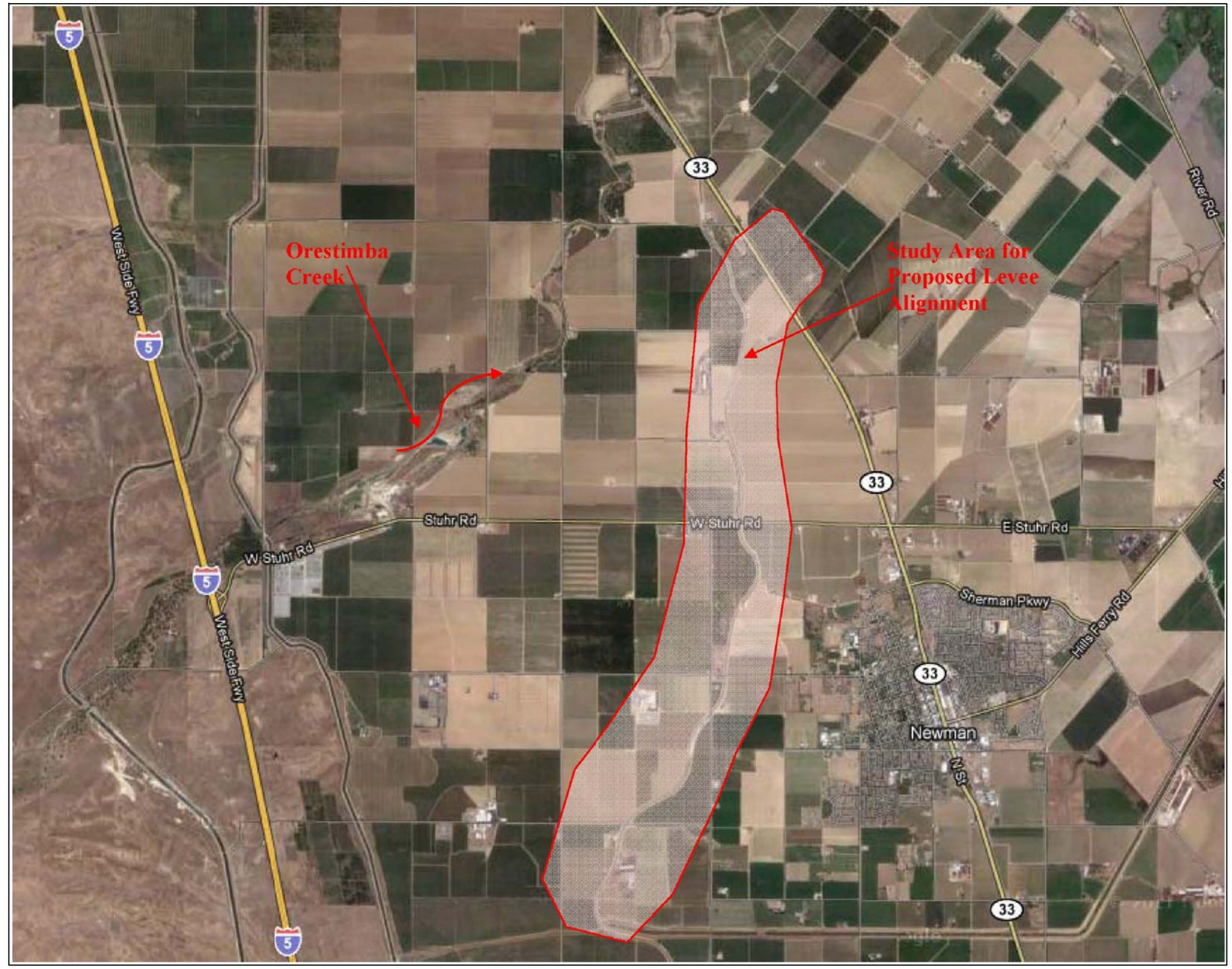
PLATES

STUDY LOCATION



HORIZONTAL SCALE: AS SHOWN

VERTICAL SCALE: AS SHOWN

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ORESTIMBA PROJECT NEWMAN CALIFORNIA
ORESTIMBA LEVEE ALIGNMENT
SITE MAP

DATE:	SCALE:	SHEET NO.
17 NOVEMBER 2011	NO SCALE	PLATE 1

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ORESTIMBA LEVEE ALIGNMENT
PROPOSED LEVEE ALIGNMENT

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VERTICAL SCALE: AS SHOWN

DATE:	SCALE:	SHEET NO.
17 NOVEMBER 2011	AS SHOWN	PLATE 2

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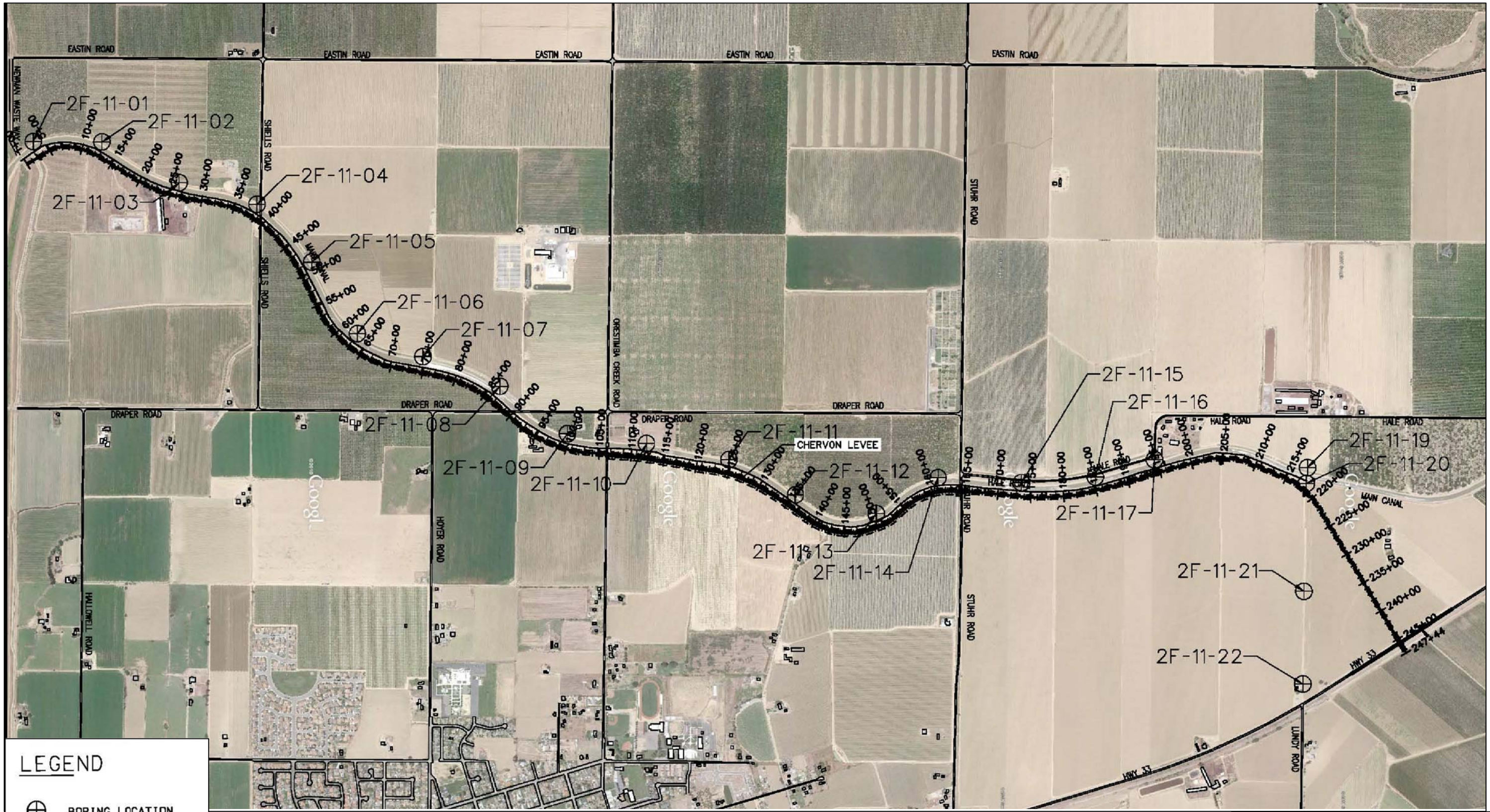

LEGEND

- BORING LOCATION
- EXISTING BUILDING
- EXISITNG BRIDGE

800' 400' 0 800'

HORIZONTAL SCALE: AS SHOWN

VERTICAL SCALE: AS SHOWN

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BORING LOCATIONS

DATE:	SCALE:	SHEET NO.
17 NOVEMBER 2011	AS SHOWN	PLATE 3

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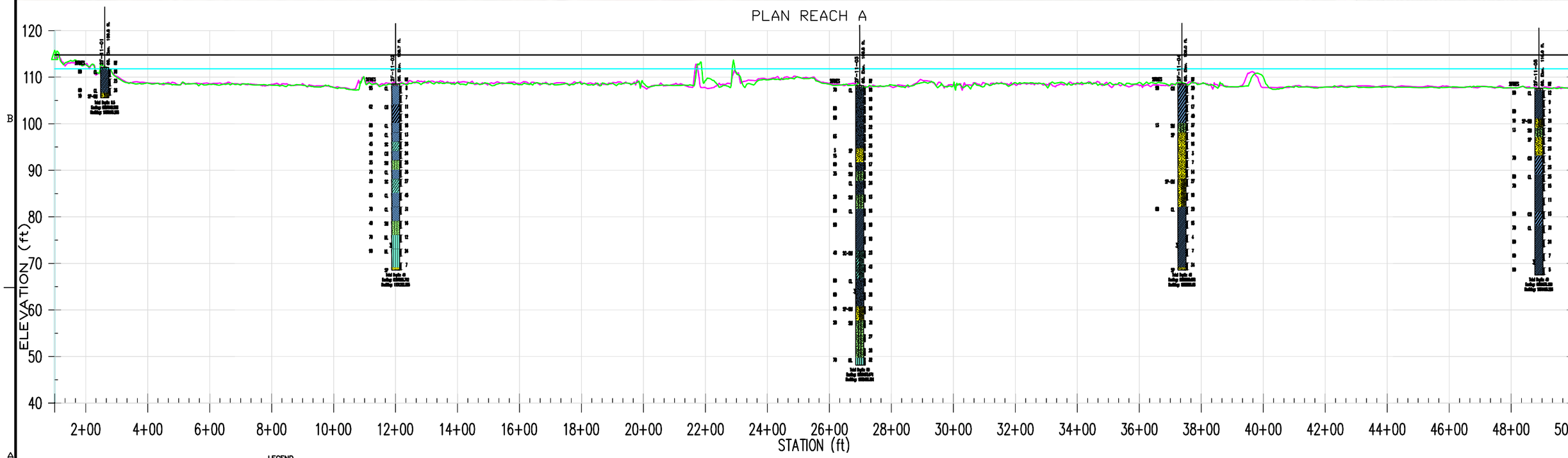
PLAN AND PROFILE SHEETS

PLAN REACH A



PROFILE REACH A

LEGEND

DESIGN LEVEE HEIGHT–LPP

WATER SURFACE

LANDSIDE TOE

EXISTING GROUND SURFACE @ LEVEE CENTER

HORIZONTAL SCALE:
AS SHOWN

VERTICAL SCALE:
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FEASIBILITY GEOTECHNICAL APPENDIX
PLAN AND PROFILE SHEETS
PROPOSED CCID CANAL EAST ALIGNMENT

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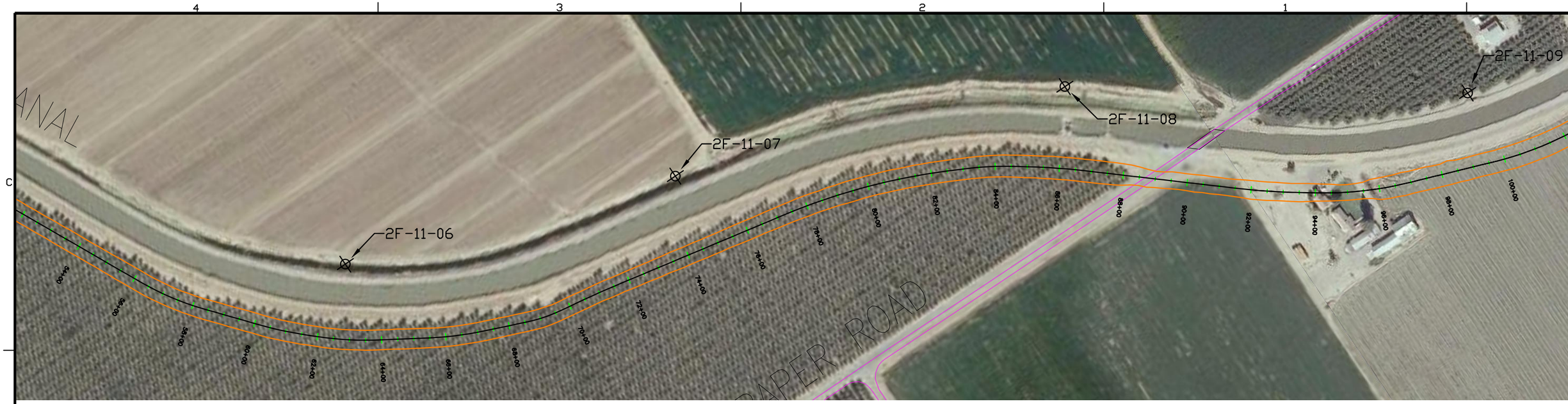

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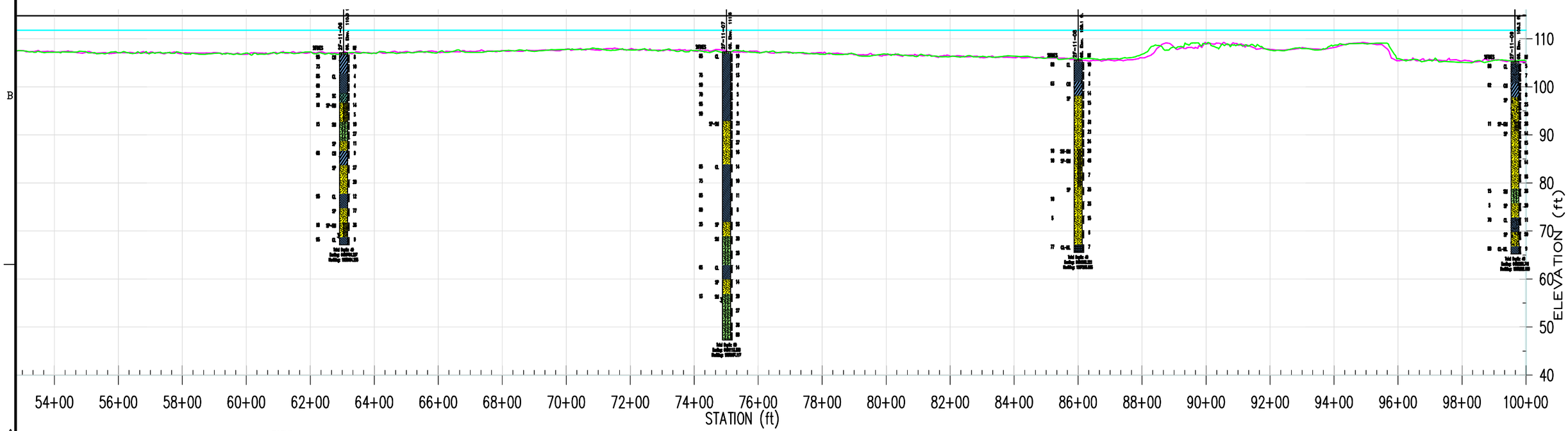

PROFILE REACH B

LEGEND

- DESIGN LEVEE HEIGHT–LPP
- WATER SURFACE
- LANDSIDE TOE
- EXISTING GROUND SURFACE @ LEVEE CENTER

HORIZONTAL SCALE:
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VERTICAL SCALE:
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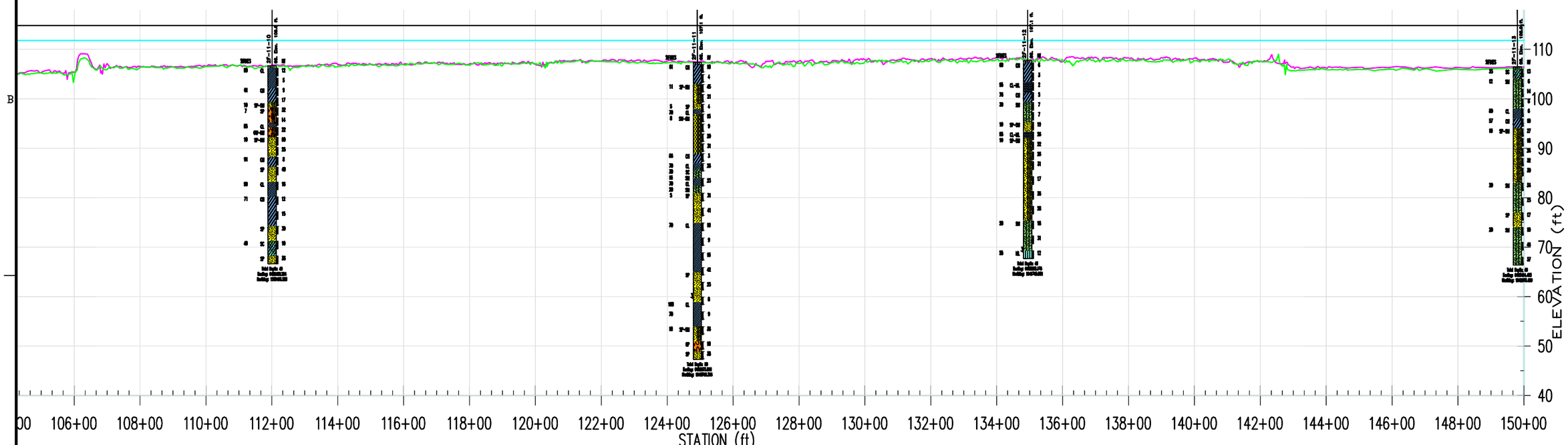

PROFILE REACH C

LEGEND

DESIGN LEVEE HEIGHT–LPP

WATER SURFACE

LANDSIDE TOE

EXISTING GROUND SURFACE @ LEVEE CENTER

HORIZONTAL SCALE:
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VERTICAL SCALE:
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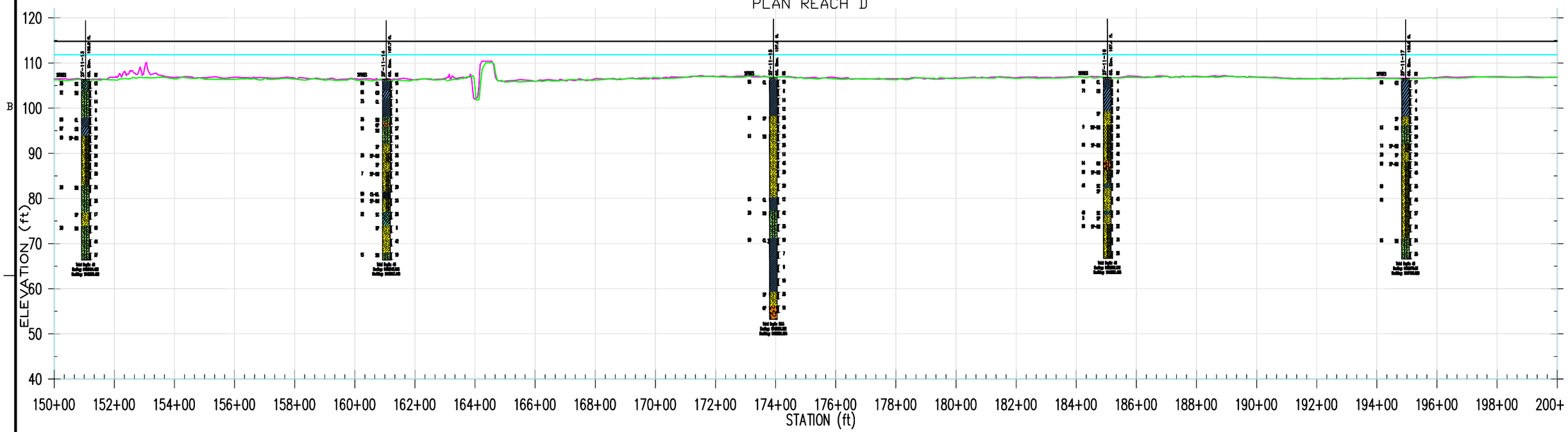

PROFILE REACH D

LEGEND

- DESIGN LEVEE HEIGHT–LPP
- WATER SURFACE
- LANDSIDE TOE
- EXISTING GROUND SURFACE @ LEVEE CENTER

HORIZONTAL SCALE:
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DATE:	SCALE:	SHEET NO.
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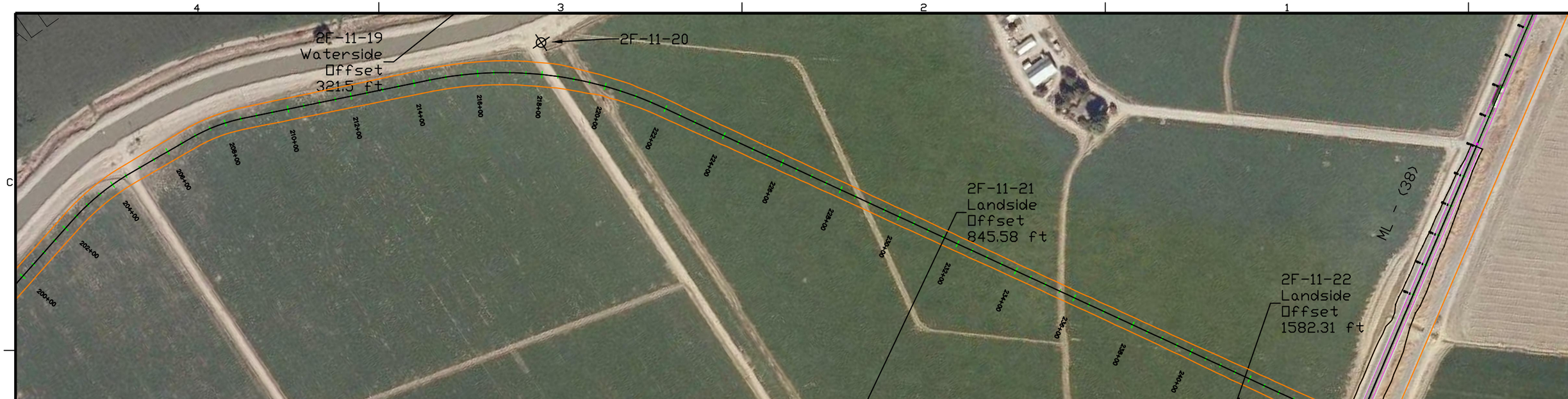

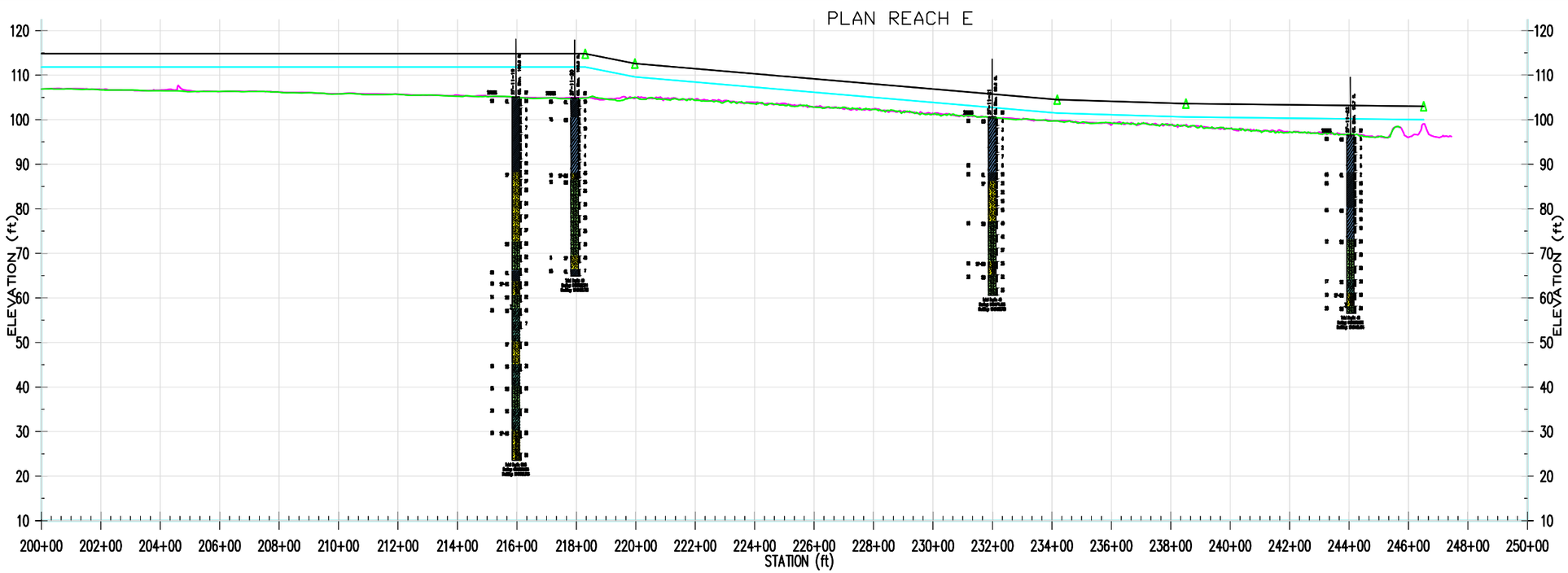

LEGEND

- DESIGN LEVEE HEIGHT-LPP
- WATER SURFACE
- LANDSIDE TOE
- EXISTING GROUND SURFACE @ LEVEE CENTER

PROFILE REACH E

HORIZONTAL SCALE:
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VERTICAL SCALE:
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DATE:	SCALE:	SHEET NO.
17 November 2011	AS SHOWN	5

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APPENDIX A

GEOTECHNICAL MEMORANDUM

MEMORANDUM FOR: CESPK-PM-C (Attn: Michelle Williams, Project Manager)

SUBJECT: Geotechnical Analysis for Orestimba Creek Project Located near Newman, Stanislaus County, CA

1.0 Introduction

This memorandum presents the preliminary results of the geotechnical evaluation for the proposed levee alignment(s) for the Orestimba Project.

2.0 Region and Site Geology

The project site is located north of the city of Newman, California (see Plate 1). The city of Newman, California is located in southwestern Stanislaus County near the border of Merced County. It is bounded on the west by the coastal Diablo Mountain Range, the east by the San Joaquin River, the north by Crows Landing, and the south by Merced County line. The watershed consists of approximately 185 square miles of mountain rangeland and irrigated farmland. Orestimba Creek is an ephemeral stream that runs through an alluvial fan and receives its flows from storm runoff from the Diablo Range and farmland irrigation (see Plate 2). Orestimba Creek is traversed by Interstate 5, the California Aqueduct, Delta Mendota Canal, CCID Canal, Highway 33, and the California Northern Railroad Company.

Orestimba Creek flows from the west towards the northeast through an alluvial fan as it drains its watershed in the Diablo Range to the San Joaquin River. The alluvial fan is composed primarily of upper Holocene Patterson Alluvium and upper Pleistocene to lower Holocene San Luis Ranch Alluvium (see Plate 3). The San Luis Ranch Alluvium is unconsolidated, coarse-grained sediments laid down as stream terraces and valley fills at fan heads, grading downstream to finer sediments on the lower fan positions (Wentworth, 1999).

3.0 Subsurface Explorations

At the initiation of this study, no previous geotechnical borings had been completed along the proposed alignment. Web Soil Survey maps were available from US Department of Agriculture showing the surface materials to be clay loam (see Plate 4). Water well borings had been completed a few miles north and east of the study area, but they had not been properly documented or classified per ASTM D 2488. In November of 2010, twenty-one (21) borings were completed along the alignment by Moore Twining Associates. Of these twenty-one borings, one boring was stopped at a depth of 6-foot due to drilling mechanical problems, fifteen borings reached a depth of 40 feet, one boring reached a depth of 53.5 feet, three borings reached a depth of 60 feet, and one boring reached a depth of 81.5 feet below ground surface. Due to funding constraints, the lower extent of the pervious foundation material could not be determined for some of the boring locations. Standard penetration blow counts were performed using an automatic trip hammer at specific intervals using a split-barrel sampler with an inside diameter of

1-3/8 inches and an outside diameter of 2 inches. Where standard penetration blow counts were preformed, disturbed samples were obtained. The explorations were located approximately 20-30 feet west of the canal berm toe along the west side of the CCID Canal. The explorations were spaced approximately 1,350 feet apart and started just north of the Newman Waste Way (see Plate 5).

For the purposes of this study these borings were the primary basis of developing the geotechnical cross-sections for analysis (Boring logs are available from Soil Design Section and will be included in the Geotech Appendix).

4.0 Stratigraphy and Geometry Used in Modeling

In order to characterize existing conditions of the study area for geotechnical analysis, idealized stratigraphy and soil parameters were developed to represent subsurface conditions along the proposed levee alignment(s). The subsurface conditions were based on index property laboratory test results; surface conditions were based on field reconnaissance; and the proposed levee sections were based on EM 1110-2-1913 design criteria. Available geometry of the canal was limited; information had to be supplemented with field measurements and assumptions. ***Figure 1*** below shows a typical cross-section. The cross-sections used in the seepage and stability modeling were based on a design water surface (DWS) elevation of four (4) feet with two (2) feet of freeboard for total levee height of six (6) feet. This DWS and height of levee was established by the PDT.

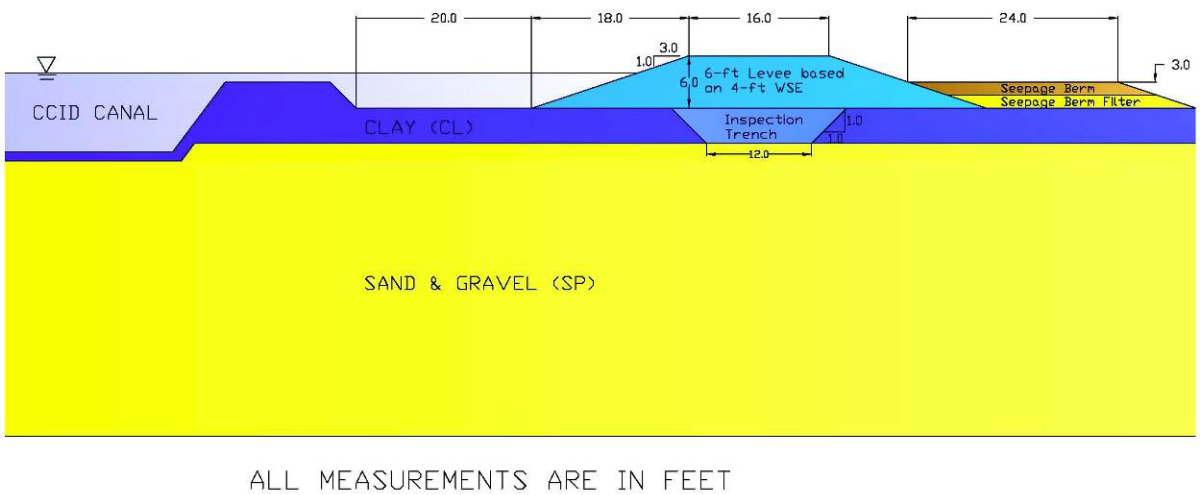


Figure 1. This cross section was drawn with the levee setback 20 feet east of the east berm of the CCID Canal. The design water surface is 4 feet and the height of levee is 6 feet.

4.1 Subsurface Conditions

Ground water was encountered in 11 of the 21 borings and varied from 35.0 to 52.0 feet bgs. From the borings it was found that the upper foundation material (blanket) consists of lean clay (CL) to fat clay (CH) varying in thickness from 4 to 23 feet. The fines content of this material varied from 58 to 95 percent; the blow counts (N-value) varied from 2 to 40; the N_{60} blow counts varied from 3 to 53, and the consistency of the cohesive material varied from soft to hard. The lower foundation material consisted of clean poorly-graded sands (SP) to poorly-graded sand with silt and gravel (SP-SM); this material varied in thickness from 16 to 64.5 feet (due to funding constraints, the lower extent of the pervious foundation material could not be determined for some borings). The blow counts (N-value) varied from 3 to 80; the N_{60} blow counts varied from 4 to 106, and the relative density ranges from very loose to very dense.

5.0 Seepage Evaluation

Seepage analyses were performed to evaluate underseepage and through seepage for the proposed levee. Due to the presence of the CCID Canal, a seepage evaluation was performed on the canal to determine if any adverse seepage conditions in the canal will affect the proposed levee. The location of the canal with respect to the levee influences the seepage evaluation. For example, if the canal is located on the waterside of the levee, as shown in ***Figure 1***, the canal will create a shortened seepage entrance point into the pervious foundation under the levee. If the canal is located on the landside of the levee, the canal can affect the seepage exiting out of the foundation of the levee. Both of these conditions affect mostly underseepage. Pore pressures generated from the seepage analysis for the levee embankment and upper foundation are used to evaluate through seepage effects through the use of slope stability methods. High pore pressures produce de-stabilizing effects that will result in lower factors of safety in the slope stability analyses.

Steady state seepage analysis was performed on nineteen (19) cross-sections taken perpendicular to the levee profile utilizing SEEP 2D within GMS 7.1.6 (Groundwater Modeling System), a finite element program. Results from the seepage analysis were used to calculate landside levee toe and bottom of canal average vertical exit gradients. An average vertical exit gradient is taken as the total head drop in the vertical direction across the levee's landside blanket, divided by the blanket's thickness. This is also referred to as the uplift gradient. This gradient controls a blowout type failure through a low hydraulic conductivity blanket and is frequently referenced in typical levee design/evaluation manuals. The pore pressures and phreatic surfaces were exported to UTEXAS 4.0 for use in slope stability analysis.

Steady state seepage analysis was performed at the design water surface (DWS), and in some cases at the top of the levee. On the waterside, fixed total head conditions corresponding to the

analysis water elevation are applied along the waterside ground surface from the waterside model extents to the levee slope. On the landside, exit face boundary conditions are applied from the crest hinge point to landside extents of the model. All other boundaries not explicitly assigned a condition are assumed by the program to be no flow which include both vertical faces of the model and the bottom nodes. Material properties were determined based on boring log descriptions and index property testing, hydraulic conductivities by material classification are shown in the table below.

Material Type	Hydraulic Conductivity				
	K_H (cm/sec)	K_H (ft/day)	K_H/K_V	K_V (cm/sec)	K_V (ft/day)
Levee (CL)	$4x10^{-5}$	0.11	4	$1x10^{-5}$	0.028
Blanket Material (CL, CH)	$4x10^{-5}$	0.11	4	$1x10^{-5}$	0.028
Aquifer Material (SP-SM)	$1x10^{-2}$	28.35	4	$2.5x10^{-3}$	7.087
Seepage Berm (CL-ML)	$4x10^{-5}$	0.11	4	$1x10^{-5}$	0.028
Seepage Berm Filter (SP-SM)	$1x10^{-2}$	28.35	4	$2.5x10^{-3}$	7.087

Table 1. Hydraulic Conductivity Used in Seepage Analysis.

5.1 West Side of CCID Canal

The initial alignment proposed placing the levee on west side of the CCID Canal. With the existing canal being on the landside of the proposed levee, there were exit gradient requirements that had to be met. Per *Section V*, paragraph 8-16 of EM 1110-2-1913:

> Drainage ditches should be located such that the exit gradient in the bottom of the ditch does not exceed 0.5 at the landside levee toe and does not exceed 0.8 at a distance 45.72 m (150 ft) landward of the landside levee toe and beyond. Between the landside levee toe and 45.72 m (150 ft) landward of the landside levee toe, the maximum allowable exit gradient in the bottom of the ditch should increase linearly from 0.5 to 0.8. The exit gradient should be computed assuming the water level in the ditch is at the bottom of the ditch.

The principal of allowing higher exit gradients to occur further away from the levee is based on the concept that a catastrophic failure developing is less probable with greater distance away from the levee. If adverse seepage conditions develop away from the levee, these conditions can be responded to before any major distress occurs to the levee. This concept works if the detection of adverse seepage (i.e. particle migration) can be made in a timely manner, and corrective actions such as filling in the ditch can be performed. Given the size and the extent of

the canal, the capability to detect distress would be nearly impossible; corrective actions would be difficult.

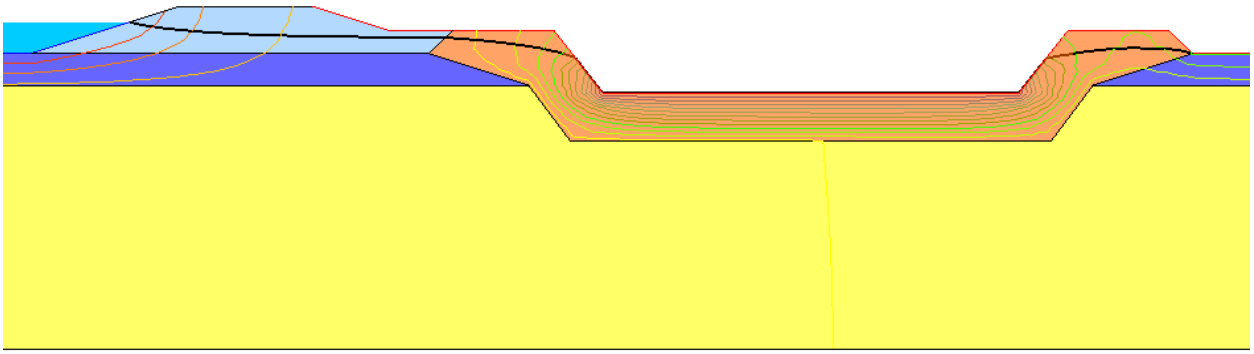
The guidance from the EM excerpt above is for smaller irrigation and drainage ditches constructed along the landside toe. Due to the size and volume of the CCID Canal, at roughly 62-feet in width and over 7 feet in depth, a more stringent exit gradient of 0.6 was assigned to the bottom of the CCID Canal. The canal was to contain water year round, but on a visit to the canal the water levels had dropped due to maintenance, and the EM states that exit gradients are to be computed assuming there is no water in the ditch.

No As-Built drawings were available from CCID; therefore, assumptions had to be made on the geometry of the canal and the thickness of the canal liner. The seepage models started out with a canal-liner thickness of one foot; this resulted in very high exit gradients. A cut-off slurry wall was not chosen to reduce the high exit gradients due to the underlying aquifer material; during boring activities, no confining layer was located to tie into with a slurry wall. To reduce the high exit gradients, the thickness of the canal liner was increased in increments. The canal liner ranged in thickness from six feet to twelve feet and was modeled with the levee in three different locations with respect to the west side of the canal, i.e., the levee section modeled directly on the west berm of the canal, the levee section set back 60 feet from the toe of the canal, and the levee section set back 100 feet from the canal.

No stability analysis was performed on the alignment along the west side of the CCID Canal because the average vertical exit gradients at the bottom of the ditch did not meet the acceptable criteria of 0.8. The acceptable exit gradients were only met at the bottom of the canal when the liner thickness was 12-feet in all three cases. This is not a cost effective solution.

The exit gradients at the landside toe of the levee were not in question when the levee was located on the canal berm; the landside toe at this point was nearly above the design water surface. For the other two cases where the levee was set back, both 60 and 100-feet, from the CCID Canal berm, the exit gradients at the landside toe were borderline; meeting design criteria of 0.5 with all changes in canal-liner thickness. The results of the seepage analysis with the levee on the canal, set back 60 feet, and set back 100 feet can be seen in ***Table 2*** through ***Table 4*** below.

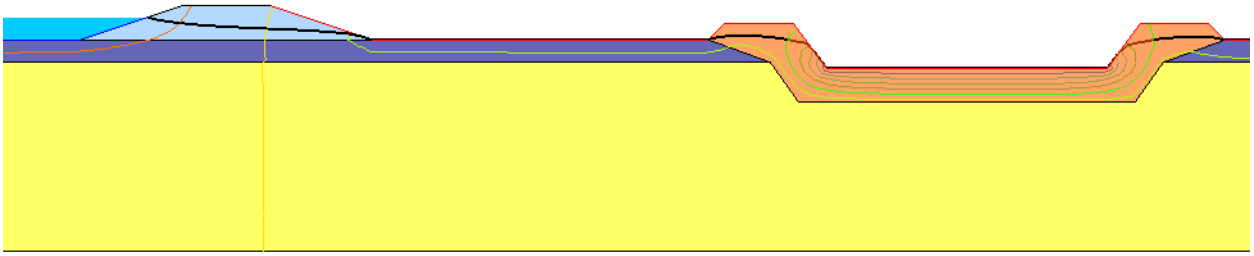
Levee On West Berm of CCID Canal



Design Water Surface (ft)	Liner Thickness (ft)	Levee on CCID Canal		
		Average Vertical Exit Gradient at Bottom of Canal	Average Vertical Exit Gradient at Landside Levee Toe	Breakout Above Landside Toe (ft)
4	6.0	**1.13**	0.007	4.5
4	8.0	**0.85**	0.006	4.5
4	10.0	**0.68**	0.005	4.5
4	12.0	**0.57**	0.003	2.8

Table 2. Levee located on west berm of CCID Canal. Results listed in **Red** exceed design criteria of 0.6. Results in **Blue** meet design criteria.

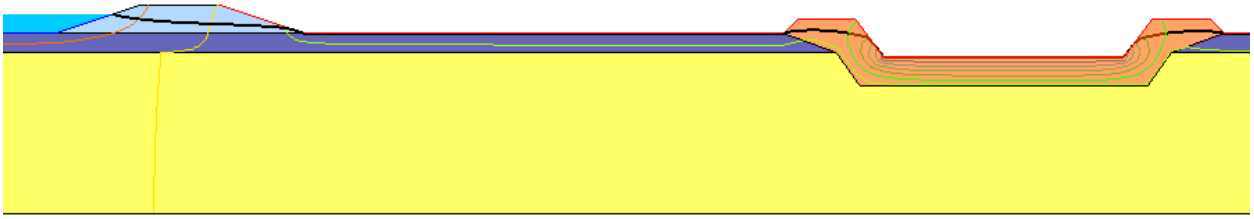
Levee Set back 60 feet from West side of CCID Canal



Design Water Surface (ft)	Liner Thickness (ft)	Levee Set-back 60-feet from CCID Canal		
		Average Vertical Exit Gradient at Bottom of Canal	Average Vertical Exit Gradient at Landside Levee Toe	Breakout Above Landside Toe (ft)
4	6.0	**1.08**	**0.47**	0.67
4	8.0	**0.81**	**0.48**	0.67
4	10.0	**0.65**	**0.49**	0.67
4	12.0	0.54	**0.49**	0.67

Table 3. Levee set back 60-feet west of west berm of CCID Canal. Results listed in **Red** exceed design criteria of 0.6. Results in **Blue** meet design criteria of 0.5 for levee toe.

Levee Set back 100 feet from West side of CCID Canal



Design Water Surface (ft)	Liner Thickness (ft)	Levee Set-back 100-feet from CCID Canal		
		Average Vertical Exit Gradient at Bottom of Canal	Average Vertical Exit Gradient at Landside Levee Toe	Breakout Above Landside Toe (ft)
4	6.0	**1.05**	**0.46**	0.67
4	8.0	**0.79**	**0.47**	0.67
4	10.0	**0.63**	**0.47**	0.67
4	12.0	0.53	**0.48**	0.67

Table 4. Levee set back 100-feet west of west berm of CCID Canal. Results listed in **Red** exceed design criteria of 0.6. Results in **Blue** meet design criteria of 0.5 for levee toe.

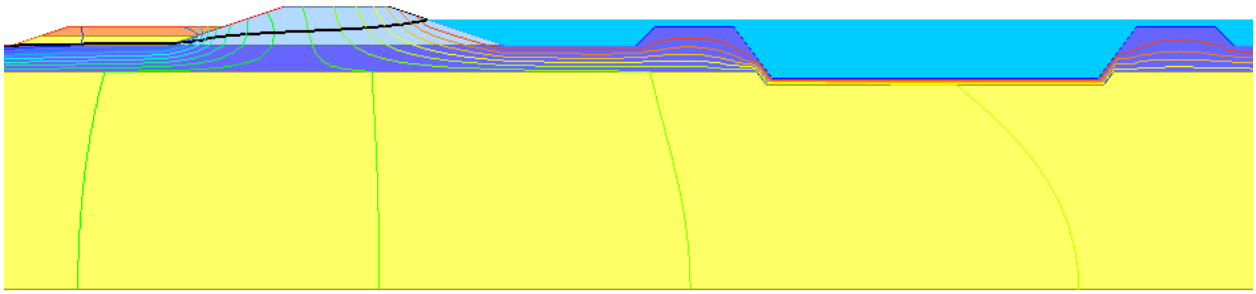
5.2 East Side of CCID Canal

After reviewing the exit gradient results of the levee alignment along the west side of the CCID Canal, the PDT decided to evaluate an alignment along the east side of the canal. Since the CCID Canal would now be on the waterside of the proposed levee alignment (***Figure 1***), the exit gradient criteria from EM 1110-2-1913 was 0.5 at the landside levee toe for the design water surface. Where a seepage berm is needed, current USACE criteria states that exit gradient shall not exceed 0.5 at the levee toe and 0.8 at the toe of the seepage berm for the design water surface. Future USACE and current State of California criteria for exit gradients also apply and state that exit gradients shall be calculated with the water surface at the top of levee. Exit gradients shall not exceed 0.6 at the landside levee toe and 0.9 at toe of seepage berm.

The PDT proposed a levee alignment directly adjacent to the berm along the east side of the CCID Canal. Due to the fact that no As-Built drawings were available from CCID, the interior slopes of the canal, liner thickness, and material type, had to be estimated. Due to the steepness of the interior slopes, and the lack of material properties of the canal, there could be the potential for slope failure during a rapid drawdown event. With this in mind it was decided the levee would be offset from the canal a minimum of 20 feet to maintain an independent structure built on material with current geotechnical information.

After reviewing the boring logs, it was determined that there were two different clay blanket thicknesses that needed to be evaluated. One reach, approximately 0.75 miles in length, had a minimum blanket thickness of approximately 4 feet. The remaining alignment to be analyzed had a minimum blanket thickness of 7.5 feet. Levee sections without a seepage berm followed the USACE criteria of a maximum exit gradient at the landside toe of the levee of 0.5. Levee sections with a seepage berm had to meet the two different criteria listed in above in the first paragraph of 5.2. The results of these analyses are shown in ***Table 5***.

<u>Levee Set back 20 feet from East side of CCID Canal</u>



Seepage Analysis Results for 6' & 8' Levee Heights Setback 20' from Toe to Toe						
Levee Height (ft)	Water Surface (ft)	Blanket Thickness (ft)	w/ 3' seepage berm	Seepage berm width (ft)	Average Vertical Exit Gradient at Landside Levee Toe	Exit Gradient at Toe of Seepage Berm
6.0	4.0	4.0	no	N/A	0.51	N/A
6.0	4.0	4.0	yes	24	0.29	0.48
6.0	4.0	7.5	no	N/A	0.27	N/A
6.0	6.0	7.5	no	N/A	0.38	N/A
6.0	6.0	4.0	no	N/A	0.76	N/A
6.0	6.0	4.0	yes	24	0.44	0.72
8.0	6.0	4.0	no	N/A	0.75	N/A
8.0	6.0	4.0	yes	32	0.43	0.69
8.0	8.0	4.0	yes	32	0.58	0.93
8.0	8.0	4.0	yes	40	0.58	0.91
8.0	8.0	4.0	yes	48	0.58	0.89
8.0	6.0	7.5	no	N/A	0.37	N/A
8.0	8.0	7.5	no	N/A	0.50	N/A

Table 5. Levee set back 20-feet east of east berm of CCID Canal. Different levee heights are listed with different water surfaces.

6.0 Slope Stability Analysis

Stability analysis was conducted on east side alignment cross-sections. Embankment stability against shear failure was analyzed using the UTEXAS 4.0 software package. Long-term conditions were analyzed with steady state seepage along the landside slope of the levee with pore pressures and waterside distributed loads imported from seepage analysis using SEEP 2D within GMS 7.1.6. Analysis to find factors of safety against sliding were conducted using a floating grid search routine to identify the critical failure surfaces using the Spencer Procedure with all sliding surfaces assumed to be a circular arc within the embankment and/or foundation. For purposes of determining the susceptibility of the levee to experience static shear failure, only landside slip surfaces were analyzed, with water surface elevations at the design water surface.

The long-term evaluation was considered with steady-state seepage and is based on the assumption of a fully developed phreatic surface through the embankment. Saturated unit weights are used in the embankment and the pore water pressure is imported from SEEP 2D within GMS 7.1.6. External water pressures from the channel are applied as a distributed load against the waterside slope. Material properties were determined using laboratory test results and Figures 3-2 and 3-5 of EM 1110-2-1913. No shear strength testing was performed on soil samples; therefore, shear strength parameters have been empirically based. Effective friction angles were assigned to materials based on correlations with plasticity index for cohesive soil, and Standard Penetration Test values for cohesionless soils. Cohesion for lean clay material was assumed to be 50 psf and 0 psf for the poorly-graded-sand-with-gravel aquifer material. Typical effective strengths and unit weights by material classification are shown in ***Table 6***.

Material Type	Effective Strength		Total Unit Weight (pcf)
	Angle of Internal Friction	Cohesion (psf)	
Levee (CL)	28	50	120
Blanket Material (CL, CH)	28	50	120
Aquifer Material (SP-SM)	33	0	130
Seepage Berm (CL-ML)	28	50	120
Seepage Filter (SP-SM)	33	0	130

Table 6. Range of Material Properties Used for Stability Analysis.

A minimum critical factor of safety against sliding for long-term steady state seepage of 1.4 is given for the design water surface in Table 6-1b of EM 1110-2-1913. To also meet future USACE criteria and current State of California criteria the factor of safety against sliding for long term steady state seepage for water at the crest of the levee is 1.2. The results of the steady state seepage analysis for different levee heights and different water surfaces are summarized below in ***Table 7***.

Stability Analysis Results for 6' and 8' Levee Height							
Levee Height (ft)	Water Surface (ft)	Blanket Thickness (ft)	w/ 3' seepage berm	Average Vertical Exit Gradient at Landside Levee Toe	Exit Gradient at toe of berm	Landside Long-Term Slope Stability FOS	Landside Long-Term Berm Stability FOS
6.0	4.0	4.0	yes	0.29	0.48	3.64	2.45
6.0	4.0	7.5	no	0.27	N/A	1.99	N/A
6.0	6.0	7.5	no	0.38	N/A	1.77	N/A
6.0	6.0	4.0	yes	0.44	0.72	3.28	2.16
8.0	6.0	4.0	yes	0.43	0.69	2.64	2.26
8.0	8.0	4.0	yes	0.58	0.89	2.18	2.06
8.0	6.0	7.5	no	0.37	N/A	1.76	N/A

Table 7. Results from Stability Analysis runs in UTEXAS 4.0.

7.0 Conclusions and Recommendations

This memorandum presents the preliminary results of the geotechnical evaluation of the proposed levee alignments for the Orestimba Creek Project that will, in the future, be refined into

the Geotechnical Appendix of the F3 Orestimba General Reevaluation Report. The results and data presented herein may vary from the Final GRR.

The results of the geotechnical analysis of the 19 cross-sections presented in this memorandum shows that the exit gradients produced by a levee alignment along the west side of CCID Canal are higher than the acceptable levee design criteria stated in EM 1110-2-1913. The exit gradients induced at the bottom of the CCID Canal can be reduced by increasing the thickness of the canal liner; however, as seen from ***Table 2*** through ***Table 4***, the canal-liner thickness must be at least 12-feet thick to reduce the exit gradients to levels that meet acceptable criteria. Seepage control through the use of cutoff walls was not utilized in this analysis due to the fact a confining layer was not encountered in many of the borings.

An alignment along the east side of the CCID Canal yielded acceptable exit gradients at the landside levee toe in most regions; in the instance where a 4-foot clay blanket material is encountered, a seepage berm was utilized in the design and analysis; lowering the exit gradients to meet design criteria.

Stability analysis at both the landside levee slope and the toe of the seepage berm yielded factors of safety well above the minimum criteria of 1.4 for the design water surface and 1.2 for water at top of levee, as seen in ***Table 7***. Therefore, a deterministic evaluation of the eastern levee alignment meets USACE criteria for seepage and stability as presented in EM 1110-2-1913, "Design and Construction of Levees." These conclusions are based on the available data at the time of this memorandum.

Glen A. Johnson
Civil Engineer
Soil Design Section

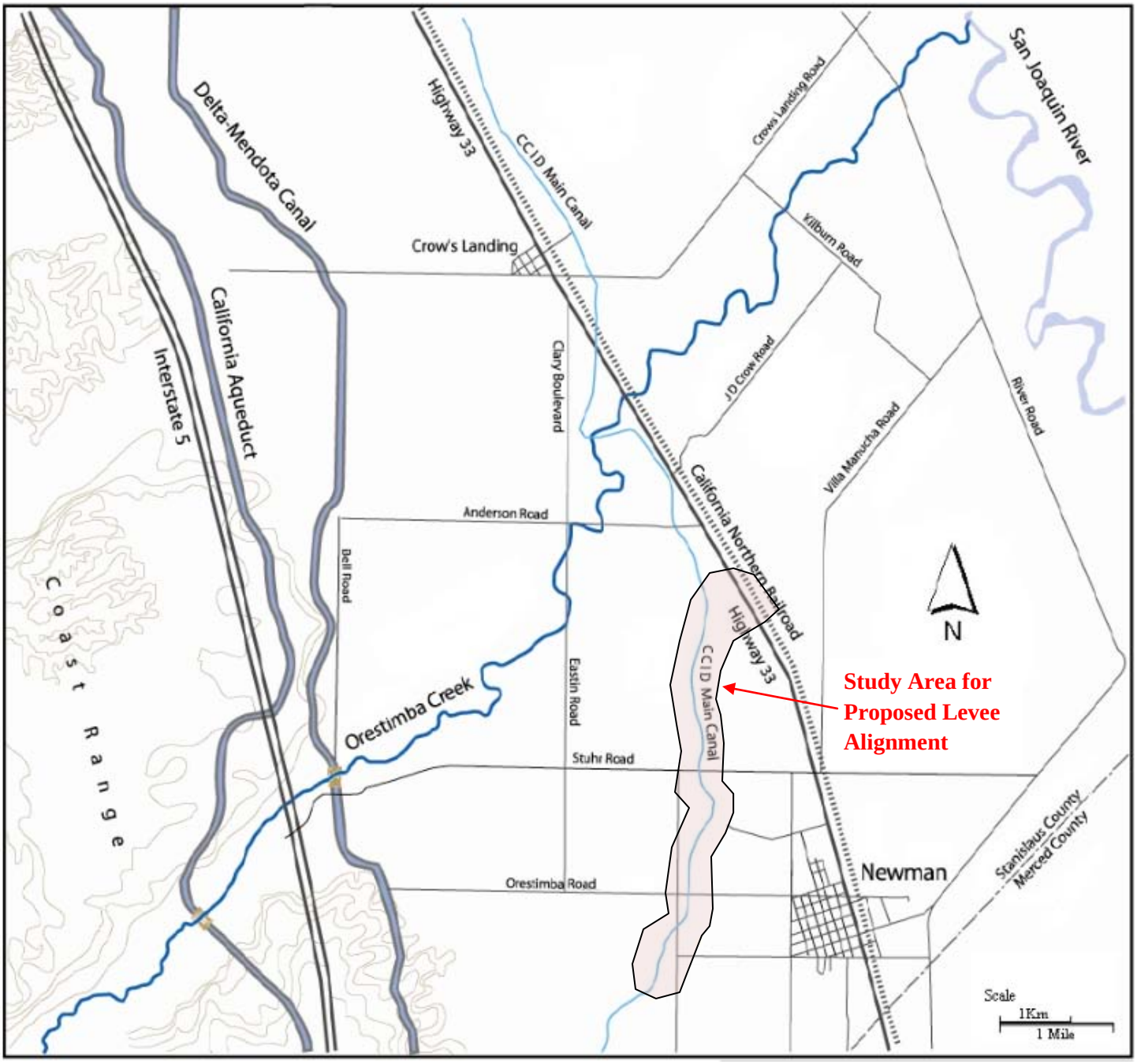
Tables (7)
Plates (5)
cc: CESPK-ED-GS-Soil Design (file copy)

References

Geotechnical Levee Practice SOP REFP10L0

US Army Corps of Engineers. EM 1110-2-1913 – Engineering and Design, Design and Construction of Levees. 30 April 2000.

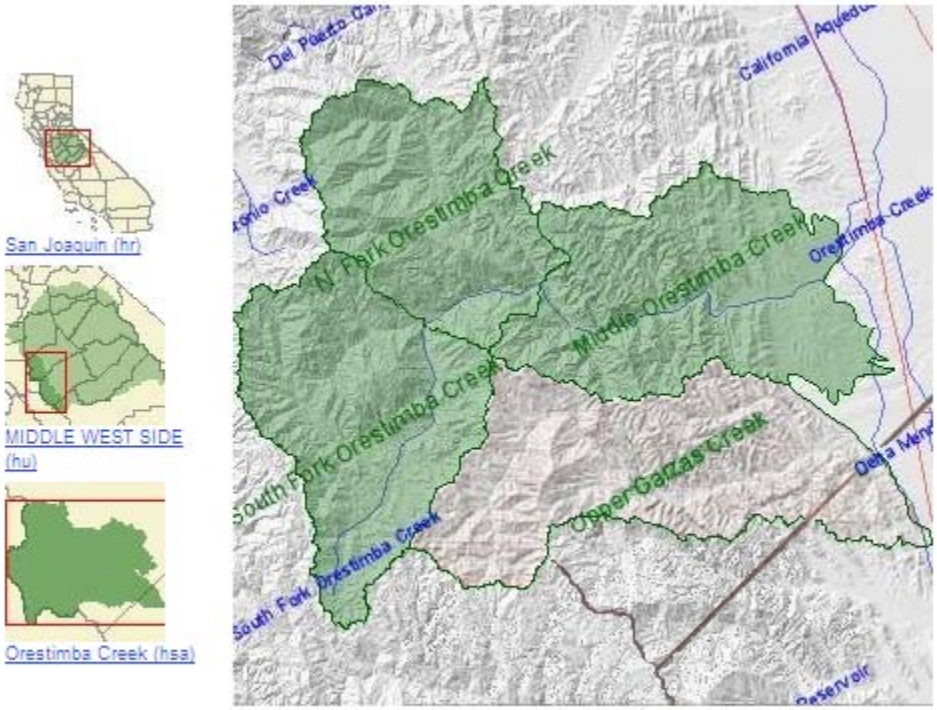
Wentworth, C.M., Blake, Jr., M.C., McLaughlin, R.J., and Graymer, R.W., 1999. Preliminary Geologic Description of the San Jose 30 X 60 Minute Quadrangle, California, 52, p., 1 Plate, Scale 1:100,000.



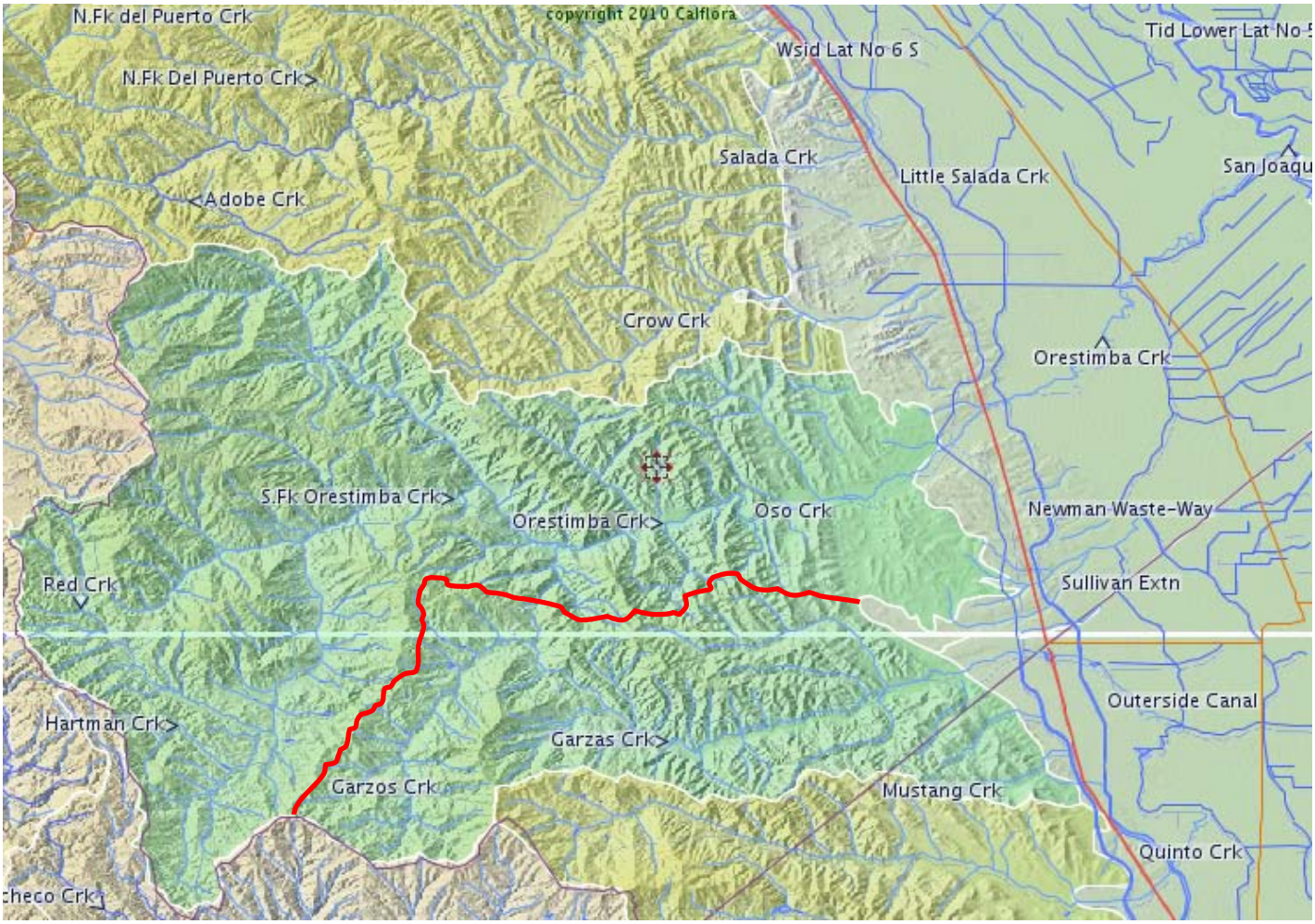
Study Location

US Army Corps
of Engineers
Sacramento District

PLATE 1 – LOCATION MAP
NEWMAN, CALIFORNIA

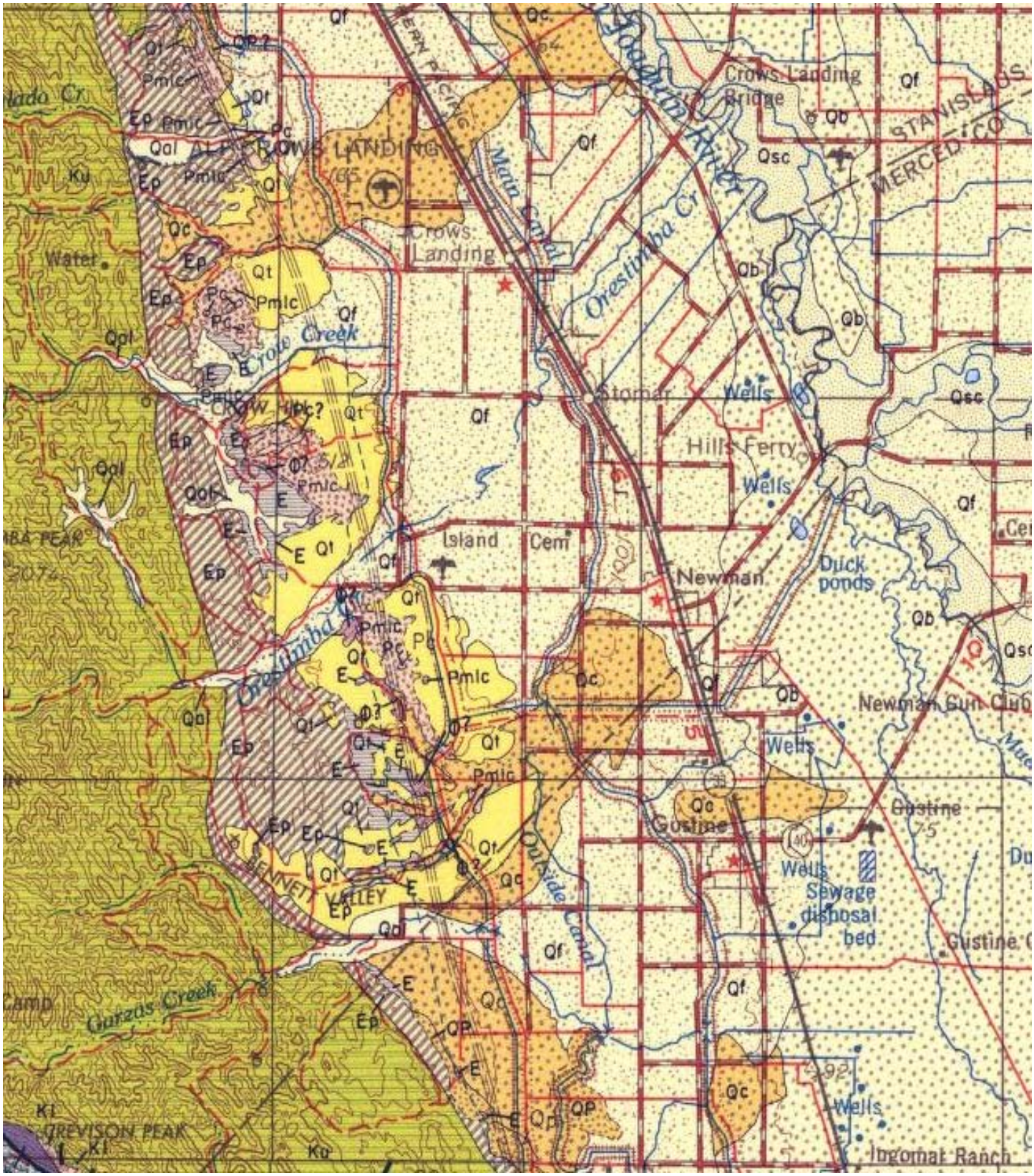


Upper Orestimba Creek Watershed



US Army Corps of Engineers
Sacramento District

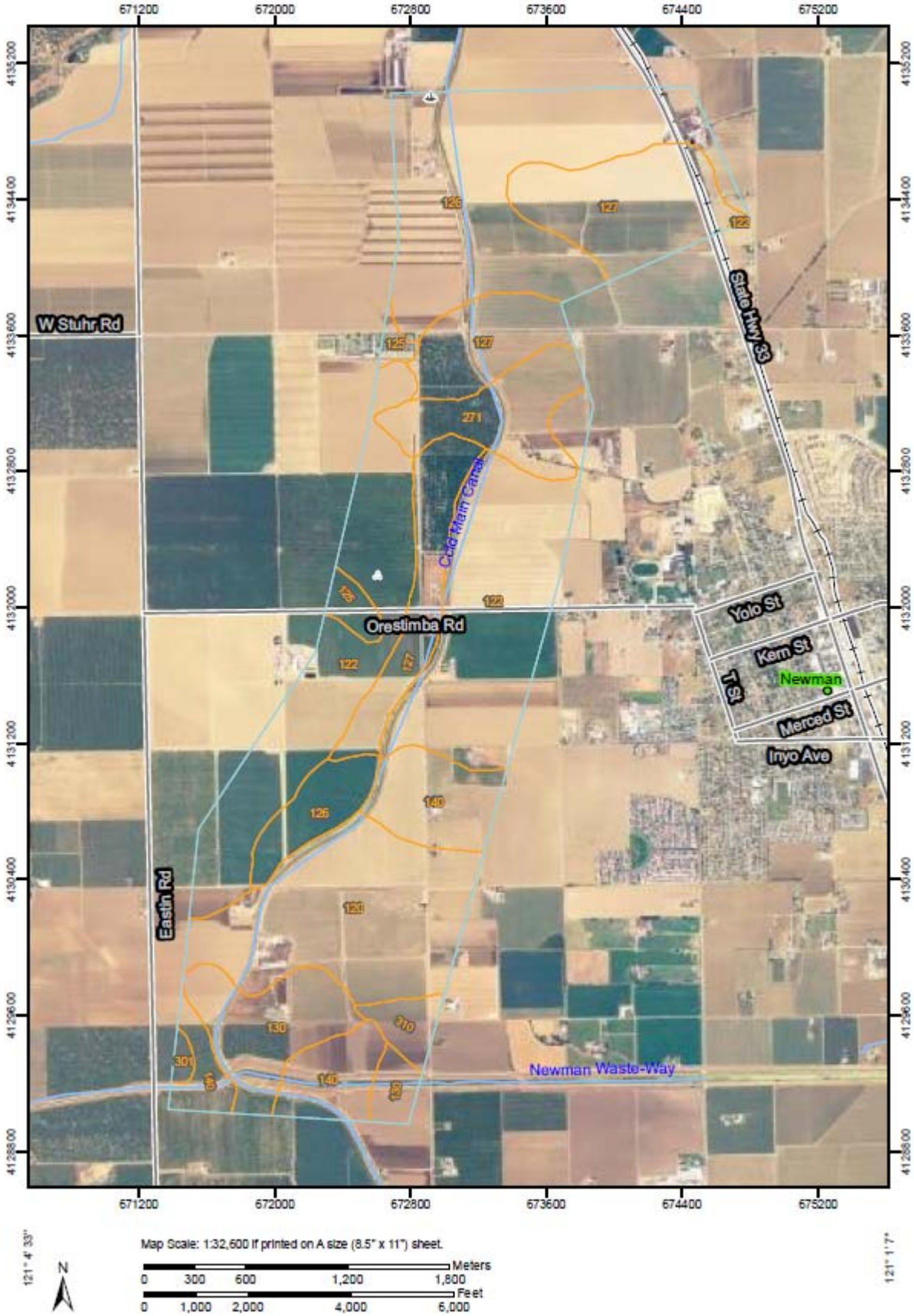
PLATE 2 – UPPER ORESTIMBA CREEK WATERSHED



Qf – Fan Deposits
Qc – Pleistocene nonmarine

US Army Corps of Engineers
Sacramento District

PLATE 3 – GEOLOGICAL MAPPING OF STUDY AREA
SAN JOSE SHEET: CALIFORNIA DIVISION OF MINES AND GEOLOGY, 1996



US Army Corps of Engineers
Sacramento District

PLATE 4 – SOIL SURVEY OF ORESTIMBA CREEK PROJECT STUDY AREA
WEB SOIL SUVEY
UNITED STATES DEPARTMENT OF AGRICULTURE

Stanislaus County, California, Western Part (CA642)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
120	Vernalis-Zacharias complex, 0 to 2 percent slopes	302.1	13.5%
122	Vernalis loam, 0 to 2 percent slopes	593.8	26.4%
125	Vernalis clay loam, 0 to 2 percent slopes	30.9	1.4%
126	Vernalis-Zacharias complex, 0 to 2 percent slopes, rarely flooded	455.9	20.3%
127	Vernalis loam, 0 to 2 percent slopes, rarely flooded	370.7	16.5%
130	Stomar clay loam, 0 to 2 percent slopes	149.1	6.6%
140	Zacharias clay loam, 0 to 2 percent slopes	189.7	8.5%
271	Elsalado loam, 0 to 2 percent slopes, rarely flooded	115.4	5.1%
301	Damluis clay loam, 2 to 8 percent slopes	7.5	0.3%
310	Deldota clay, 0 to 2 percent slopes	30.2	1.3%
Totals for Area of Interest		**2,245.2**	**100.0%**

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

- Gully
- Short Steep Slope
- Other

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:32,600 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

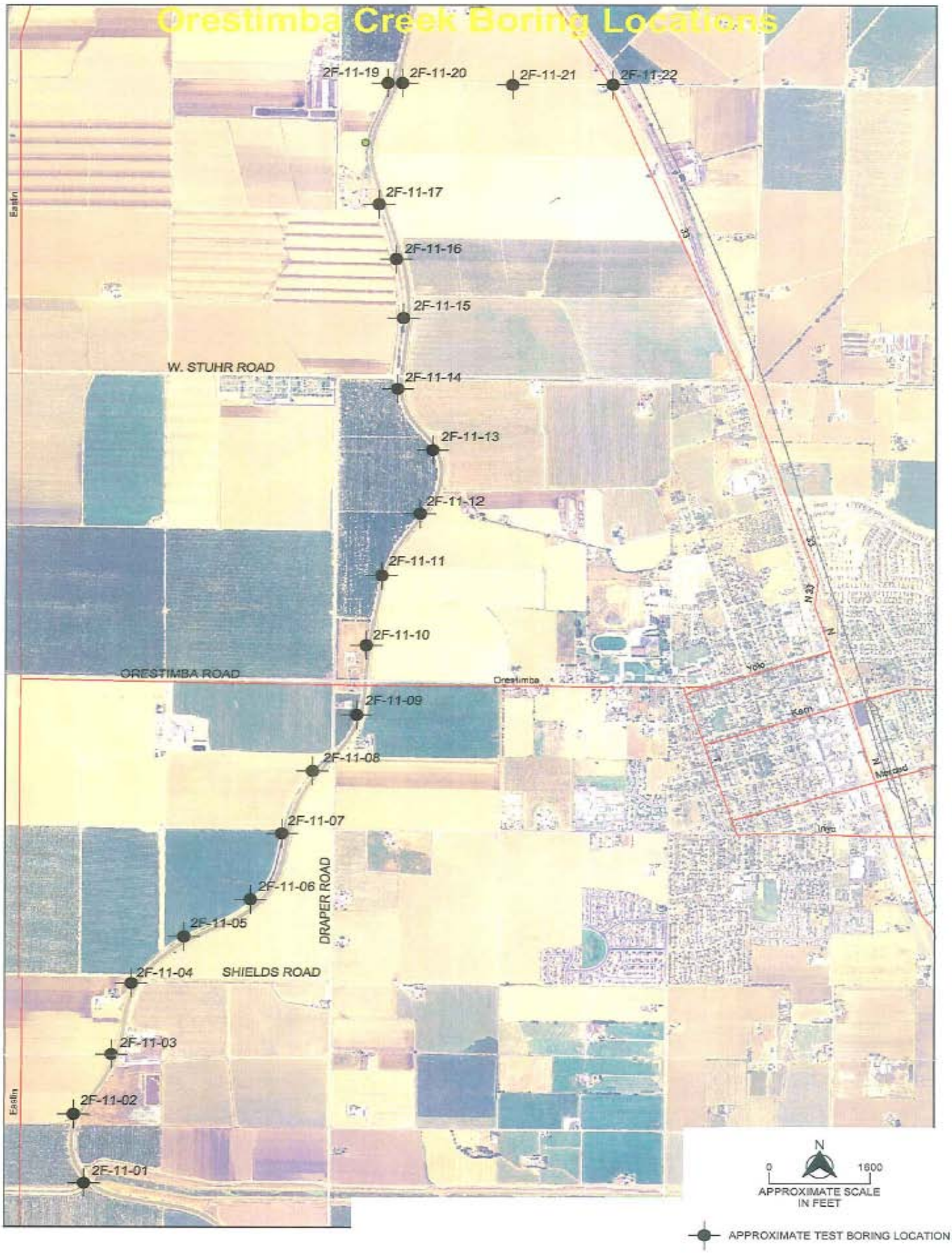
Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Stanislaus County, California, Western Part
Survey Area Data: Version 6, May 11, 2009

Date(s) aerial images were photographed: 6/12/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.



US Army Corps of Engineers
Sacramento District

PLATE 5 – ORESTIMBA CREEK PROJECT STUDY AREA
APPROXIMATE LOCATIONS OF BORINGS PERFORMED BY
MOORE TWINING ASSOCIATES
NEWMAN, STANISLAUS COUNTY, CALIFORNIA

APPENDIX B

MOORE TWINING ASSOCIATES REPORT

MOORE TWINING ASSOCIATES, INC.

January 24, 2011 C36002.01

Mr. Garner R. Reynolds
Director of Public Works
City of Newman
1162 Main Street, P.O. Box 787
Newman, California 95360

Subject: **Summary of Drilling and Geotechnical Services**
Orestimba Feasibility Study Flood Control Project
Newman, California

Dear Mr. Reynolds:

This letter has been prepared to summarize the findings of our test borings conducted as part of the Orestimba Feasibility Study Flood Control Project for the City of Newman Public Works Department.

The test borings were conducted under the periodic observations of Mr. Kiet Phan with the U.S. Army Corp of Engineers. The location of the test borings were determined based on staking locations previously placed by the U.S. Army Corp of Engineers. At the direction of Mr. Kiet Phan, the test borings were generally offset approximately 20 to 25 feet west of the stakes provided. The location of the test borings were determined by hand held GPS using State Plane Zone 3, NAD83 coordinate system. The latitude and longitude of each test boring location is reported on the final test boring logs attached herein. A site plan showing the general location of the test borings drilled have been included in Appendix A at the end of this report.

From November 1, 2010 through December 3, 2010, Moore Twining conducted a total of twenty-one (21) test borings to a depth up to 81½ feet BSG. The test borings were conducted using a CME 75 drill rig equipped with 6 5/8 inch outside diameter (O.D.) hollow stem augers (H.S.A.), 8 inch O.D. H.S.A., and a 4 inch O.D. mud rotary bit. Upon completion, the test borings were backfilled with neat cement grout to within 2-3 feet of the existing site grades. The upper 2-3 feet of the test borings were backfilled with cuttings. The soil cuttings from the hollow stem auger borings were spread evenly near the vicinity of the test borings and the mud rotary cuttings were drummed and removed off site by Moore Twining.

The soil borings were logged by a Moore Twining Licensed Professional Geologist in accordance with ASTM D2488. Soil samples were collected in accordance with ASTM D1586 and ASTM D1452, at intervals directed by the U.S. Army Corp of Engineers. The test boring logs presented on the U.S. Corp of Engineers Form 1836, are included in Appendix B at the end of this letter.

www.mooretwining.com
PH: 559.268.7021
FX: 559.268.7126
2527 Fresno Street
Fresno, CA 93721

Soil samples were collected using a standard penetration test (SPT) split barrel sampler using a 140lb Auto Trip Hammer. During sampling, SPT N-values were recorded for use in determination of Corrected N values (N_{60}). The corrected N-values were determined based on the results of the Standard Penetration Test Energy Measurements and Calibrations conducted on Moore Twining's CME 75 drill rig. A copy of the Standard Penetration Test Energy Measurements and Calibrations report, prepared by GRL Engineers, Inc., dated September 22, 2010 have been included in Appendix D at the end of this summary letter.

The soil samples were returned to Moore Twining's Fresno office for laboratory testing services. The laboratory tests were selected by the U.S. Army Corp of Engineers. These tests included moisture content (ASTM D2216), sieve analysis (ASTM D422) , and determination of plasticity index and liquid limit (ASTM 4318). The findings of the laboratory tests were utilized in preparation of the final test borings. The laboratory test results are included in Appendix C at the end of this letter.

CLOSING

Our services were performed in accordance with accepted standard of practice. This warranty is in lieu of all other warranties either expired or implied.

We appreciate the opportunity to be of service to the City of Newman. If you have any questions regarding this report, or if we can be of further assistance, please contact us at your convenience.

Sincerely,
MOORE TWINING ASSOCIATES, INC.
Geotechnical Engineering Division

PROFESSIONAL GEOLOGIST
Dean B. Ledgerwood II
No. 8725
STATE OF CALIFORNIA
exp 12/31/11

Dean B. Ledgerwood II, PG
Project Geologist

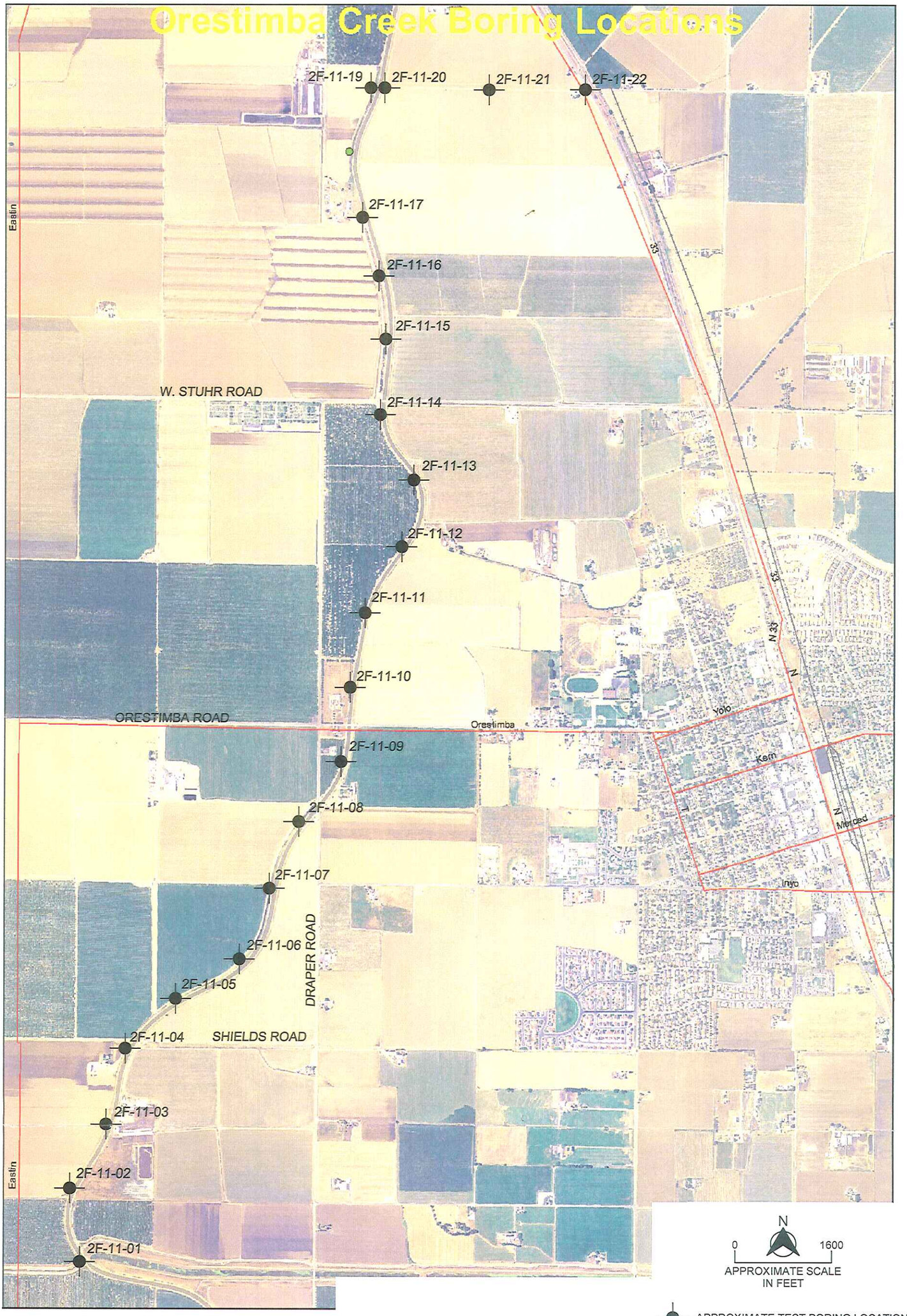
REGISTERED PROFESSIONAL ENGINEER
READ L. ANDERSEN
2810
EXP. 12-31-12
GEOTECHNICAL
STATE OF CALIFORNIA

Read L. Andersen, RGE
Manager

APPENDIX A

DRAWING

Drawing No. 1 - Test Boring Location Map



N

0 1600

APPROXIMATE SCALE IN FEET

APPROXIMATE TEST BORING LOCATION

TEST BORING LOCATION MAP ORESTIMBA FEASIBILITY STUDY FLOOD CONTROL PROJECT NEWMAN, CALIFORNIA	FILE NO. 36002-01-02	DATE DRAWN: 01/21/10	MOORE TWINING ASSOCIATES, INC.
	DRAWN BY: RM	APPROVED BY:	
	PROJECT NO. C36002.01	DRAWING NO. 1	

APPENDIX B

LOGS OF BORINGS

This appendix contains the final logs of borings. These logs represent our interpretation of the contents of the field logs and the results of the field and laboratory tests.

The logs and related information depict subsurface conditions only at these locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these test boring locations. Also, the passage of time may result in changes in the soil conditions at these test boring locations.

In addition, an explanation of the abbreviations used in the preparation of the logs and a description of the Unified Soil Classification System are provided at the end of Appendix B.

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 1 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-01
LOCATION COORDINATES	N 1930195.208 E 6397849.518
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 4
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	NE
5. DIRECTION OF HOLE	VERTICAL ☒ INCLINED ☐ _____ DEG. FROM VERT
15. DATE HOLE	STARTED 11/10/10; COMPLETED 11/10/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	6.5
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	6.5

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY with Sand (CL); Moist,10yr4/3 Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 20% Fine Sand, No HCL Reaction										
		5 6 4	10	13			28	FS#1								PP=3.5
2																
		7 10 15	25	33		Same as above except; 10yr4/4 Dark Yellow Brown, Weak HCL Reaction	67	FS#2								PP>4.5
4																
		8 11 15	26	35		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 40% Fine Sand, Trace Coarse Sand, Trace Sub Rounded Fine Gravel to 0.5 inches, No HCL Reaction	44	FS#3 FS#4								PP>4.5
6						SAND Poorly Graded with Silt (SP-SM), Moist, 10yr5/4, Yellow Brown, 90% Fine to Coarse Sand, 10% Non Plastic Fines, No HCL Reaction										
						Bottom of Boring at 6.5 Feet BSG										
8																
10																
12																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 3 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-02
LOCATION COORDINATES	N 1931232.885 E 6397855.762
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 18
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	35 Feet BSG
5. DIRECTION OF HOLE	VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐
15. DATE HOLE	STARTED 11/10/10; COMPLETED 11/10/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	40
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	40

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr3/4, Dark Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium to High Toughness, 5% Fine Sand, No HCL Reaction										
		5 6 4	10	13			28	FS#1								PP=3.5
2						Same as above except; 10yr4/4 Dark Yellow Brown, Weak HCL Reaction										
		7 10 15	25	33			67	FS#2								PP>4.5
4						FAT CLAY, Sandy (CH); Moist, 10yr6/8 Brownish Yellow, High Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand, Weak HCL Reaction			0	38	62	61	39	15.5	CH	
		2 5 6	11	15			44	FS#3								PP=2.25
6						Same as above except; Trace Coarse Sand, No HCL Reaction										
		5 7 12	19	25			39	FS#4								PP=4.0
8						LEAN CLAY with Sand (CL); Moist, 10yr5/4 Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 20% Fine Sand, Strong HCL Reaction										
		7 9 9	18	24			56	FS#5								PP>4.5
10						LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 55% Low Plastic Fines, Medium to High Dry Strength, None Dilatency, Low to Medium Tough, 45% Fine Sand, Strong HCL Reaction										
		4 5 8	13	17			67	FS#6								PP=2.5
12						SAND, Clayey (SC); Moist, 10yr5/4 Yellow Brown, 55% Fine to Medium Sand,										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-02
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1931232.885 E 6397855.762	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		14 13 13	26	35		45% Low Plastic Fines, High Dry Strength, None Dilatency, Low to Medium Tough, No HCL Reaction	72	FS#7								
16		8 9 15	24	32		FAT CLAY, Sandy (CH); Moist, 10yr5/4 Yellow Brown, Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand, Strong HCL Reaction	83	FS#8	0	42	58	58	39	12.1	CH	PP=4.0
18		9 11 15	26	35		SAND, SILTY (SM); Moist, 10yr5/4 Yellow Brown, 65% Fine to Medium Sand, 35% None to Low Plastic Fines, No HCL Reaction	89	FS#9								
20		12 16 20	36	48		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 30% Fine Sand, Trace Medium to Coarse Sand, Weak HCL Reaction	83	FS#10								PP>4.5
22		6 12 15	27	36		SAND, Clayey (SC); Moist, 10yr5/8 Yellow Brown, 70% Fine to Medium Sand, 30% Low Plastic Fines, High Dry Strength, None Dilatency, Low to Medium Tough, No HCL Reaction	83	FS#11	0	70	30					
24		12 20 25	45	60		LEAN CLAY with Sand (CL); Moist, 7.5yr5/6 Strong Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 15% Fine to Coarse Sand, Trace Coarse Subrounded Gravel to 1 inch, No HCL Reaction	83	FS#12								PP>4.5
26		12 16 15	31	41		LEAN Clay, Sandy (CL); Moist, 10yr6/6 Brownish Yellow, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 30% Fine to Coarse Sand, Trace Coarse Subrounded Gravel to 1 inch, No HCL Reaction	67	FS#13								PP>4.5
28																
30		5 8 8	16	21		SAND, Silty (SM); Moist, 2.5yr6/6 Olive Yellow, 60% Fine Sand, 40% Non Plastic Fines, No HCL Reaction	100	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-02
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District; SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1931232.885 E 6397855.762	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		2 6 6	12	16		SILT, Sandy (ML); Moist, 5yr5/4 Pale Olive, 70% Non Plastic Fines, No Dry Strength, Slow Dilatency, No Thread, 30% Fine Sand, No HCL Reaction	100	FS#15								PP=1.5
34																
36		8 10 14	24	32		SILT, Clayey (ML/CL); Wet, 5yr5/4 Olive, 90% Non to Low Plastic Fines, No Dry Strength, None Dilatency, Low Toughness, No Thread, 10% Fine Sand, No HCL Reaction	100	FS#16								
38																
		2 3 4	7	9		Same as Above	100	FS#17								
40						SAND, Poorly Graded (SP), Wet, 10yr6/8 Brownish Yellow, 100% Fine to Medium Sand, No HCL Reaction		FS#18								
						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 4 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 8" HSA / 4" Mud Rotary		
2. HOLE NO.: 2F-11-03	LOCATION COORDINATES: N 1932408.891 E 6398473.671	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 25
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: 44.5 Feet BSG		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/29/10	COMPLETED: 11/29/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 60	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 60			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY, Sandy, (CL); Moist, 10yr5/6, Yellow Brown, 70% Low Plastic Fines, High Dry Strength, Non Dilatency, Medium Tough, 30% Fine Sand, Trace Fine Subangular Gravel to 0.3 inch, No HCL Reaction										
		11 7 8	18	24			44	FS#1	5	41	54					PP=3.0
2						Same as Above										
		6 5 5	10	13			33	FS#2				37	20			PP=3.5
4						Same as Above Except; 80% Fines, 20% Fine to Medium Sand, No Gravel										
		7 9 10	19	25			33	FS#3								PP>4.5
6						LEAN CLAY, With Sand (CL); Moist, 10yr4/6 Dark Yellow Brown, 90% Low Plastic Fines, High Dry Strength, Non Dilatency, Medium Toughness, 10% Fine Sand, No HCL Reaction										
		7 10 11	21	28			33	FS#4								PP>4.5
8						Same as Above										
		8 9 13	22	29			44	FS#5								PP>4.5
10						LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, Low Plastic Fines, High Dry Strength, Non Dilatency, Medium Toughness, Fine Sand, No HCL Reaction										
		7 8 8	16	21			61	FS#6	0	37	63	28	15	12.2	CL	PP>4.5
12						Same As Above										PP=2.0

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-03

PROJECT	INSTALLATION	SHEET 2 OF 4 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1932408.891 E 6398473.671	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		3 4 21	25	33			67	FS#7 FS#8								
14						SAND, Poorly Graded (SP); Moist, 10yr7/2 Light Gray, 90% Fine to Coarse Sand, 5% Non Plastic Fines, 5% Fine Sub Angular Gravel to 0.3 inches, Weak HCL Reaction										
		13 14 20	34	45		SAND, Silty With Gravel (SM); Moist, 10yr7/2 Light Gray, Fine to Coarse Sand, Fine to Coarse Sub Angular Gravel to 1.5 inches, Strong HCL Reaction	67	FS#9	35	50	15					
16																
		7 7 10	17	23		LEAN CLAY, Sandy (CL); Moist, 10yr5/6 Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 40% Fine to Medium Sand, No HCL Reaction	61	FS#10								PP=3.5
18																
		7 8 11	19	25		SAND, Silty (SM); Moist, 10yr5/6 Yellow Brown, Fine to Medium Sand, Low Plastic Fines, No HCL Reaction	72	FS#11	0	65	35	NV	NP	9.9	SM	
20																
		8 9 15	24	32		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, No HCL Reaction	78	FS#12								PP=4.5
22																
24		5 6 7	13	17		SAND, Silty (SM); Moist, 10yr5/8 Yellow Brown, 80% Fine Sand, 20% Non-plastic Fines, No HCL Reaction	39	FS#13								
26																
		11 7 9	16	21		LEAN CLAY, With Sand (CL); Moist, 10yr4/4 Dark Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 20% Fine Sand, No HCL Reaction	44	FS#14								PP>4.5
28																
30		3 4 6	10	13		LEAN CLAY, (CL); Moist, 10yr5/6 Yellow Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, No HCL	44	FS#15								PP=2.0

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-03	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 4 SHEETS
LOCATION COORDINATES N 1932408.891 E 6398473.671	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
						Reaction										
32																
		3 7 11	18	24		Same as Above	89	FS#16								PP>4.5
34																
36		3 10 13	23	31		Silty, Clayey Sand (SM-SC); Moist, 10YR5/4 Yellow Brown, Fine Sand, Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, No HCL Reaction	83	FS#17	0	52	48	24	7	14.9	SM-SC	
38																
		11 16 27	43	57		Same as Above Except; Trace Fine Subangular Gravel to 0.3 inches, Strong HCL Reaction	89	FS#18								
40																
42		8 19 27	46	61		LEAN CLAY, with Sand (CL); Moist, 7.5yr6/6 Reddish Yellow, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine to Medium Sand, Trace Fine to Coarse Sub Rounded Gravel to 0.5 inches, Strong HCL Reaction	61	FS#19									PP>4.5
44																
		15 17 21	38	51		LEAN CLAY, Sandy (CL); Wet, 10yr5/6 Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 40% Fine Sand, Trace Fine to Coarse Sub Rounded to Sub Angular Gravel to 0.6 inches, Strong HCL Reaction	44	FS#20									Switched to Mud Rotary
46																
48		15				SAND, Poorly Graded with Silt (SP-SM); Wet, 10yr6/6 Brownish Yellow, 90% Fine Sand, 10% Non Plastic Fines, No HCL										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-03	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 4 OF 4 SHEETS
LOCATION COORDINATES N 1932408.891 E 6398473.671	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		16 18	34	45		Reaction	56	FS#21								
50																
		12 15 16	31	41		SAND, Silty (SM); Wet, 10yr5/2 Grayish Brown, 80% Fine Sand, 20% Non Plastic Fines, No HCL Reaction	100	FS#22								
52																
54		12 11 15	26	35		Same as Above Except; Trace Coarse Sub Angular Gravel to 0.6 inches, Weak to Strong HCL Reaction	94	FS#23								
56																
		8 12 16	28	37		Same as Above Except; 65% Fine Sand, 35% Non Plastic Fines, No HCL Reaction	100	FS#24								
58																
		9 12 20	32	43		SILT, Sandy (ML), Wet, 10yr5/2 Gray Brown, 70% Non Plastic Fines, 30% Fine Sand, Strong HCL Reaction	100	FS#25								PP>4.5
60						Bottom of Boring at 60 Feet BSG										
62																
64																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-04	LOCATION COORDINATES: N 1933586.65 E 6398800.678	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 18
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: 35.0 Feet BSG		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/10/10	COMPLETED: 11/10/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, (CH); Moist, 10yr6/4 Light Yellow Brown, High Plastic Fines, 90% High Dry Strength, Medium Toughness, 10% Fine Sand, No HCL Reaction										
	■	13 11 9	20	27			22	FS#1								PP>4.5
2																
	■	6 4 4	8	11		Same as Above except; FAT CLAY, With Sand (CH); 10yr5/6 Yellow Brown	44	FS#2	0	25	75	53	30	7.5	CH	PP>4.5
4																
	■	6 7 10	17	23		Same as Above Except Trace Coarse Sand, Weak HCL Reaction	44	FS#3								PP>4.5
6																
	■	8 15 25	40	53		Same as Above Except; 100% Fines, Trace Fine Sand, Strong HCL Reaction	67	FS#4								PP>4.5
8																
	■	15 17 20	37	49		SAND, Silty with Gravel (SM); Moist, 10yr6/2 Light Brownish Gray, Fine to Coarse Sand, Fine to Coarse Sub Rounded Gravel to 1.1 inches, Non Plastic Fines, Weak HCL Reaction	83	FS#5	37	50	13					
10																
	■	5 9 10	19	25		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Sub Rounded Gravel to 0.8 inches, No HCL Reaction	56	FS#6								
12																
	■					Same as Above Except; Fine to Coarse Sub Rounded Gravel to 1										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-04	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 2 OF 3 SHEETS
LOCATION COORDINATES N 1933586.65 E 6398800.678	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		5 8 8	16	21		inch, Strong HCL Reaction	61	FS#7								
14																
		2 1 2	3	4		SAND, Poorly Graded (SP); Moist, 10yr6/8 Brownish Yellow, 100% Fine to Medium Sand, No HCL Reaction	67	FS#8								
16																
		2 3 4	7	9		Same as Above	100	FS#9								
18																
		3 5 9	14	19		Same as Above Except; 100% Fine to Coarse Sand, Trace Fine Sub Rounded Gravel to 0.5 inches	100	FS#10								
20																
		7 11 16	27	36		SAND, Poorly Graded With Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Sub Rounded Gravel to 1 inches, No HCL Reaction	100	FS#11								
22																
24		6 5 5	10	13		Same as Above Except; Fine Subrounded Gravel to 0.5 inch, Trace Coarse Sub Rounded Gravel to 1 inch	89	FS#12	23	65	12					
26																
		5 15 14	29	39		LEAN CLAY, Sandy (CL); Moist, 10yr5/6 Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency, Low to Medium Toughness, 40% Fine Sand, No HCL Reaction	89	FS#13								PP=3.0
28																
30		9 8 7	15	20		Same as Above Except; Trace Subrounded Fine Gravel to 0.5 inch	89	FS#14								PP=3.5

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-04
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District; SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1933586.65 E 6398800.678	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		2 2 2	4	5		Same as Above Except; 10yr4/6 Dark Yellow Brown, Trace Coarse Sand	100	FS#15	1	37	62	42	23	16.1	CL	PP=3.5
34																
36		3 4 3	7	9		Same as Above Except; Wet	78	FS#16								PP=2.5
38																
		2 5 29	34	45		Same as Above	100	FS#17 FS#18								PP=2.5
40						SAND, Poorly Graded With Gravel (SP); Wet, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1.5 inches, Strong HCL Reaction										
						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 3 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-05
LOCATION COORDINATES	N 1934415.226 E 6399678.189
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 17
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	37.5 Feet BSG
5. DIRECTION OF HOLE	VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐
15. DATE HOLE	STARTED 11/9/10; COMPLETED 11/9/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	40
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	40

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr4 3 Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Weak HCL Reaction										
	■	5 6 6	12	16			22	FS#1								PP=2.0
2																
	■	3 5 4	9	12		Same as Above Except; Trace Coarse Sand	28	FS#2								PP>4.5
4																
	■	2 1 2	3	4		LEAN CLAY With Sand (CL); 10yr5/6 Yellow Brown, Moist, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Coarse Subrounded Gravel to 1.3 inches, Strong HCL Reaction	28	FS#3								PP=2.5
6																
	■	12 9 12	21	28		SAND, Poorly Graded With Silt (SP-SM); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 10% Non Plastic Fines, 10% Fine Sub Rounded Gravel to 0.5 inch, No HCL Reaction	67	FS#4								
8																
	■	13 10 13	23	31		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subrounded Gravel to 1 inches, Non Plastic Fines, No HCL Reaction	78	FS#5	37	50	13					
10																
	■	6 10 12	22	29		SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Subrounded Gravel to 1.1 inches, Weak HCL Reaction	83	FS#6								
12																
	■					Same as Above Except; Gravel to 1.3 inches, No HCL Reaction										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-05	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 2 OF 3 SHEETS
LOCATION COORDINATES N 1934415.226 E 6399678.189	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		4 13 10	23	31			83	FS#7								
14																
		2 3 5	8	11		FAT CLAY, Sandy (CH); Moist, 10yr4/6 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, Strong HCL Reaction	89	FS#8	0	30	70	50	31	16.8	CH	PP=1.5
16																
		5 10 13	23	31		Same as Above Except; Weak to Strong HCL Reaction	100	FS#9								PP=3.5
18																
		7 11 14	25	33		LEAN CLAY, With Sand (CL), Moist, 10yr5/6 Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Fine Subrounded Gravel to 0.4 inches, Strong HCL Reaction	100	FS#10								PP>4.5
20																
		4 5 10	15	20		LEAN CLAY, Sandy (CL), Moist, 10yr5/8 Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, No HCL Reaction	89	FS#11								PP=3.0
22																
24		6 5 6	11	15		Same as Above Except; Trace Medium to Coarse Sand	56	FS#12								PP=2.5
26																
		4 5 8	13	17		FAT CLAY, Sandy (CH); Moist, 10yr5/6 Yellow Brown, 90% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Strong HCL Reaction	56	FS#13	0	35	65	58	37	15.0	CH	PP=3.75
28																
30		10 14 17	31	41		LEAN CLAY, Sandy (CL); Moist, 10yr4/6 Dark Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine	100	FS#14								PP>4.5

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-05	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1934415.226 E 6399678.189	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
						to Medium Sand, No HCL Reaction										
32																
		7 11 13	24	32		LEAN CLAY, With Sand (CL); Moist, 10yr4/6 Dark Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Strong HCL Reaction	89	FS#15								PP>4.5
34																
36		3 3 4	7	9		LEAN CLAY, Sandy (CL); Moist, 10yr5/6 Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 40% Fine Sand, No HCL Reaction	89	FS#16								PP=2.0
38																
		2 2 3	5	7		LEAN CLAY (CL); Moist, 10yr5 8 Yellow Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Low to Medium Toughness, 20% Fine Sand, Trace Medium to Coarse Sand, Weak HCL Reaction	78	FS#17								PP=2.5
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 3 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-06
LOCATION COORDINATES	N 1935104.235 E 6400764.227
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 17
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	38.5 Feet BSG
5. DIRECTION OF HOLE	VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐
15. DATE HOLE	STARTED 11/9/10; COMPLETED 11/9/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	40
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	40

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, with Sand (CH); Moist, 10yr4/3 Brown, 95% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Strong HCL Reaction										
		3 4 4	8	11			33	FS#1								PP=4.5
2						Same as Above										
		4 5 5	10	13			83	FS#2	1	26	73	60	37	11.3	CH	PP=2
4																
		2 2 2	4	5		LEAN CLAY, With Sand (CL); Moist, 10yr5/3 Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, Weak HCL Reaction	44	FS#3								PP=1.5
6																
		2 2 2	4	5		LEAN CLAY, Sandy (CL); Moist 10yr4/6 Dark Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency Low to Medium Toughness, 40% Fine Sand, Strong HCL Reaction	44	FS#4								PP=1.25
8																
		3 4 5	9	12		SAND, Clayey with Gravel (SC); Moist, 10yr4/6 Dark Yellow Brown, 80% Fine Sand, 20% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Coarse Gravels Sub Rounded to 1.5 inches, Strong HCL Reaction	39	FS#5	28	34	38					PP=4.0
10																
		10 8 6	14	19		SAND, Poorly Graded With Silt and Gravel (SP-SM); Moist 10yr6/3 Pale Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse Sub Rounded Gravel to 1 inch, 10% Non Plastic Fines, No HCL Reaction	44	FS#6								
12																
						Same as Above Except; Gravel to 1.5 inches										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-06
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District; SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1935104.235 E 6400764.227	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		5 2 3	5	7			33	FS#7								
14																
		10 9 10	19	25		SAND, Silty With Gravel (SM); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 15% Fine to Coarse Sub Rounded Gravel to 2 inches, 15% Non Plastic Fines, No HCL Reaction	33	FS#8								
16																
		13 15 12	27	36		Same as Above Except; 10yr5/3 Brown, Gravel to 1.5 inches, Weak HCL Reaction	67	FS#9	40	47	13					
18																
		9 7 4	11	15		SAND, Poorly Graded (SP); Moist, 10yr5/3 Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Sub Rounded Gravel to 0.8 inches, No HCL Reaction	44	FS#10								
20																
		5 4 5	9	12		FAT CLAY, Sandy (CH); Moist, 10yr4/6 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, No HCL Reaction	56	FS#11	0	32	68	58	36	13.9	CH	PP>4.5
22																
24		11 14 13	27	36		SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine Gravel Sub Rounded to 0.5 inches, No HCL Reaction	89	FS#12								
26																
		13 11 9	20	27		Same as Above Except; 10yr6/4 Light Yellow Brown, Fine to Coarse Sub Rounded Gravel to 1 inch	78	FS#13								
28																
30		4 4 8	12	16		LEAN CLAY (CL); Moist, 10yr5 6 Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, 10% Fine Sand, No HCL Reaction	100	FS#14								PP=3.0

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-06
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1935104.235 E 6400764.227	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		23 46 34	77	102		SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Sub Rounded Gravel to 1 inch, No HCL Reaction	67	FS#15								
34																
36		13 18 18	36	48		SAND, Poorly Graded With Silt (SP-SM); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 10% Non Plastic Fines, 10% Fine Sub Rounded Gravel to 0.6 inches, No HCL Reaction	56	FS#16								
38																
		9 4 5	9	12		LEAN CLAY (CL); Moist, 10yr6/6 Brownish Yellow, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, No HCL Reaction	83	FS#17								PP=2.5
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 4 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	8" HSA / 4" Mud Rotary
2. HOLE NO.	2F-11-07
LOCATION COORDINATES	N 1936107.117 E 6401113.338
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 25
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	52.0 Feet BSG
5. DIRECTION OF HOLE	VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐
15. DATE HOLE	STARTED 12/1/10; COMPLETED 12/1/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	60
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	60

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY With Sand (CL); Moist, 10yr4/4 Dark Yellow Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, Weak HCL Reaction										
		3 4 6	10	13			44	FS#1								PP>4.5
2																
		6 8 9	17	23		Same as Above Except; No HCL Reaction	44	FS#2								PP>4.5
4																
		4 6 7	13	17		Same as Above Except; 75% Fines, 25% Fine Sand, Strong HCL Reaction	33	FS#3								PP=4.5
6																
		2 2 2	4	5		LEAN CLAY (CL); Moist 10yr5/6 Yellow Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Strong HCL Reaction	22	FS#4								PP=1.5
8																
		2 3 2	5	7		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, Strong HCL Reaction	44	FS#5								PP=1.5
10																
		1 2 4	6	8		LEAN CLAY with Sand (CL); Moist, 10yr5/4 Yellow Brown, Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, No HCL Reaction	44	FS#6	0	26	74	32	15	18.4	CL	PP=2.25
12																
						Same as Above Except; Trace Subrounded Fine Gravel to 0.5										PP>4.5

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-07
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 4 SHEETS
LOCATION COORDINATES: N 1936107.117 E 6401113.338	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		3 4 5	9	12		inches	83	FS#7								
14																
		10 10 11	21	28		SAND, Poorly Graded With Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.3 inches, Strong HCL Reaction	67	FS#8	39	50	11					
16																
		7 12 19	31	41		Same as Above Except; Gravel to 1 inch, No HCL Reaction	78	FS#9								
18																
		18 22 15	37	49		Same as Above	100	FS#10								
20																
		10 8 8	16	21		SAND, Poorly Graded (SP); Moist, 10yr4/3 Brown, 95% Fine to Coarse Sand, 5% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	94	FS#11								
22																
24		7 7 7	14	19		LEAN CLAY, With Sand (CL); Moist, 10yr5/6 Yellow Brown, 85% Low Plastic Fines, High Dry Strength, Non Dilatency, Medium Toughness, 15% Fine Sand, No HCL Reaction	100	FS#12								PP=2.75
26																
		4 5 5	10	13		Same as Above Except; LEAN CLAY, Sandy (CL); Weak HCL Reaction	89	FS#13	0	40	60	35	18	17.7	CL	PP=1.5
28																
30		4 5 6	11	15		Same as Above Except; No HCL Reaction	100	FS#14								PP=2.25

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-07
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 3 OF 4 SHEETS
LOCATION COORDINATES: N 1936107.117 E 6401113.338	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		4 4 4	8	11		Same as Above Except; Weak HCL Reaction	56	FS#15								PP=2.5
34																
36		8 26 27	53	70		SAND, Clayey (SC); Moist, 10yr5/3 Brown, 75% Fine to Medium Sand, 25% Low Plastic Fines, No HCL Reaction	100	FS#17 FS#16								
						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, Weak HCL Reaction										
38																
		14 13 17	30	40		SAND, Silty with Gravel (SM); Moist, 10yr5/3 Brown, 88% Fine to Coarse Sand, 12% Non Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	100	FS#18								
40																
42		20 12 13	25	33		Same as above	78	FS#19	41	46	13					
44																
		8 6 8	14	19		LEAN CLAY, Sandy (CL); Moist, 10yr5/3 Brown, 65% Low Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, 35% Fine Sand, Trace Fine Subrounded Gravel to 0.3 inches, No HCL Reaction	100	FS#20								PP=2.5
46																
48		24				SAND, Poorly Graded with Gravel (SP); Moist, 10yr4/3 Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-07
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 4 OF 4 SHEETS
LOCATION COORDINATES: N 1936107.117 E 6401113.338	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		10 4	14	19		Subrounded to Subangular Gravel to 1.2 inches, No HCL Reaction	100	FS#21								
50																
		8 12 17	29	39		SAND, Silty with Gravel (SM); Moist, 10yr5/3 Brown, Fine to Coarse Sand, Non Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 0.8 inches, Weak HCL Reaction	100	FS#22	43	44	13					
52																
54		16 13 14	27	36		Same as Above Except; No HCL Reaction	83	FS#23								
56																
		17 18 18	36	48		Same as Above Except; Fine Subrounded to Subangular Gravel to 0.5 inches	100	FS#24								
58																
		26 43 37	80	106		Same as Above Except; Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	100	FS#25								
60						Bottom of Boring at 60 Feet BSG										
62																
64																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-08	LOCATION COORDINATES: N 1937265.985 E 6401562.221	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 17
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/8/10	COMPLETED: 11/8/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY, with Sand (CL); Moist, 10yr4/3 Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Coarse Sand, No HCL Reaction										
	■	6 5 5	10	13			33	FS#1								PP>4.5
2																
	■	2 2 2	4	5		Same as Above Except; Weak HCL Reaction	33	FS#2								PP=4.25
4																
	■	1 1 2	3	4		FAT CLAY, Sandy (CH); Moist, 10yr4/4 Dark Yellow Brown, High Plastic Fines, High Dry Strength, Medium Toughness, Fine Sand, Strong HCL Reaction	39	FS#3	1	36	63	51	30	12.0	CH	PP=2.5
6																
	■	1 3 11	14	19		Same as Above Except; Fine to Medium Sand	44	FS#4 FS#5								
8						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 0.7 inches, Weak HCL Reaction										
	■	8 7 8	15	20		SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine Subrounded Gravel to 0.4 inches, No HCL Reaction	56	FS#6								
10																
	■	5 4 5	9	12		Same as Above Except; 100% Fine to Medium Sand, Weak HCL Reaction	67	FS#7								
12																
	■					SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-08	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 2 OF 3 SHEETS
LOCATION COORDINATES N 1937265.985 E 6401562.221	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		6 14 17	31	41		Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 0.8 inches, Weak HCL Reaction	56	FS#8								
16		12 8 13	21	28		Same as Above Except; Gravel to 1.5 inches	6	FS#9								
18		16 14 10	24	32		Same as Above Except; No HCL Reaction	78	FS#10								
20		5 9 11	20	27		SAND, Well Graded with Silt and Gravel (SW-SM); Fine to Coarse Sand, Fine to Coarse Subrounded Gravel to 1 inches, No HCL Reaction	67	FS#11	32	58	10					
22		21 26 20	46	61		SAND, Poorly Graded with Silt and Gravel (SP-SM); 10yr6/4 Light Yellow Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1.2 inches, 10% Non Plastic Fines, Weak HCL Reactions	72	FS#12								
24		7 5 2	7	9		No Recovery	0									
26		24 20 15	35	47		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 0.8 inches, No HCL Reaction	89	FS#13								
30		18 15 18	33	44		SAND, Poorly Graded with Silt (SP); Moist, 10yr5/3 Brown, 85% Fine to Coarse Sand, 10% Non Plastic Fines, 5% Fine Subrounded Gravels to 0.3 inches,	89	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-08	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1937265.985 E 6401562.221	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
						No HCL Reaction										
32																
		9 9 6	15	20		SAND, Poorly Graded (SP); Moist, 10yr5/4 Yellow Brown, 90% Fine to Medium Sand, Trace Coarse Sand, 5% Non Plastic Fines, 5% Fine to Coarse Subrounded Gravel to 0.7 inches, No HCL Reaction	89	FS#15								
34																
36		15 3 3	6	8		Same as Above Except; Gravel to 0.9 inches	56	FS#16								
38																
		4 3 4	7	9		SILTY CLAY, with Sand (CL-ML); Moist, 10yr5/6 Light Yellow Brown, Low Plastic Fines, Medium Dry Strength, Non Dilatency, Low to Medium Toughness, Fine Sand, Weak HCL Reaction	67	FS#17	1	22	77					PP=1.5
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-09	LOCATION COORDINATES: N 1938292.199 E 6402280.741	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 17
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/8/10	COMPLETED: 11/8/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY, with Sand (CL); Moist, 10yr4/4 Dark Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Subrounded Gravel to 0.4 inches, No HCL Reaction										
	■	3 3 2	5	7			33	FS#1								PP>4.5
2						Same as Above Except; Strong HCL Reaction, No Gravel										
	■	4 3 4	12	16			44	FS#2								PP>4.5
4																
	■	5 5 4	9	12		FAT CLAY, Sandy (CH); Moist, 10yr5/5 Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, Strong HCL Reaction	44	FS#3	0	38	62	50	29	12.3	CH	PP>4.5
6																
	■	2 3 5	8	11		Same as Above Except; Fine to Medium Sand, Trace Fine Subrounded Gravel to 0.4 inches, No HCL Reaction	44	FS#4								PP=3.5
						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 0.7 inches, No HCL Reaction		FS#5								
8																
	■	10 10 13	23	31		Same as Above Except; Gravel to 1 inch	67	FS#6								
10																
	■	10 8 12	20	27		Same as Above Except; Subrounded to Subangular Gravel to 1.5 inches, Strong HCL Reaction	67	FS#7								
12																
	■					Sand, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale			27	62	11					

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-09	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 2 OF 3 SHEETS
LOCATION COORDINATES N 1938292.199 E 6402280.741	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		10 15 13	28	37		Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1.3 inches, Non Plastic Fines, No HCL Reaction	72	FS#8								
16		6 6 6	14	19		SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Subrounded Gravel to 1.2 inches, No HCL Reaction	78	FS#9								
18		4 8 7	15	20		Same as Above	100	FS#10								
20		4 8 8	16	21		No Recovery	0									
22		8 8 6	14	19		Same as Above Except; Gravel to 1.5 inches	28	FS#11								
24		8 6 12	18	24		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, No HCL Reaction	78	FS#12								
26		6 12 16	20	27		SAND, Silty with Gravel (SM); Moist, 10yr5/3 Brown, Fine to Coarse Sand, Fine to Coarse Subrounded Gravel to 1.0 inch, 10% Non to Low Plastic Fines, Strong HCL Reaction	100	FS#13	33	52	15					
28																
30		6 8 12	28	37		SAND, Poorly Graded (SP); Moist, 10yr5/3 Brown, 90% Fine to Coarse Sand, 5% Fine to Coarse Subrounded Gravel to 0.8 inches, 5% Non Plastic Fines, No HCL	100	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-09
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1938292.199 E 6402280.741	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
						Reaction										
32																
		3 3 8				LEAN CLAY, Sandy (CL); Moist, 10Yr4/4 Dark Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 30% Fine Sand, No HCL Reaction	89	FS#15								PP=2.5
34																
36		9 24 26	50	67		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.1 inches, No HCL Reaction	100	FS#16								
38																
		4 3 6	9	12		SILTY CLAY, with Sand (CL-ML); Moist, 10yr5/4 Yellow Brown, 80% Low Plastic Fines, Medium Dry Strength, None Dilatency, Low to Medium Toughness, 20% Fine Sand, No HCL Reaction	89	FS#17								PP=2.0
40						Bottom of Boring At 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-10	LOCATION COORDINATES: N 1939496.529 E 6402430.284	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 20
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/4/10	COMPLETED: 11/4/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY, With Sand (CL); Moist, 10yr5/3 Brown, 80% Low Plastic Fines, High Dry Strength , None Dilatency, Medium Toughness, 20% Fine Sand, Trace Sub Rounded Fine Gravel to 0.4", No HCL Reaction										
		6 6 6	12	16			42	FS#1								PP>4.5
2																
		3 2 3	5	7		Same as Above Except; 10yr4/4 Dark Yellow Brown	19	FS#2								PP=4.0
4																
		4 4 5	9	12		FAT CLAY, Sandy (CH); Moist 10yr4/4 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine to Medium Sand, Trace Fine to Coarse Subrounded Gravel to 1.3 inches, Strong HCL Reaction	53	FS#3	6	43	61	50	31	9.1	CH	PP=3.5
6																
		6 6 11	17	23		Same as Above	72	FS#4 FS#5								PP=3
8						SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/4 Light Yellow Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1 inch, 10% Non Plastic Fines, Weak HCL Reaction			58	35	7					
		11 14 18	32	43		Well Graded Gravel with Silt and Sand (GW-GM); 10yr6/3 Light Yellow Brown, Fine to Coarse Subrounded Gravel to 1.6 inches, Fine to Coarse Sand, Non Plastic Fines, Weak to Strong HCL Reaction	61	FS#6								
10																
		4 6 8	14	19		AT 10.5 Feet BSG Same as Above	69	FS#7 FS#8 FS#9								
12						At 11.5 Feet BSG: SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 95% Fine to Coarse Sand, 5% Non Plastic Fines, Subrounded to Subangular Gravel to 0.3 inches, Weak HCL Reaction			45	44	11					

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-10

PROJECT	INSTALLATION	SHEET 2 OF 3 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1939496.529 E 6402430.284	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		14 11 11	22	29		LEAN CLAY, With Sand (CL); Moist, 10yr4/4 Dark Yellow Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, Trace Coarse Gravel to 1 inch, Weak HCL Reaction	67	FS#10								
16		16 29 31	60	80		Poorly Graded Gravel with Silt and Sand (GP-GM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Subrounded Gravel to 1.4 inches, Fine to Coarse Sand, Non Plastic Fines, No HCL Reaction, 2 inch Lens of Silty Sand	89	FS#11								
18		12 18 7	25	33		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1 inch, 5% Non Plastic Fines, Strong HCL Reaction Same as Above	61	FS#12								
20		2 2 6	8	11		FAT CLAY with Sand (CH); Moist, 10yr5/ 4, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, Trace Subrounded Coarse Gravel to 1 inch, Weak HCL Reaction	83	FS#13	4	15	81	55	32	20.7	CH	PP=1.5
22		19 19 21	40	53		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 75% Fine to Coarse Sand, 25% Fine to Coarse Subrounded Gravel, Weak HCL Reaction	67	FS#14								
24		4 8 10	18	24		LEAN CLAY (CL); Moist, 10yr4/ 4 Dark Yellow Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Trace Fine to Coarse Subrounded Gravel to 0.7 inches, 1 inch Poorly Graded Sand Lens, No HCL Reaction	67	FS#15								PP=1.0
26																
28		4 5 7	12	16		FAT CLAY with Sand (CH); Moist, 10yr4/4 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Coarse Sand, Weak HCL Reaction	67	FS#16	3	26	71	56	33		CH	PP=2.5
30		3 5 10	15	20		Same as Above Except; 90% Fines, 10% Fine to Medium Sand, Strong HCL Reaction	78	FS#17								PP=4.0

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-10
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District; SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1939496.529 E 6402430.284	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
34		17 23 16	39	52		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/3 Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1.1 inches, Weak HCL Reaction	78	FS#18								
36		3 3 7	10	13		SAND, Clayey (SC); Moist, 10yr5/4 Yellow Brown, 60% Fine to Medium Sand, 40% Low Plastic Fines, No HCL Reaction	78	FS#19								
38																
40		13 18 18	36	48		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/3 Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1.5 inches, Weak HCL Reaction	75	FS#20								
						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 4 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 8" HSA / 4" Mud Rotary		
2. HOLE NO.: 2F-11-11	LOCATION COORDINATES: N 1940740.366 E 6402673.096	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 30
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: 47.5 Feet BSG		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/2/10	COMPLETED: 11/3/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 60	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 60			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, Sandy (CH); Moist, 10yr4/3 Brown, High Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, Fine Sand, Trace Fine Subrounded Gravel to 0.4 inches, No HCL Reaction										
		4 5 5	10	13			40	FS#1	6	33	61	50	31	9.1	CH	PP>4.5
2																
		1 2 2	4	5		Same as Above Except; Trace Subangular Gravel to 0.4 inches	28	FS#2								PP=2.75
4																
		22 22 23	45	60		SAND, Poorly Graded with Silt and Gravel, (SP-SM); Moist, 10yr6/2 Light Brown Gray, 65% Fine to Coarse Sand, 25% Subangular to Subrounded Gravel to 1.4 inches, 10% Non Plastic Fines, Weak to Strong HCL Reaction	92	FS#3	42	47	11					
6																
		10 10 11	21	28		Same as Above Except; Gravel to 1.5 inches, Weak HCL Reaction	81	FS#4								
8																
		4 1 3	4	5		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/2 Light Brown Gray, 70% Fine to Coarse Sand, 25% Fine to Coarse Subangular to Subrounded Gravel to 1 inch, 5% Non Plastic Fines, Strong HCL Reaction	58	FS#5 FS#6								PP=2.75
10						LEAN CLAY, Sandy (CL); Moist, 10yr4/4 Dark Yellow Brown, 70% Low Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, Trace Fine Subangular to Subrounded Gravel to 0.5 inches, No HCL Reaction										
		6 8 7	15	20			69	FS#7	44	48	8					
12						SAND, Well Graded with Silt and Gravel (SW-SM); Moist, 10yr5/4 Yellow Brown, Fine to Coarse Sand, Fine to Coarse Subangular to Subrounded Gravel to 1.2 inches, Non Plastic Fines, No HCL										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-11
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 4 SHEETS
LOCATION COORDINATES: N 1940740.366 E 6402673.096	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		4 4 5	9	12		Reaction Same as Above Except; Fine to Coarse Subangular to Subrounded Gravel to 1.2 inches, Weak HCL Reaction	75	FS#8								
14																
		7 9 11	20	27		Same as Above Except; Gravel to 1.5 inches	75	FS#9								
16																
		9 15 16	31	41		Same as Above	78	FS#10								
18																
		4 1 2	3	4		FAT CLAY (CH); Moist, 10yr4/4 Dark Yellow Brown, High Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, Trace Fine Sand, No HCL Reaction	67	FS#11	0	14	86	56	33	20.5	CH	PP=2.25
20																
		3 8 18	26	35		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 70% Low Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, No HCL Reaction	86	FS#12								PP=1.75
						SAND, Clayey (SC); Moist, 10yr5/4 Yellow Brown, 70% Fine to Medium Sand, 30% Low Plastic Fines, No HCL Reaction		FS#13								
22								FS#14								
						SAND, Silty, with Gravel (SM); Moist, 10yr5/4 Yellow Brown, 60% Fine to Medium Sand, 25% Fine to Coarse Subangular to Subrounded Gravel to 0.8 inches, 15% Non to Low Plastic Fines, No HCL Reaction										
24		3 9 14	23	31		LEAN CLAY, Sandy (CL); Moist, 10yr4/4 Dark Yellow Brown, 70% Low Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, Trace Fine to Coarse Subrounded Gravel to 1 inch, No HCL Reaction	61	FS#15								PP=1.5
								FS#16								
						SAND, Silty with Gravel (SM); Moist, 10yr5/4 Yellow Brown, 60% Fine to Medium Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 0.8 inch, 20% Non to Low Plastic Fines, No HCL Reaction										
26																
		10 15 16	31	41		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/3 Brown, 65% Fine to Coarse Sand, 30% Fine to Coarse Subangular to Subrounded Gravel to 1.3 inches, 5% Non Plastic Fines, No HCL Reaction	75	FS#17								
28																
30		17 24 17	41	55		Same as Above Except; 75% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, 5% Non Plastic Fines, No HCL Reaction	75	FS#18								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-11	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 4 SHEETS
LOCATION COORDINATES N 1940740.366 E 6402673.096	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
34		5 5 5	10	13		LEAN CLAY, Sandy (CL); Moist, 10yr4/4 Dark Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, No HCL Reaction	61	FS#19								PP=2.25
36		3 4 5	9	12		LEAN CLAY (CL); Moist, 10yr4/5 Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Trace Coarse Gravel to 1.4 inches, Strong HCL Reaction	94	FS#20								PP=2.5
38																
40		5 7 8	15	20		LEAN CLAY, Sandy (CL); Moist, 10yr4/5 Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, Trace Coarse Subrounded Gravel to 0.8 inches, No HCL Reaction	56	FS#21								PP=4.5
42		11 22 20	42	56		Same as Above Except; Trace Fine Gravel to 0.5 inches	83	FS#22 FS#23								PP=3.5
44						SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/4 Yellow Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1 inches, No HCL Reaction										
46		10 17 8	25	33		Same as Above	67	FS#24								
48		9				Same as Above Except; Wet, Subrounded Gravel to 1.5 inches										PP=3 Switched

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-11

PROJECT	INSTALLATION	SHEET 4 OF 4 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1940740.366 E 6402673.096	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		3 5	8	11		LEAN CLAY (CL); Wet, 10yr4/4 Dark Yellow Brown, 100% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Trace Fine to Coarse Sand, No HCL Reaction	100	FS#26 FS#25								to Mud Rotary
50																
		4 4 5	9	12		LEAN CLAY, Sandy (CL); Wet, 10yr4/6 Dark Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine to Coarse Sand, Trace Subrounded Gravel to 1 inches, No HCL Reaction	58	FS#27								PP=2.75
52																
54		5 17 19	36	48		SAND, Poorly Graded with Silt and Gravel (SP-SM); Wet, 10yr4/4 Dark Yellow Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1.1 inches, 10% Non Plastic Fines, No HCL Reaction	89	FS#28								
56																
		2 3 7	10	13		GRAVEL, Poorly Graded with Sand (GP); Wet, 10yr4/4 Dark Yellow Brown, 75% Fine Subrounded to Subangular Gravel to 0.5 inches, 25% Medium to Coarse Sand, Trace Coarse Gravel to 1 inch, No HCL Reaction	100	FS#29								
58																
		6 15 23	38	51		SAND, Poorly Graded with Gravel (SP); Wet, 10yr4/4 Dark Yellow Brown, 60% Fine to Coarse Sand, 40% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, No HCL Reaction	67	FS#30								
60						Bottom of Boring at 60 Feet BSG										
62																
64																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 3 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-12
LOCATION COORDINATES	N 1941745.831 E 6403208.176
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 18
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	38.5 Feet BSG
5. DIRECTION OF HOLE	VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐
15. DATE HOLE	STARTED 11/2/10; COMPLETED 11/2/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	40
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	40

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, Sandy with Gravel (CH); Moist, 10yr4/4 Dark Yellow Brown, High Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, Fine Sand, Trace Coarse Subangular Gravel to 1 inches, No HCL Reaction										
		2 4 4	8	11			42	FS#1	19	21	60	55	34	10.4	CH	PP=2.75
2						Same as Above Except; 10yr5/3 Dark Brown, No Gravel, Weak HCL Reaction										
		2 1 2	3	4			28	FS#2								PP=3.5
4						SILTY CLAY (CL-ML), Moist, 10yr4/4 Dark Yellow Brown, 95% Low Plastic Fines, Medium Dry Strength, Non Dilatency, Medium Toughness, 5% Fine Sand, Strong HCL Reaction										
		1 1 1	2	3			42	FS#3								PP=2.75
6						FAT CLAY with Sand (CH); Moist, 10yr4/4 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand, Weak HCL Reaction										
		1 2 3	5	7			53	FS#4	0	24	76	53	30	15.2	CH	PP=1.5
8						SAND, Silty (SM); Moist, 10yr4/4 Dark Yellow Brown, 70% Fine to Medium Sand, 30% Non Plastic Fines, Trace Fine Subrounded Gravel to 0.5 inches, No HCL Reaction										
		2 2 5	8	11			44	FS#5								
10						Same as Above Except; Non to Low Plastic Fines, Trace Fine to Coarse Subangular Gravel to 1 inch										
		3 4 3	7	9			61	FS#6	2	53	45					
12						SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr5/3 Brown,										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-12	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 2 OF 3 SHEETS
LOCATION COORDINATES N 1941745.831 E 6403208.176	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		10 10 9	19	25		75% Fine to Coarse Sand, 15% Fine to Coarse Subangular Gravel to 1.2 inches, 10% Non Plastic Fines, Weak HCL Reaction	50	FS#7								
14																
		4 10 16	26	35		SILTY CLAY (CL-ML); Moist, 10yr5/4 Yellow Brown, 95% Low Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Strong HCL Reaction	89	FS#8								PP=0.75
16						SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subangular to Subrounded Gravel to 1 inch, 10% Non Plastic Fines, Weak HCL Reaction		FS#9								
		11 11 11	22	29		Same as Above	67	FS#10								
18																
		9 10 13	23	31		Same as Above Except; Gravel to 1.2 inches, Weak to Strong HCL Reaction	64	FS#11								
20																
		12 15 16	31	41		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subangular to Subrounded Gravel to 1.3 inches, Non Plastic Fines, Weak HCL Reaction	94	FS#12	34	54	12					
22																
24		10 7 10	17	23		Same as Above Except; 10yr5/4 Yellow Brown Fine to Coarse Subangular to Subrounded Gravel to 1.4 inches, Non to Low Plastic Fines	89	FS#13								
26																
		15 16 20	36	48		Same as Above Except; 75% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1.1 inches, No HCL Reaction	89	FS#14								
28																
30		9 15 13	25	33		Same as Above Except; Weak HCL Reaction	69	FS#15								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-12
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District; SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1941745.831 E 6403208.176	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		8 14 17	31	41		SAND, Silty with Gravel (SM); Moist, 10yr5/4 Yellow Brown, 60% Fine to Coarse Sand, 20% Non Plastic Fines, 20% Fine to Coarse Subangular to Subrounded Gravel to 1.3 inches, Weak HCL Reaction	61	FS#16								
34																
36		8 14 17	31	41		Same as Above Except; Fine to Coarse Sand, Subrounded to Subangular Coarse Gravel to 1.1 inches, No HCL Reaction	61	FS#17								
38																
		4 6 6	12	16		SILT, Sandy (ML); Moist, 10yr5/4 Yellow Brown, 55% Non Plastic Fines, Low Dry Strength, Slow Dilatency, Low Toughness, 45% Fine Sand, Trace Rounded Gravel to 0.25 inches, No HCL Reaction	100	FS#18								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 3 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-13
LOCATION COORDINATES	N 1942978.499 E 6403494.483
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 16
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	NE
5. DIRECTION OF HOLE	VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐
15. DATE HOLE	STARTED 11/2/10; COMPLETED 11/2/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	40
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	40

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						SAND, Clayey with Gravel (SC); Moist, 10yr5/4 Yellowish Brown, Fine Sand, Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine to Coarse Subrounded to Subangular Gravel to 1.3 inches, No HCL Reaction										
	■	7 7 6	13	17			67	FS#1	18	47	35	43	24		SC	
2																
	■	5 3 3	6	8		SAND, Silty with Gravel (SM); Moist, 10yr4/4 Dark Yellow Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1 inches, Non Plastic Fines, Strong HCL Reaction	64	FS#2	38	50	12					
4																
	■	3 7 7	14	19		Same As Above Except; 10yr5/4 Yellow Brown, Weak HCL Reaction	39	FS#3								
6																
	■	3 4 4	8	11		No Recovery	0									
8																
	■	2 2 4	6	8		LEAN CLAY, with Sand (CL); Moist, 10yr4/4 Dark Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, 20% Fine Trace Subrounded Gravel to 0.5 inches, Weak HCL Reaction	47	FS#4								PP=4.0
10																
	■	4 5 5	10	13		FAT CLAY, Sandy (CH); Moist 10yr4/4 Dark Yellow Brown High Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand, Trace Fine to Coarse Subrounded Gravel to 0.8 inches, Strong HCL Reaction	64	FS#5	2	41	57	53	32	9.7	CH	PP=3.5
12																
	■					SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/2 Light										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-13	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 2 OF 3 SHEETS
LOCATION COORDINATES N 1942978.499 E 6403494.483	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		11 13 14	27	36		Gray Brown, 50% Fine to Coarse Sand, 40% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, 10% Non Plastic Fines, Weak HCL Reaction	39	FS#6								
16		9 8 10	18	24		SAND, Poorly Graded with Gravel; Moist, 10yr6/2 Light Gray Brown, 70% Fine to Coarse Sand, 30% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, Weak HCL Reaction	72	FS#7								
18		8 11 13	23	31		SAND, Poorly Graded with Silt and Gravel; Moist, 10yr6/2 Light Gray Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, Weak HCL Reaction	81	FS#8	37	53	10					
20		14 17 15	32	43		Same As Above Except; 10yr5/2 Grayish Brown, Fine to Coarse Subrounded to Subangular Gravel to 1.3"	86	FS#9								
22		11 13 17	30	40		Same as Above Except; Gravel to 1 inch	97	FS#10								
24		18 14 20	34	45		SAND, Silty with Gravel (SM); Moist, 10yr4/3 Brown, 65% Fine to Coarse Sand, 20% Non to Low Plastic Fines, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, Weak HCL Reaction	81	FS#11								
26																
28		13 10 13	23	31		SAND, Silty (SM); Moist, 10yr4/3 Brown, 60% Fine to Coarse Sand, 30% Low Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, Weak to Strong HCL Reaction	75	FS#12								
30		10 9 8	17	23		SAND, Poorly Graded with Gravel (SP); Moist, 10yr4/3 Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1.5	69	FS#13								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-13	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1942978.499 E 6403494.483	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
						inches, No HCL Reaction										
32																
		9 6 4	10	13		SAND, Silty (SM); Moist, 10yr4/3 Brown, 70% Fine to Coarse Sand, 20% Low Plastic Fines, 10% Fine to Coarse Subangular to Subrounded Gravel to 1.3 inches, Weak HCL Reaction	67	FS#14								
34																
36		20 23 21	44	59		SAND, Silty with Gravel (SM); Moist, 10yr4/3 Brown, 60% Fine to Coarse Sand, 20% Low Plastic Fines, 20% Fine to Coarse Subangular to Subrounded Gravel to 1.5 inches, Weak HCL Reaction	89	FS#15								
38																
		11 17 20	37	49		SAND, Silty (SM); Moist, 10yr5/4 Yellow Brown, 65% Fine to Medium Sand, 35% Non to Low Plastic Fines, Trace Subrounded to Subangular Gravel to 1.2 inches, No HCL Reaction, 2 inch Lense of Clay	86	FS#16								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 3 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-14
LOCATION COORDINATES	N 1943917.448 E 6402947.518
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 18
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	NE
5. DIRECTION OF HOLE	VERTICAL ☒ INCLINED ☐ _____ DEG. FROM VERT
15. DATE HOLE	STARTED 11/1/10; COMPLETED 11/1/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	40
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	40

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						Lean CLAY, with Sand (CL); Moist, 2.5yr5/3 Light Olive Brown, 80% Low to Medium Plastic Fines, Hard Strength, None Dilatency, Low Toughness, 20% Fine Sand, Trace Coarse Subrounded Gravel to 0.75 inches, No HCL Reaction										
		6 7 8	15	20			62	FS#1								PP=2.0
2						FAT CLAY, Sandy (CH); Moist, 2.5yr5/3 Light Olive Brown, High Plastic Fines, None Dilatency, Low Toughness, High Dry Strength, Fine Sand, Trace Coarse Gravel to 0.75 inches, No HCL Reaction			3	29	68	50	29	9	CH	
		5 4 5	9	12			48	FS#2								PP=4.0
4						LEAN CLAY, with Sand (CL); Moist, 2.5yr5/3 Light Olive Brown, 75% Low Plastic Fines, Medium to High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, 5% Fine to Coarse Subrounded Gravel to 1 inch, No HCL Reaction										
		3 3 2	5	7			43	FS#3								PP>4.5
6						Same as Above Except; 2.5yr6/4 Light Yellow Brown, Weak HCL Reaction										
		3 4 4	8	11			36	FS#4								PP>4.5
8						SAND, Silty (SM); Moist, 10yr5/6 Yellow Brown, 65% Fine Sand, 35% Non Plastic Fines, None Dry Strength, Slow Dilatency, Low Toughness, No HCL Reaction										
		5 9 25	34	45			72	FS#5								
10						GRAVEL, Poorly Graded with Sand (GP); Moist, 2.5yr7/2 Light Gray, 80% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, 20% Fine to Medium Sand, Weak HCL Reaction		FS#6	27	55	18					
		15 13 14	27	36		SAND, Silty with Gravel (SM); Moist, 2.5yr7/2 Light Gray, Fine to Coarse Sand, Fine Subrounded to Subangular Gravel to 0.5 inches, No HCL Reaction	44	FS#7								
12						Same as Above Except; Fine Subangular to Subrounded Gravel to										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-14
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1943917.448 E 6402947.518	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		4 12 14	26	35		0.6 inches	61	FS#8								
16		4 8 6	14	19		SAND, Poorly Graded with Gravel (SP); Dry, 10yr6/2 Light Brownish Gray, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1.2 inches, No HCL Reaction	53	FS#9								
18		3 15 18	33	44		SAND, Poorly Graded with Gravel and Silt (SP-SM); Moist, 10yr5/3 Brown, 60% Fine to Coarse Sand, 30% Non Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.3 inches, No HCL Reaction	61	FS#10								
20		13 13 10	23	31		SAND, Poorly Graded with Gravel (SP); Moist, 10yr7/2 Light Gray, 70% Fine to Coarse Sand, 30% Fine to Coarse Subrounded to Subangular Gravel to 2 inches, Weak HCL Reaction	36	FS#11								
22		4 17 14	31	41		SAND, Poorly Graded with Silt and Gravel (SP-SM); 10yr6/3 Pale Brown, Fine to Coarse Sand, Coarse Subrounded to Subangular Gravel to 1.5 inches, Weak HCL Reaction	89	FS#12	32	61	7					
24		12 16 13	29	39		Same as Above	89	FS#13								
26						SILTY CLAY (CL-ML); Moist, 10yr5/4 Yellow Brown, 90% Low Plastic Fines, Medium to High Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Weak HCL Reaction										
28		17 13 10	23	31		SAND, Poorley Graded with Gravel and Silt (SP-SM); Moist, 10yr5/3 Brown, 65% Fine to Coarse Sand, 25% Fine to Coarse Subangular to Subrounded Gravel to 1.2 inches, 10% Non Plastic Fines, Weak HCL Reaction	92	FS#14								
30		6 13 13	26	35		SAND, Clayey (SC); Moist, 10yr5/3 Brown, Fine Sand, Low Plastic Fines, Medium to High Strength, Non Dilatency, Medium Toughness, Trace Fine Gravel to	81	FS#15	5	63	32					

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-14	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1943917.448 E 6402947.518	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
						0.5 inches, No HCL Reaction										
32																
		5 3 3	6	8		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/3 Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1 inch, Weak HCL Reaction	44	FS#16								
34																
		16 24 18	42	56		Same as Above Except; Gravel to 1.2 inches, No HCL Reaction	92	FS#17								
36																
38																
		10 6 13	19	25		SAND, Silty with Gravel (SM); Moist, 10yr5/3 Brown, 65% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1.4 inches, 15% Non Plastic Fines, Weak HCL Reaction	78	FS#18								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 4 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	8" HSA / 4" Mud Rotary
2. HOLE NO.	2F-11-15
LOCATION COORDINATES	N 6403024.684 E 1945184.102
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 21
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	36.5 Feet BSG
5. DIRECTION OF HOLE	VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐
15. DATE HOLE	STARTED 11/30/10; COMPLETED 11/30/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	53.5
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	53.5

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr5 4 Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, No HCL Reaction										
	■	5 5 5	10	13			56	FS#1								PP>4.5
2																
	■	3 4 4	8	11		Same as Above Except; Trace Fine Subrounded Gravel to 0.25 inches	44	FS#2								PP>4.5
4																
	■	6 7 7	14	19		Same as Above Except; LEAN CLAY, with Sand (CL); No Gravel, Strong HCL Reaction	56	FS#3	0	23	77	36	21	9.5	CL	PP=4.0
6																
	■	4 5 7	12	16		Same as Above Except; Trace Fine Subangular Gravel to 0.2 inches	56	FS#4								PP=2.0
8																
	■	15 22 31	53	70		SAND, Poorly Graded with Silt (SP-SM); Moist, 10yr6/2 Light Gray Brown, 80% Fine Coarse Sand, 10% Non Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, Weak HCL Reaction	78	FS#5								
10																
	■	19 20 25	45	60		Same as Above Except; Gravel to 1.3 inches	100	FS#6								
12																
	■					SAND, Silty with Gravel (SM); Moist, Fine to Coarse Sand, Non Plastic Fines,			32	55	13					

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-15
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 4 SHEETS
LOCATION COORDINATES: N 6403024.684 E 1945184.102	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		9 10 15	25	33		Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	89	FS#7								
14																
		8 9 16	25	33		Same as Above Except; Gravel to 1.5 inches	83	FS#8								
16																
		5 6 8	14	19		Same as Above Except; Gravel to 1 inch	22	FS#9								
18																
		17 18 25	43	57		Same as Above Except; 75% Fine to Coarse Sand, 15% Non Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inch, Weak HCL Reaction	78	FS#10								
20																
		14 14 16	30	40		Same as Above Except; Gravel to 1 inch, Strong HCL Reaction	83	FS#11								
22																
24		15 13 16	29	39		Same as Above Except; Fine to Coarse Subrounded to Subangular Gravel to 0.75 inches, Weak HCL Reaction	100	FS#12								
26																
		3 4 8	12	16		LEAN CLAY (CL); Moist, 10yr5/6 Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Trace Coarse Sand, No HCL Reaction	44	FS#13								PP=3.25
28																
30		14 17 25	37	49		SAND, Silty (SM); Moist, 10yr5/3 Brown, 70% Fine to Coarse Sand, 20% Non Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.2	78	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-15
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 3 OF 4 SHEETS
LOCATION COORDINATES: N 6403024.684 E 1945184.102	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
						inches, Trace Clay, No HCL Reaction										
32																
		17 15 20	35	47		Same as Above Except; Weak HCL Reaction	94	FS#15								
34																
36		3 4 6	10	13		LEAN CLAY (CL); Wet, 10yr5/6 Yellowish Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, No HCL Reaction	100	FS#16								PP=1.5
38																
		3 3 4	7	9		Same as Above Except; Trace Fine Subrounded Gravel to 0.5 inches	100	FS#17								PP=1.75 Switched to Mud Rotary
40																
42		3 4 5	9	12		Same as Above Except; LEAN CLAY, Sandy (CL); No Gravel	100	FS#18	0	37	63	39	22	18.8	CL	PP=1.5
44																
		3 4 6	10	13		Same as Above	100	FS#19								PP=2.0
46																
48		9				SAND, Poorly Graded (SP); Wet, 10yr6/4 Light Yellow Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Subrounded to										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-15
PROJECT Orestimba, Newman	INSTALLATION Sacramento District — SHEET 4 OF 4 SHEETS
LOCATION COORDINATES N 6403024.684 E 1945184.102	COORDINATE SYSTEM State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		17 16	33	44		Subangular Gravel to 1 inch, No HCL Reaction	83	FS#20								
50																
		5 8 11	19	25		GRAVEL, Poorly Graded (GP); Wet, 10yr5/1 Gray, 90% Fine to Coarse Subrounded to Subangular Gravel, 10% Fine to Coarse Sand, No HCL Reaction	67	FS#21								
52																
54						Bottom of Boring at 53.5 Feet BSG NOTE: Hole Collapsed to 50 Feet BSG after advancement to 53.5 Feet BSG. Attempted One Redrill, After Redrill Caving Occurred to 50 Feet BSG. Test Hole Terminated Per Discussion with Army Corp										
56																
58																
60																
62																
64																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 3 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-16
LOCATION COORDINATES	N 1946302.426 E 6402938.173
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 20
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	NE
5. DIRECTION OF HOLE	VERTICAL ☒ ____ DEG. FROM VERT; INCLINED ☐
15. DATE HOLE	STARTED 11/4/10; COMPLETED 11/4/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	40
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	40

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr4/3 Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Trace Coarse Subrounded Sand, No HCL Reaction										
	■	2 2 2	4	5			28	FS#1								PP=4.0
2																
	■	2 2 2	4	5		FAT CLAY with Sand (CH); Moist, 10yr6/6 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand, No HCL Reaction	44	FS#2	0	29	71	57	35	11.4	CH	PP=3.5
4																
	■	2 2 3	5	7		Same as Above Except; Trace Subrounded Gravel to 0.4 inches, Strong HCL Reaction	8	FS#3								PP=2.5
6																
	■	3 10 7	17	23		FAT CLAY, SANDY (CH); Moist, 10yr6/6 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand ,Trace Coarse Subrounded Gravel to 1.5 inches, Strong HCL Reaction	78	FS#4 FS#5	8	34	58	58	35	10.9	CH	PP=3.5
8						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1.1 inches, Weak HCL Reaction										
	■	6 14 16	30	40		Same as Above Except; Gravel to 1.5 inches, Strong HCL Reaction	50	FS#6								
10																
	■	10 13 13	26	35		SAND, Well Graded with Silt and Gravel (SW-SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1.1 inches, Non Plastic Fines,No HCL Reaction	72	FS#7	41	50	9					
12																
	■					Same as Above Except; 80% Fine to Coarse Sand, 20% Fine to										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-16
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1946302.426 E 6402938.173	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		9 16 20	36	48		Coarse Subrounded Gravel to 1 inch, Weak to Strong HCL Reaction	78	FS#8								
16		9 16 20	36	48		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, 10% Non Plastic Fines, No HCL Reaction	83	FS#9								
18		21 20 22	42	56		Same as Above Except; Gravel to 0.75 inches, Weak HCL Reaction	83	FS#10								
20		20 16 9	25	33		GRAVEL, Silty with Sand (GM); Moist, 10yr4/4 Dark Yellow Brown, Fine to Coarse Subrounded Gravel to 1 inch, Non Plastic Fines, Fine to Coarse Sand, Weak HCL Reaction	67	FS#11	45	41	14					
22		13 20 17	37	49		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 10% Non Plastic Fines, 5% Fine to Coarse Subrounded Gravel to 1.3 inches, Strong HCL Reaction	83	FS#12								
24		3 8 17	25	33		SAND, Clayey (SC); Moist, 10yr4/6 Dark Yellow Brown, 60% Fine Sand, 40% Low Plastic Fines, Trace Coarse Sands, No HCL Reaction	78	FS#13								
26						SAND, Poorly Graded (SP); 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Subangular to Subrounded Gravel to 0.75 inches, No HCL Reaction		FS#14								
28		15 23 20	43	57		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, Weak HCL Reaction	83	FS#15								
30		13 14 11	25	33		SAND, Clayey (SC); Moist, 10yr4/6 Dark Yellow Brown, 60% Fine Sand, 40% Low Plastic Fines, No HCL Reaction	100	FS#16								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-16
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1946302.426 E 6402938.173	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 75% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1.3 inches, 5% Non Plastic Fines, No HCL Reaction		FS#17								
32																
		10 9 13	22	29		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1.3 inches, 10% Non Plastic Fines, Weak HCL Reaction	56	FS#18								
34																
		17 16 15	31	41		Same as Above Except; Gravel to 0.8 inches, No HCL Reaction	61	FS#19								
36																
38																
		17 14 14	28	37		Same as Above Except; Weak HCL Reaction	67	FS#20								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-17	LOCATION COORDINATES: N 1947196.028 E 6402675.93	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 17
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/4/10	COMPLETED: 11/4/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, with Sand (CH); Moist, 10yr5/3 Brown, 85% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, Trace Fine Subangular Gravel to 0.5 inches, No HCL Reaction										
		9 9 8	17	23			44	FS#1								PP>4.5
2																
		3 3 3	6	8		Same as Above Except; FAT CLAY, Sandy (CH)	44	FS#2	2	28	70	59	36	8.1	CH	PP>4.5
4																
		1 1 3	4	5		Same as Above Except; FAT CLAY, With Sand (CH); Strong HCL Reaction	67	FS#3	2	24	74	61	37	8.2	CH	PP>4.5
6																
		3 4 5	9	12		Same as Above Except; Trace Coarse Sand	83	FS#4								PP>4.5
8																
		12 15 23	28	37		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 30% Fine to Coarse Subangular to Subrounded Gravel to 1.5 inches, Weak HCL Reaction	83	FS#5								
10																
		16 12 14	26	35		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subangular to Subrounded Gravel to 1.2 inches, Non Plastic Fines, Weak HCL Reaction	67	FS#6	41	46	13					
12																
						Same as Above Except; Gravel to 1.4 inches, Strong HCL										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-17
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1947196.028 E 6402675.93	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		13 16 13	29	39		Reaction	78	FS#7								
14																
		9 8 7	15	20		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1.1 inches, Non Plastic Fines, No HCL Reaction	67	FS#8	43	46	11					
16																
		15 18 11	29	39		SAND, Silty with Gravel (SP); Moist, 10yr4/3 Brown, 65% Fine to Coarse Sand, 20% Non Plastic Fines, 15% Fine to Coarse Subrounded Gravel to 1.5 inches, Weak HCL Reaction	89	FS#9								
18																
		9 17 17	34	45		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1.4 inches, 10% Non Plastic Fines, No HCL Reaction	83	FS#10								
20																
		9 24 21	45	60		Same as Before Except; Gravel to 1.2 inches, Strong HCL Reaction	67	FS#11								
22																
24		14 17 18	35	47		SAND, Poorly Graded with Silt (SP-SM); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.4 inches, 10% Non Plastic Fines, Weak HCL Reaction	56	FS#12								
26																
		15 23 20	43	57		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1.1 inches, 10% Non Plastic Fines, No HCL Reaction	83	FS#13								
28																
30		15 13 14	27	36		Same as Above Except; Gravel to 1.5 inches, Weak HCL Reaction	83	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-17
PROJECT Orestimba, Newman	INSTALLATION Sacramento District — SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1947196.028 E 6402675.93	COORDINATE SYSTEM State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		11 13 18	31	41		Same as Above Except; Gravel to 1.1 inches, No HCL Reaction	78	FS#15								
34																
36		12 17 17	34	45		SAND, Silty with Gravel (SM); Moist, 10yr5/4 Brown, 60% Fine to Coarse Sand, 15% Non Plastic Fines, 25% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, No HCL Reaction	100	FS#16								
38																
		13 13 22	35	47		Same as Above Except; Gravel to 1 inch	78	FS#17								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 5 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	8" HSA / 4" Mud Rotary
2. HOLE NO.	2F-11-19
LOCATION COORDINATES	N 1949518.346 E 6402797.056
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 27
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	47.5 Feet BSG
5. DIRECTION OF HOLE	VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐
15. DATE HOLE	STARTED 12/1/10; COMPLETED 12/3/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	81.5
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	81.5

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr4/3 Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Weak HCL Reaction										
	■	5 6 8	14	19			22	FS#1								PP=4.0
2																
	■	3 3 2	5	7		Same as Above Except; Strong HCL Reaction	33	FS#2								PP=3.5
4																
	■	2 1 3	4	5		Same as Above	56	FS#3								PP=1.5
6																
	■	2 3 4	7	9		Same as Above Except; 10yr5/6 Yellow Brown, Weak HCL Reaction	56	FS#4								PP=1.75
8																
	■	3 4 7	11	15		Same as Above Except; LEAN CLAY, With Sand (CL)	89	FS#5	0	20	80	35	19	16.1	CL	PP=2.75
10																
	■	3 3 5	8	11		Same as Above Except; Strong HCL Reaction	56	FS#6								PP=2.5
12																
	■					Same as Above Except; Trace Subangular Gravel to 0.3 inches			0	15	85	36	16	21.1	CL	PP=1.5

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-19
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 5 SHEETS
LOCATION COORDINATES: N 1949518.346 E 6402797.056	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		2 2 2	4	5			44	FS#7								
14																
		3 5 7	12	16		Same as Above Except; No Gravel, No HCL Reaction	89	FS#8								PP=2.0
16																
		3 12 10	30	40		Same as Above Except; Weak HCL Reaction SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 95% Fine to Coarse Sand, 5% Fine Subrounded to Subangular Gravel to 0.4 inches, No HCL Reaction	100	FS#10 FS#9								PP=1.5
18																
		11 11 16	27	36		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/2 Grayish Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1.2 inches, No HCL Reaction	89	FS#11								
20																
		7 15 18	33	44		Same as Above	89	FS#12								
22																
24		11 16 18	34	45		Same as Above Except; Fine to Course Subrounded to Subangular Gravel to 1 inch, Trace Non Plastic Fines	100	FS#13								
26																
		21 27 30	57	76		Same as Above Except; 80% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, 5% Non Plastic Fines	100	FS#14								
28																
30		11 10 17	27	36		Same as Above Except; Gravel to 1.5 inches, Weak HCL Reaction	100	FS#15								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-19	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 5 SHEETS
LOCATION COORDINATES N 1949518.346 E 6402797.056	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		10 14 16	30	40		SAND, Silty with Gravel (SM); Moist, 10yr5/2 Grayish Brown, Fine to Coarse Sand, Non Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 1.2inches, Strong HCL Reaction	78	FS#16	20	67	13					
34																
36		20 27 25	52	69		Same as Above Except; 85% Fine to Coarse Sand, 10% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, 5% Non Plastic Fines, Weak HCL Reaction	100	FS#17								
38																
		9 4 8	12	16		Same as Above LEAN CLAY (CL); Moist, 10yr5 4 Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Coarse Sand, No HCL Reaction	100	FS#19 FS#18								PP=2.5
40																
42		26 18 10	28	37		SAND, Poorly Graded with Clay (SP-SC); Moist, 10yr5/3 Brown, 80% Fine to Coarse Sand, 10% Low Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 0.9 inches, Weak HCL Reaction	100	FS#20								
44																
		12 18 14	32	43		SAND, Silty with Gravel (SM); Moist, 10yr5/3 Brown, Fine to Coarse Sand, Non Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 1 inch, Trace Clay, No HCL Reaction	89	FS#21	18	68	14	NV	NP		SM	
46																
48		19				SAND, Clayey (SC); Wet, 10yr5/4 Yellow Brown, 55% Fine to Coarse Sand, 35% Low Plastic Fines, 10% Fine to Coarse										Switched to Mud

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-19
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 4 OF 5 SHEETS
LOCATION COORDINATES: N 1949518.346 E 6402797.056	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		25 20	45	60		Subrounded to Subangular Gravel to 1.5 inches, No HCL Reaction	44	FS#22								Rotary
50																
		4 4 3	7	9		No Recovery	0									
52																
54																
56		4 5 5	10	13		SAND, Poorly Graded with Gravel (SP); Wet, 10yr6/2 Gray Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1.5 inches, No HCL Reaction	22	FS#22A								
58																
60		10 13 18	31	41		SAND, Clayey with Gravel (SC); Moist, 10yr5/8 Yellow Brown, Fine to Coarse Sand, Low Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	56	FS#23	36	48	16					
62																
64																
		4 8	18	24		SAND, Silty with Gravel (SM); Moist, 10yr4/5 Brown, Fine to Coarse Sand, Non Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 1.5	28	FS#24	35	50	15					

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-19	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 5 OF 5 SHEETS
LOCATION COORDINATES N 1949518.346 E 6402797.056	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
66		10				inches, Trace Clay, No HCL Reaction										
68																
70		8 9 23	32	43		SAND, Clayey (SC); Wet, 10yr5/3 Brown, 70% Fine to Coarse Sand, 20% Low Plastic Fines, 10% Fine to Coarse Subrounded Gravel to 1 inch, No HCL Reaction	17	FS#25								
72																
74																
76		10 18 40	58	77		SAND, Poorly Graded with Clay (SP-SC); Moist, 10yr5/3 Brown, 80% Fine to Coarse Sand, 10% Low Plastic Fines, 10% Fine to Coarse Gravel to 1.5 inches, No HCL Reaction	17	FS#26								
78																
80		13 23 36	59	78		Same as Above	17	FS#27								
82						Bottom of Boring at 81.5 Feet BSG										

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 3 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-20
LOCATION COORDINATES	N 1949498.733 E 6403038.214
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 18
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	NE
5. DIRECTION OF HOLE	VERTICAL ☒ INCLINED ☐ _____ DEG. FROM VERT
15. DATE HOLE	STARTED 11/5/10; COMPLETED 11/5/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	40
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	40

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr3/4 Dark Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Weak HCL Reaction										
	■	3 5 5	10	13			39	FS#1								PP>4.5
2						LEAN CLAY, with Sand (CL); Moist, 10yr5/4 Yellow Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, No HCL Reaction										
	■	5 3 3	6	8			33	FS#2								PP>4.5
4						FAT CLAY, with Sand (CH); Moist, 10yr5/3 Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, No HCL Reaction			0	25	75	58	37	12.7	CH	
	■	4 4 5	9	12			50	FS#3								PP=2.5
6						Same as Above										
	■	4 4 6	10	13			61	FS#4								PP=4.5
8						Same as Above Except; Trace Coarse Sand, Weak HCL Reaction										
	■	3 3 4	7	9			28	FS#5								PP=4.0
10						Same as Above Except; 10yr5/6 Yellow Brown, 80% Fines, 20% Fine Sand, Strong HCL Reaction										
	■	1 3 3	6	8			56	FS#6								PP=1.5
12						Same as Above Except; FAT CLAY (CH); 10yr5/6 Yellow Brown,			0	4	96	58	36	22.9	CH	PP=1.25

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-20
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1949498.733 E 6403038.214	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		1 2 2	4	5		Trace Fine Sand	44	FS#7								
14																
		3 3 5	8	11		Same as Above Except; Trace Subrounded Gravel to 0.8 inches, No HCL Reaction	67	FS#8								PP=2.0
16																
		3 22 21	43	57		Same as Above	78	FS#10 FS#9								
18						SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 65% Fine to Coarse Sand, 25% Fine to Coarse Subrounded Gravel to 1.3 inches, 10% Non Plastic Fines, No HCL Reaction										
		5 10 15	25	33		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 0.75 inches, 2 inch Poorly Graded Sand Lense with Fine to Medium no Gravel, Non Plastic Fines, No HCL Reaction	50	FS#11	27	57	16					
20																
		10 17 17	34	45		Same as Above Except; Weak HCL Reaction	61	FS#12								
22																
24		11 9 12	21	28		Same as Above Except; Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	100	FS#13								
26																
		9 14 14	28	37		Same as Above Except; Gravel to 1.5 inches	78	FS#14								
28																
30		20 18 17	35	47		Same as Above Except; Weak to Strong HCL Reaction	89	FS#15								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-20
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1949498.733 E 6403038.214	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		7 12 19	31	41		Same as Above Except: 10yr4/4 Dark Yellow Brown, Fine Subrounded Gravel to 0.5 inches, No HCL Reaction	83	FS#16	16	61	23					
34																
36		20 30 18	48	64		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/3 Brown, 80% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1.5 inches, 5% Non Plastic Fines, Weak HCL Reaction	100	FS#17								
38																
		3 3 4	7	9		LEAN CLAY (CL); Moist, 10yr4/6 Dark Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Trace Fine Subrounded Gravel to 0.4 inches, Strong HCL Reaction	44	FS#18								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-21	LOCATION COORDINATES: N 1949463.769 E 6404671.685	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 17
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/5/10	COMPLETED: 11/5/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY with Sand (CH); Moist, 10yr4/3 Brown, 95% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, No HCL Reaction										
		2 2 2	4	5			28	FS#1								PP>4.5
2																
		1 1 2	3	4		Same as Above Except; Strong HCL Reaction	39	FS#2								PP=2.5
4																
		2 2 2	4	5		Same as Before Except; Weak HCL Reaction	39	FS#3	0	23	77	58	37	13	CH	PP=4.0
6																
		1 1 1	2	3		Same As Above Except; 10yr4/4 Dark Yellow Brown	39	FS#4								PP=2.25
8																
		2 2 5	4	5		Same as Above Except; Strong HCL Reaction	39	FS#5								PP=1.5
10																
		4 4 4	8	11		FAT CLAY, Sandy (CH); Moist, 10yr5/4 Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Low to Medium Toughness, Fine Sand, Strong HCL Reaction	50	FS#6	0	37	63	58	39	13.9	CH	PP=2.0
12																
						LEAN CLAY (CL); Moist, 10yr4/3 Brown, 95% Low Plastic Fines, High Dry											PP=1.75

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-21
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1949463.769 E 6404671.685	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		3 7 12	19	25		Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Strong HCL Reaction	56	FS#7								
16		10 12 9	21	28		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Subrounded Gravel to 1 inch, Trace Non Plastic Fines, No HCL Reaction	100	FS#8								
18		8 10 12	22	29		Same as Above Except; Gravel to 0.75 inches	83	FS#9								
20		4 4 9	13	17		Same as Above Except; 2 inch Lense of Silty Sand	83	FS#10								
22		4 8 7	15	20		Same as Above Except; Gravel to 1.2 inches	67	FS#11								
24		20 21 19	40	53		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 10% Fine to Coarse Subrounded Gravel to 1.2 inches, 10% Non Plastic Fines, No HCL Reaction	83	FS#12								
26		17 20 22	42	56		Same as Above Except; Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches	100	FS#13	40	47	13					
28		15 15 12	27	36		Same as Above Except; 10yr4/3 Brown	89	FS#14	35	52	13					

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-21
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1949463.769 E 6404671.685	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		9 11 14	25	33		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/5 Pale Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, 10% Non Plastic Fines, Weak HCL Reaction	78	FS#15								
34																
36		12 18 14	32	43		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, 65% Fine to Coarse Sand, 20% Non Plastic Fines, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, Weak HCL Reaction	100	FS#16								
38																
		11 15 18	33	44		Same as Above Except; No HCL Reaction	89	FS#17								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 3 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-22
LOCATION COORDINATES	N 1949448.404 E 6406078.534
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 17
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	38.5 Feet BSG
5. DIRECTION OF HOLE	VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐
15. DATE HOLE	STARTED 11/5/10; COMPLETED 11/5/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	40
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	40

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, Sandy (CH); Moist, 10yr3/5 Dark Brown, 80% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Fine Subrounded Gravel to 0.4 inches										
		2 2 3	5	7			36	FS#1								PP>4.5
2																
		1 1 2	3	4		Same as Above Except; No Gravel	39	FS#2	0	30	70	59	39	13.2	CH	PP>4.5
4																
		2 1 2	3	4		Same as Above Except; Weak HCL Reaction	39	FS#3								PP=3.5
6																
		2 2 3	5	7		Same as Above Except; 10yr5/6 Yellow Brown, Strong HCL Reaction	39	FS#4								PP=2.75
8																
		2 1 1	2	3		LEAN CLAY, Sandy (CL); Moist, 10yr4/4 Dark Yellow Brown, 65% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 35% Fine Sand, No HCL Reaction	33	FS#5								PP=3
10																
		2 6 7	13	17		LEAN CLAY, with Sand (CL); Moist, 10yr5/3 Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, Weak HCL Reaction	78	FS#6								PP=3.5
12																
						Same as Above Except; 75% Fines, 25% Fine Sand										PP=2.0

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-22
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1949448.404 E 6406078.534	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		4 6 6	12	16			61	FS#7								
14																
		5 6 6	12	16		Same as Above Except; Strong HCL Reaction	67	FS#8								PP=2.5
16																
		5 5 7	12	16		FAT CLAY, Sandy (CH); Moist, 10yr5/4 Yellow Brown, 65% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 35% Fine Sand, No HCL Reaction	78	FS#9								PP=2.5
18																
		2 3 8	11	15		Same as Above	78	FS#10	1	40	59	62	40	16.9	CH	PP=2.5
20																
		2 2 2	4	5		Same as Above Except; Trace Coarse Sand, Trace Coarse Subrounded Gravel to 0.3 inches, Weak HCL Reaction	67	FS#11								PP=1.0
22																
24		15 14 10	24	32		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, No HCL Reaction	78	FS#12	36	52	12					
26																
		16 19 20	39	52		Same as Above	100	FS#13								
28																
30		13 15 15	30	40		Same as Above Except; Gravel to 1.1 inches	100	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-22
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District; SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1949448.404 E 6406078.534	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		3 6 15	21	28		SAND, Clayey with Gravel (SC); Moist, 10yr5/3 Brown, Fine to Coarse Sand, Low Plastic Fines, Fine to Coarse Subrounded Gravel to 1.3 inches, No HCL Reaction	100	FS#15	34	49	17					
34																
36		6 9 9	18	24		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr5/2 Grayish Brown, 80% Fine to Coarse Sand, 10% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, 10% Non Plastic Fines, No HCL Reaction	89	FS#16								
38																
		13 16 18	34	45		SAND, Silty with Gravel (SM); Wet, 10yr4/3 Brown, 65% Fine to Coarse Sand, 20% Non Plastic Fines, 15% Fine to Coarse Subrounded Gravel to 1.3 inches, No HCL Reaction	89	FS#17								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	LEAN Clay
	Poorly graded sand with silt
	FAT Clay
	Clayey sand
	Silty sand
	Silt
	Silty Clay
	Poorly graded sand
	Silty Sand to Clayey Sand
	Well graded sand with silt
	Well graded gravel with silt
	Poorly graded gravel
	Silty gravel
	Poorly graded sand with clay

Notes:

1. Test borings were conducted between November 1, 2010 and December 3, 2010, using a CME 75 drill rig equipped with 6 5/8 inch O.D. Hollow Stem Augers and Mud Rotary Drill Methods using a 4 inch diameter bit.

2. Groundwater was encountered at the depths ranging from 35 and 47.5 feet BSG during drilling of the test borings.

3. Test Boring locations were located based on existing staking provided by U.S. Army Corp. The test boring locations were recorded by hand held GPS.

4. These logs and laboratory data are subject to the interpretation and analysis by others. Moore Twining shall not be held responsible for incorrect useage of the data.

5. Results of tests conducted on samples recovered are reported on the logs. Abbreviations used are:

PP	=	Pocket Penetrometer (TSF)
N60	=	Corrected N-Value (does not include correction for rod length or borehole diameter.)
Nr	=	Uncorrected; Field Blow Count
LL	=	Liquid limit
PI	=	Plasticity index
MC	=	Moisture Content (%)
GRAVEL	=	Percent Retained on #4 Sieve
SAND	=	Percent Passing #4 Sieve and Retained on #200 Sieve
FINES	=	Percent Passing #200 Sieve

KEY TO SYMBOLS

Symbol	Description
Misc. Symbols	
	Boring continues
	Water table during drilling
Soil Samplers	
	Standard penetration test

APPENDIX C

RESULTS OF LABORATORY TESTS

This appendix contains the individual results of the following tests. The results of the moisture content and dry density tests are included on the test boring logs in Appendix B. These data, along with the field observations, were used to prepare the final test boring logs in Appendix B.

These Included:	To Determine:
Moisture Content (ASTM D2216)	Moisture contents representative of field conditions at the time the sample was taken.
Atterberg Limits (ASTM D4318)	The consistency and "stickiness," as well as the range of moisture contents within which the material is "workable
Grain-Size Distribution (ASTM D422)	Size and distribution of soil particles, i.e., sand, gravel and fines (silt and clay).

Client: City of Newman Public Works

Report Date: 12/23/2010

Project: Orestimba Feasibility Study - Flood Control Project Drilling

Project Number: C36002.01

		Percent Passing By Dry Weight												Atterberg			
		Gravel, inches					Sand (Sieve No.)						Fines	Limits			
Location	Depth, ft	1-1/2	1	3/4	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	LL	PI	% Moisture	USCS Classification
2F-11-02, FS-3	4.5-6.0	100	100	100	100	100	100	100	99	99	98	85	62	61	39	15.5	CH (Sandy fat Clay)
2F-11-02, FS-8	14.5-16	100	100	100	100	100	100	99	99	98	95	76	58	58	39	12.1	CH (Sandy fat clay)
2F-11-02, FS-11	20.5-22	100	100	100	100	100	100	100	99	99	90	52	30	NA	NA	NA	SC (Clayey sand)
2F-11-03, FS-1	0.5-2.0	100	100	100	100	100	95	93	90	88	81	68	54	NA	NA	NA	CL (Sandy lean clay)
2F-11-03, FS-2	2.5-4.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	37	20	NA	CL (Sandy lean clay)
2F-11-03, FS-6	10.5-12	100	100	100	100	100	100	100	100	99	97	84	63	28	15	12.2	CL (Sandy lean clay)
2F-11-03, FS-9	14.5-16	100	100	96	91	82	65	50	41	36	30	21	15	NA	NA	NA	SM (Silty sand with gravel)
2F-11-03, FS-11	18.5-20	100	100	100	100	100	100	100	100	100	96	58	35	NV	NP	9.9	SM (Silty sand)
2F-11-03, FS-17	35.5-37	100	100	100	100	100	100	99	99	98	91	72	48	24	7	14.9	SC-SM (Silty, clayey sand)
2F-11-04, FS-2	2.5-4	100	100	100	100	100	100	99	99	98	94	87	75	53	30	7.7	CH (Fat clay with sand)
2F-11-04, FS-5	8.5-10	100	94	86	80	74	63	51	43	36	27	19	13	NA	NA	NA	SM (Silty sand with gravel)
2F-11-04, FS-12	23.5-25	100	100	100	98	90	77	63	51	40	25	16	12	NA	NA	NA	SP-SM (Poorly graded sand w/silt and gravel)
2F-11-04, FS-15	32.5-34	100	100	100	100	100	99	98	96	95	93	83	62	42	23	16.1	CL (Sandy lean clay)
2F-11-05, FS-5	8.5-10	100	92	87	75	72	63	51	41	33	24	18	13	NA	NA	NA	SM (Silty sand with gravel)
2F-11-05, FS-8	14.5-16	100	100	100	100	100	100	99	99	98	96	84	70	50	31	16.8	CH (Sandy fat clay)
2F-11-05, FS-13	26.5-28	100	100	100	100	100	100	99	98	97	93	80	65	58	37	15	CH (Sandy fat clay)
2F-11-06, FS-2	2.5-4	100	100	100	100	99	99	98	97	96	93	85	73	60	37	11.3	CH (Fat clay with sand)
2F-11-06, FS-5	8.5-10	100	87	87	79	78	72	67	65	63	57	48	38	NA	NA	NA	SC (Clayey sand with gravel)
2F-11-06, FS-9	16.5-18	100	92	84	79	73	60	47	38	31	24	18	13	NA	NA	NA	SM (Silty sand with gravel)
2F-11-06, FS-11	20.5-22	100	100	100	100	100	100	100	100	99	97	87	68	58	36	13.9	CL (Sandy fat clay)
2F-11-07, FS-6	10.5-12	100	100	100	100	100	100	100	100	100	98	90	74	32	15	18.4	CL (Lean clay with sand)
2F-11-07, FS-8	14.5-16	100	100	92	82	76	61	51	44	36	23	15	11	NA	NA	NA	SP-SM (Poorly graded sand w/silt and gravel)
2F-11-07, FS-13	26.5-28	100	100	100	100	100	100	100	100	99	95	81	60	35	18	17.7	CL (Sandy lean clay)
2F-11-07, FS-19	41.5-43	100	100	89	80	73	59	47	38	31	25	18	13	NA	NA	NA	SM (Silty sand with gravel)
2F-11-07, FS-21	47.5-49	100	100	89	80	72	57	44	36	31	24	18	13	NA	NA	NA	SM (Silty sand with gravel)

Client: City of Newman Public Works

Report Date: 12/23/2010

Project: Orestimba Feasibility Study - Flood Control Project Drilling

Project Number: C36002.01

		Percent Passing By Dry Weight												Atterberg			
		Gravel, inches					Sand (Sieve No.)					Fines		Limits			
Location	Depth, ft	1-1/2	1	3/4	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	LL	PI	% Moisture	USCS Classification
2F-11-08, FS-3	4.5-6	100	100	100	100	100	99	99	98	97	93	79	63	51	30	12	CH (Sandy fat clay)
2F-11-08, FS-11	18.5-20	100	100	100	90	83	68	54	43	34	21	14	10	NA	NA	NA	SW-SM (Well-graded sand w/silt and gravel)
2F-11-08, FS-17	38.5-40	100	100	100	99	99	99	99	98	98	97	93	77	NA	NA	NA	CL-ML (Silty clay with sand)
2F-11-09, FS-3	4.5-6	100	100	100	100	100	100	98	96	94	88	76	62	50	29	12.3	CH (Sandy fat clay)
2F-11-09, FS-8	12.5-14	100	100	93	82	73	60	49	39	30	21	15	11	NA	NA	NA	SP-SM (Poorly graded sand w/silt and gravel)
2F-11-09, FS-13	26.5-28	100	100	98	87	83	67	53	41	32	25	19	15	NA	NA	NA	SM (Silty sand with gravel)
2F-11-10, FS-3	4.5-6.0	100	100	100	98	96	94	92	91	89	74	72	61	50	31	9.1	CH (Sandy fat clay)
2F-11-10, FS-6	8.5-10	100	77	70	57	54	42	34	26	19	14	9	6.7	NA	NA	NA	GW-GM (Well graded gravel w/silt and sand)
2F-11-10, FS-10	12.5-14	100	91	77	73	68	56	46	39	33	23	15	11	NA	NA	NA	GP-GM (Poorly graded gravel w/silt and sand)
2F-11-10, FS-13	18.5-20	100	100	100	96	96	96	95	95	94	91	88	81	55	32	20.7	CH (Fat clay with sand)
2F-11-10, FS-16	26.5-28	100	100	100	98	98	97	95	94	93	90	84	71	56	33	NA	CH (Fat clay with sand)
2F-11-11, FS-1	0.5-2.0	100	100	100	100	99	96	94	93	91	87	79	69	51	30	8.7	CH (Sandy fat clay)
2F-11-11, FS-3	4.5-6.0	100	100	92	77	72	58	47	39	31	23	15	11	NA	NA	NA	SP-SM (Poorly graded sand w/silt and gravel)
2F-11-11, FS-7	10.5-12	100	100	96	85	76	56	41	31	24	16	11	7.7	NA	NA	NA	SW-SM (Well graded sand w/silt and gravel)
2F-11-11, FS-11	18.5-20	100	100	100	100	100	100	100	100	100	99	95	86	50	31	20.5	CH (Fat clay)
2F-11-12, FS-1	0.5-2.0	100	100	83	83	83	81	80	79	79	77	71	60	55	34	10.4	CH (Sandy fat clay with gravel)
2F-11-12, FS-4	6.5-8.0	100	100	100	100	100	99	99	99	98	96	88	76	53	30	15.2	CH (Fat clay with sand)
2F-11-12, FS-6	10.5-12	100	100	100	100	98	98	97	96	95	87	63	45	NA	NA	NA	SM (Silty sand)
2F-11-12, FS-12	20.5-22	100	100	100	88	82	66	51	40	31	21	15	12	NA	NA	NA	SP-SM (Poorly graded sand with silt and gravel)
2F-11-13, FS-1	0.5-2.0	100	100	100	95	91	82	74	70	65	55	44	35	43	24	NA	SC (Clayey sand with gravel)
2F-11-13, FS-2	2.5-4.0	100	95	95	81	75	62	53	47	41	29	17	12	NA	NA	NA	SM (Silty sand with gravel)
2F-11-13, FS-5	10.5-12	100	100	100	99	98	98	97	96	94	88	73	57	53	32	9.7	CH (Sandy fat clay)
2F-11-13, FS-8	16.5-18	100	100	94	88	79	63	49	39	32	21	13	9.7	NA	NA	NA	SP-SM (Poorly graded sand with silt and gravel)

Client: City of Newman Public Works

Report Date: 12/23/2010

Project: Orestimba Feasibility Study - Flood Control Project Drilling

Project Number: C36002.01

		Percent Passing By Dry Weight												Atterberg			
		Gravel, inches					Sand (Sieve No.)						Fines	Limits			
Location	Depth, ft	1-1/2	1	3/4	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	LL	PI	% Moisture	USCS Classification
2F-11-14, FS-2	2.5-4.0	100	100	100	100	99	97	95	94	92	88	80	68	50	29	8.9	CH (Sandy fat clay)
2F-11-14, FS-7	10.5-12	100	100	96	91	88	73	59	49	41	33	24	18	NA	NA	NA	SM (Silty sand with gravel)
2F-11-14, FS-12	20.5-22	100	92	89	80	76	68	60	54	44	26	11	7.2	NA	NA	NA	SP-SM (Poorly graded sand with silt and gravel)
2F-11-14, FS-15	29.5-31	100	100	100	99	98	95	92	89	86	72	46	32	NA	NA	NA	SC (Clayey sand)
2F-11-15, FS-3	2.5-4	100	100	100	100	100	100	99	99	98	97	90	77	36	21	9.5	CL (Lean clay with sand)
2F-11-15, FS-7	12.5-14	100	100	95	87	82	68	52	38	30	22	16	13	NA	NA	NA	SM (Silty sand with gravel)
2F-11-15, FS-18	41.5-43	100	100	100	100	100	100	99	98	96	90	79	63	39	22	18.8	CL (Sandy lean clay)
2F-11-16, FS-2	2.5-4.0	100	100	100	100	100	100	99	98	98	95	85	71	57	35	11.4	CH (Fat clay with sand)
2F-11-16, FS-4	6.5-7.0	100	100	100	100	95	92	89	87	85	81	70	58	58	35	10.9	CH (Sandy fat clay)
2F-11-16, FS-7	10.5-12	100	100	89	80	75	59	46	35	26	18	12	9.2	NA	NA	NA	SW-SM (Well graded sand with silt and gravel)
2F-11-16, FS-11	18.5-20.0	100	100	89	74	69	55	43	36	31	26	18	14	NA	NA	NA	GM (Silty gravel with sand)
2F-11-17, FS-2	2.5-4.0	100	100	100	100	100	98	96	94	93	90	82	70	59	36	8.1	CH (Sandy fat clay)
2F-11-17, FS-3	4.5-6.0	100	100	100	100	100	98	97	97	94	94	87	74	61	37	8.2	CH (Fat clay with sand)
2F-11-17, FS-6	10.5-12	100	88	85	77	71	59	48	39	32	25	18	13	NA	NA	NA	SM (Silty sand with gravel)
2F-11-17, FS-8	14.5-16	100	100	92	77	70	57	43	33	26	20	15	11	NA	NA	NA	SP-SM (Poorly graded sand with silt and gravel)
2F-11-19, FS-5	8.5-10	100	100	100	100	100	100	100	100	100	98	90	80	35	19	16.1	CL (Lean clay with sand)
2F-11-19, FS-7	12.5-14	100	100	100	100	100	100	100	99	97	95	91	85	36	16	21.1	CL (Lean clay)
2F-11-19, FS-11	18.5-20	100	92	90	84	75	60	47	37	31	25	17	13	NA	NA	NA	SM (Silty sand with gravel)
2F-11-19, FS-16	32.5-34	100	100	100	93	86	71	56	46	38	29	19	14	NA	NA	NA	SM (Silty sand with gravel)
2F-11-19, FS-21	44.5-46	100	100	100	92	86	72	59	51	45	31	20	15	NV	NP	NA	SM (Silty sand with gravel)
2F-11-19, FS-23	60-61.5	100	100	93	89	81	64	48	39	34	28	20	16	NA	NA	NA	SC (Clayey sand with gravel)
2F-11-19, FS-24	65-66.5	100	100	83	80	77	65	51	41	33	25	19	15	NA	NA	NA	SM (Silty sand with gravel)

Client: City of Newman Public Works

Report Date: 12/23/2010

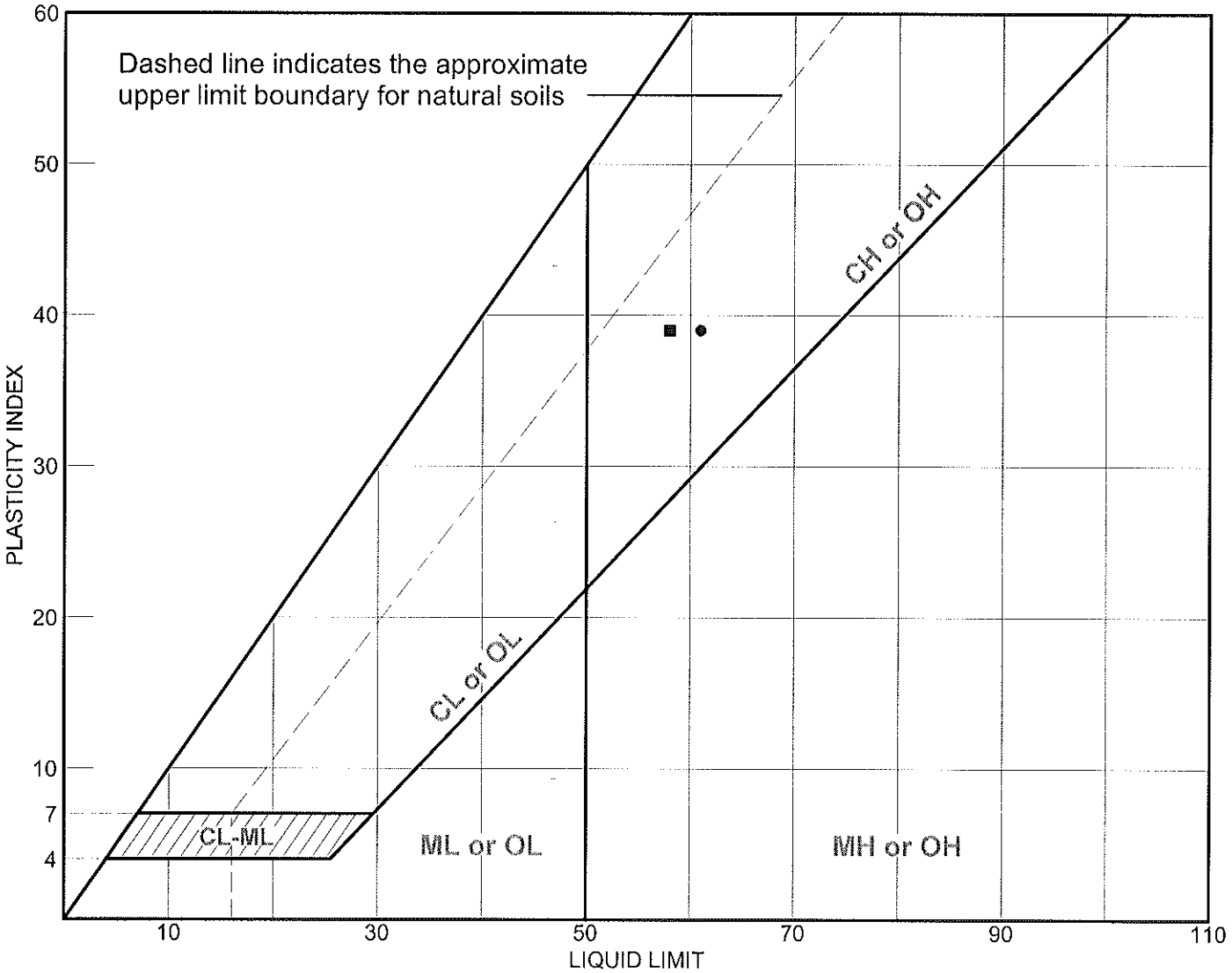
Project: Orestimba Feasibility Study - Flood Control Project Drilling

Project Number: C36002.01

		Percent Passing By Dry Weight												Atterberg			
		Gravel, inches					Sand (Sieve No.)						Fines	Limits			
Location	Depth, ft	1-1/2	1	3/4	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	LL	PI	% Moisture	USCS Classification
2F-11-20, FS-3	4.5-6.0	100	100	100	100	100	100	100	99	99	96	87	75	58	37	12.7	CH (Fat clay with sand)
2F-11-20, FS-7	12.5-14	100	100	100	100	100	100	100	100	99	99	97	96	58	36	22.9	CH (Fat clay)
2F-11-20, FS-11	18.5-20	100	100	100	92	88	73	59	47	39	30	22	16	NA	NA	NA	SM (Silty sand with gravel)
2F-11-20, FS-16	32.5-34	100	100	100	99	93	84	76	71	66	55	35	23	NA	NA	NA	SM (Silty sand with gravel)
2F-11-21, FS-2	2.5-4.0	100	100	100	100	100	100	100	99	99	96	88	77	58	37	13.0	CH (Fat clay with sand)
2F-11-21, FS-6	10.5-20	100	100	100	100	100	100	99	99	98	93	78	63	58	39	13.9	CH (Sandy fat clay)
2F-11-21, FS-13	26.5-28	100	100	98	82	74	60	47	38	31	24	17	13	NA	NA	NA	SM (Silty sand with gravel)
2F-11-21, FS-14	29.5-31	100	94	92	86	79	65	52	41	33	26	18	13	NA	NA	NA	SM (Silty sand with gravel)
2F-11-22, FS-2	2.5-4.0	100	100	100	100	100	100	100	100	100	97	84	70	59	39	13.2	CH (Sandy fat clay)
2F-11-22, FS-10	18.5-20	100	100	100	100	100	99	97	96	94	88	72	59	62	40	16.9	CH (Sandy fat clay)
2F-11-22, FS-12	23.5-25	100	100	98	85	80	64	50	40	32	23	17	12	NA	NA	NA	SM (Silty sand with gravel)
2F-11-22, FS-15	32.5-34	100	100	97	86	81	66	53	44	38	28	21	17	NA	NA	NA	SC (Clayey sand with gravel)

NA: Not Applicable
NV: No Value
NP: Non Plastic

LIQUID AND PLASTIC LIMITS TEST REPORT

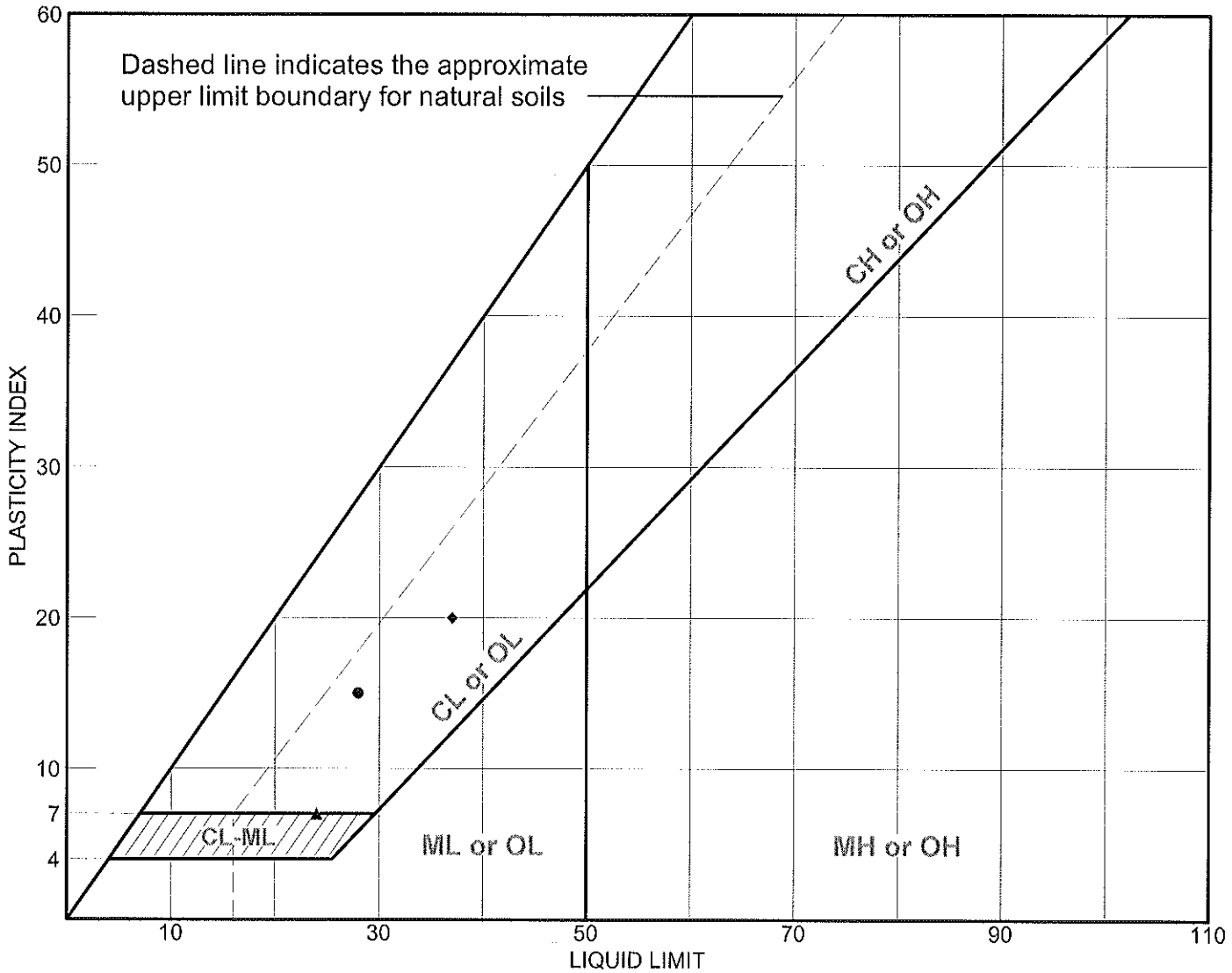


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-02	FS-3	4.5-6.0 Feet	15.5%	22	61	39	CH
■	2F-11-02	FS-8	14.5-16.0 Feet	12.1 %	19	58	39	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

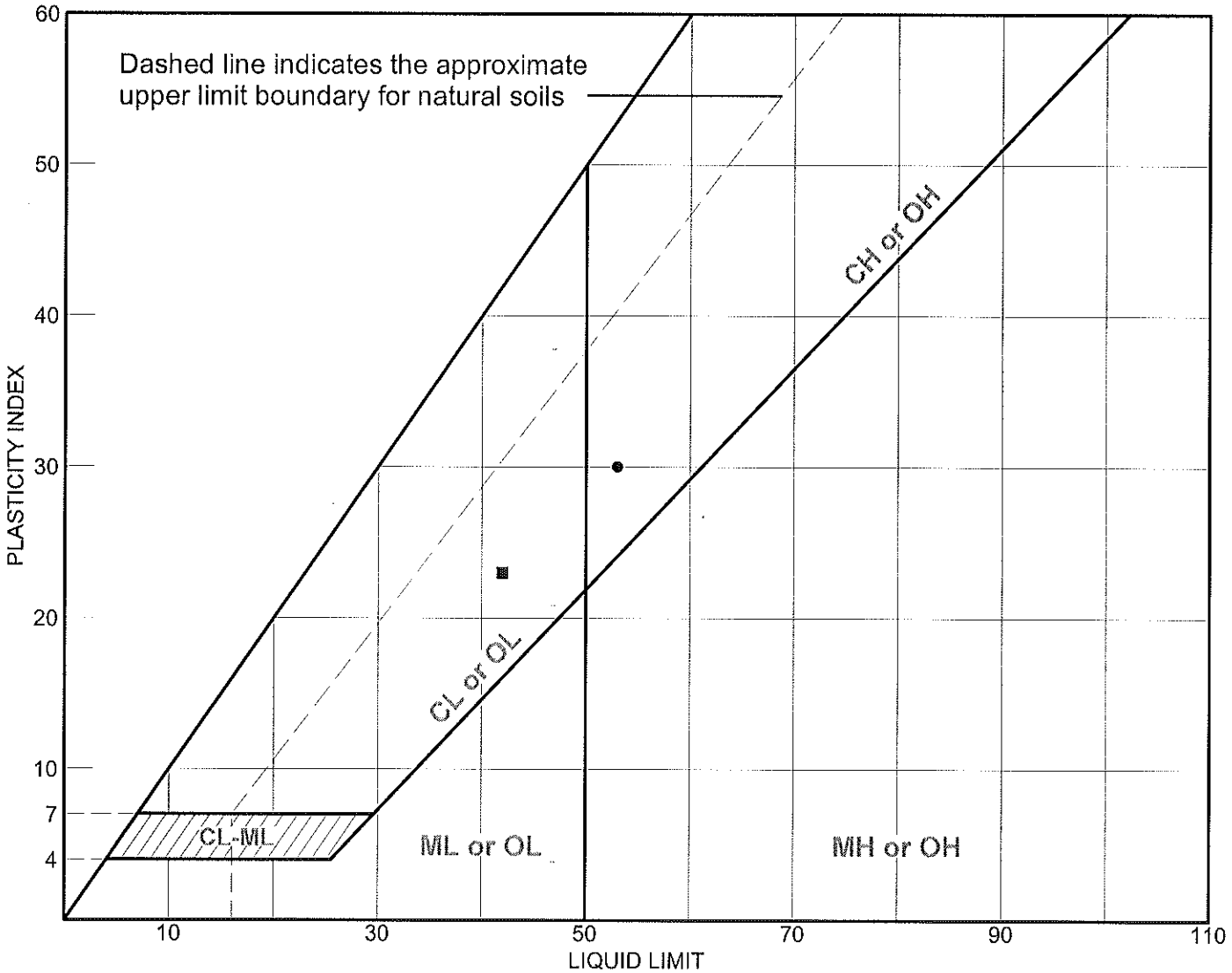


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-03	FS-6	10.5-12 Feet	12.2%	13	28	15	CL
■	2F-11-03	FS-11	18.5-20 Feet	9.9 %	NP	NV	NP	SM
▲	2F-11-03	FS-17	35.5-37 Feet	14.9%	17	24	7	SC-SM
◆	2F-11-03	FS-2	2.5-4.0 Feet	6.1%	17	37	20	CL

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

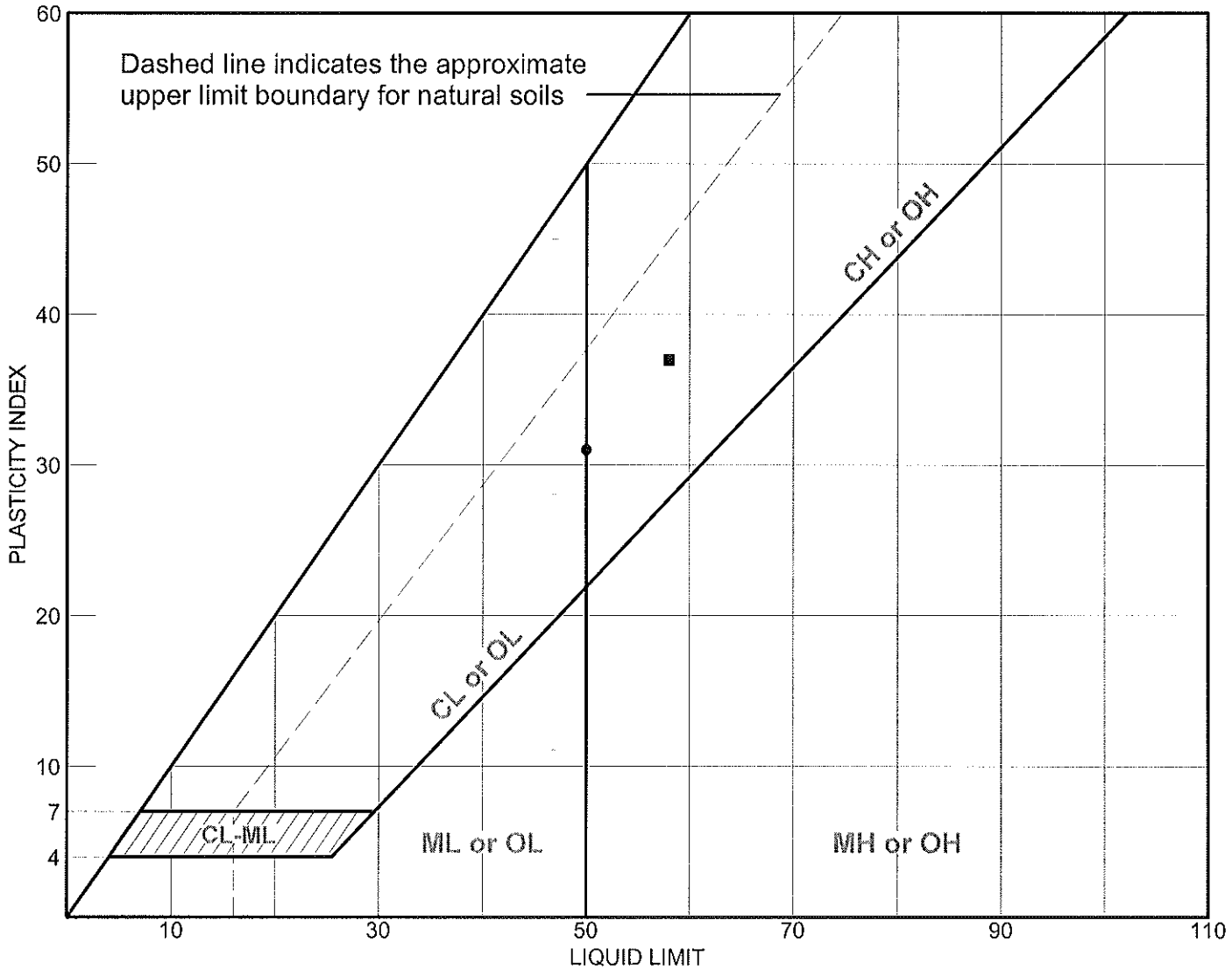


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-04	FS-2	2.5-4.0 Feet	7.7%	23	53	30	CH
■	2F-11-04	FS-15	32.5-34 Feet	16.1%	19	42	23	CL

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

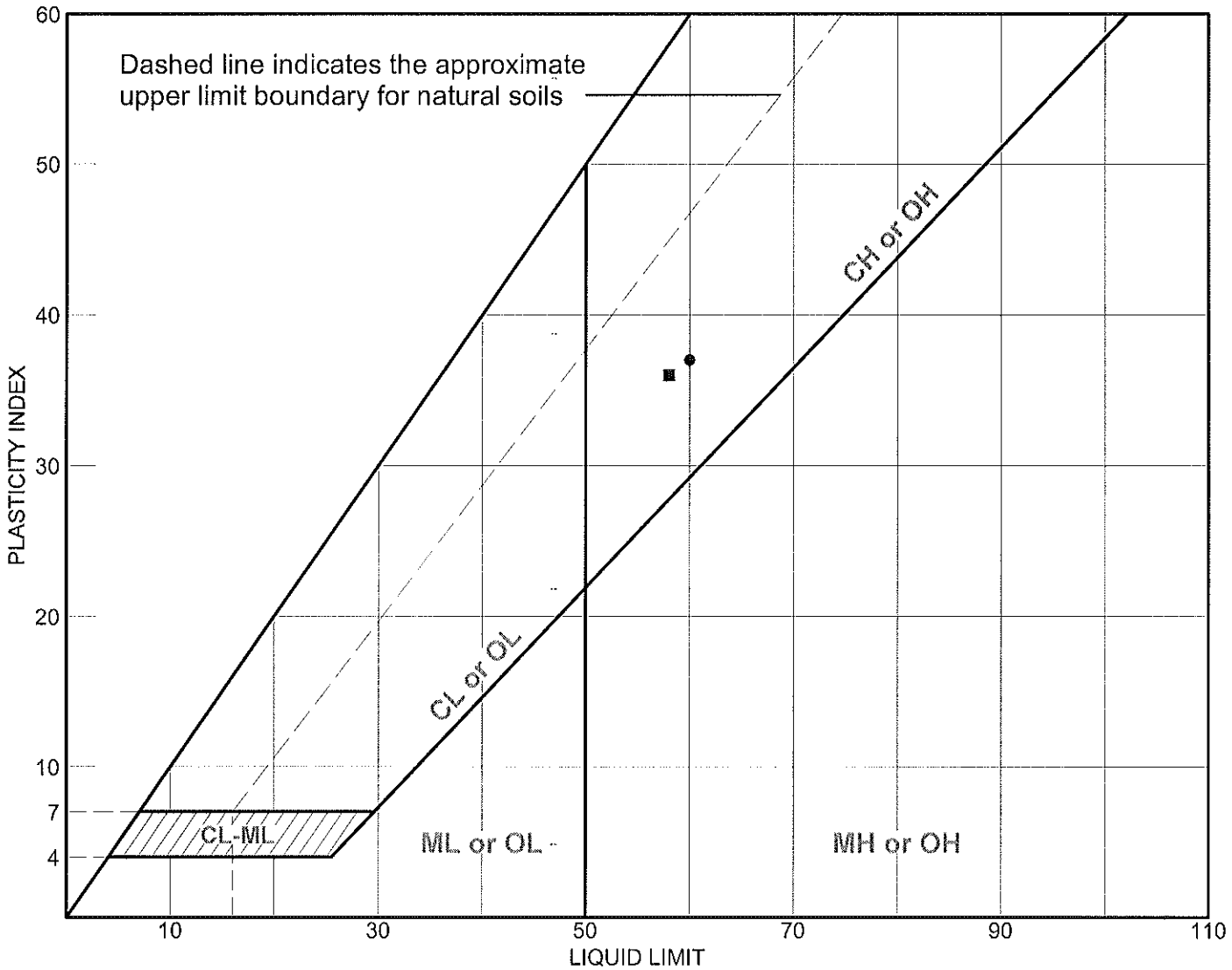
LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-05	FS-8	14.5-16 Feet	16.8	19	50	31	CH
■	2F-11-05	FS-13	26.5-28 Feet	15.0%	21	58	37	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

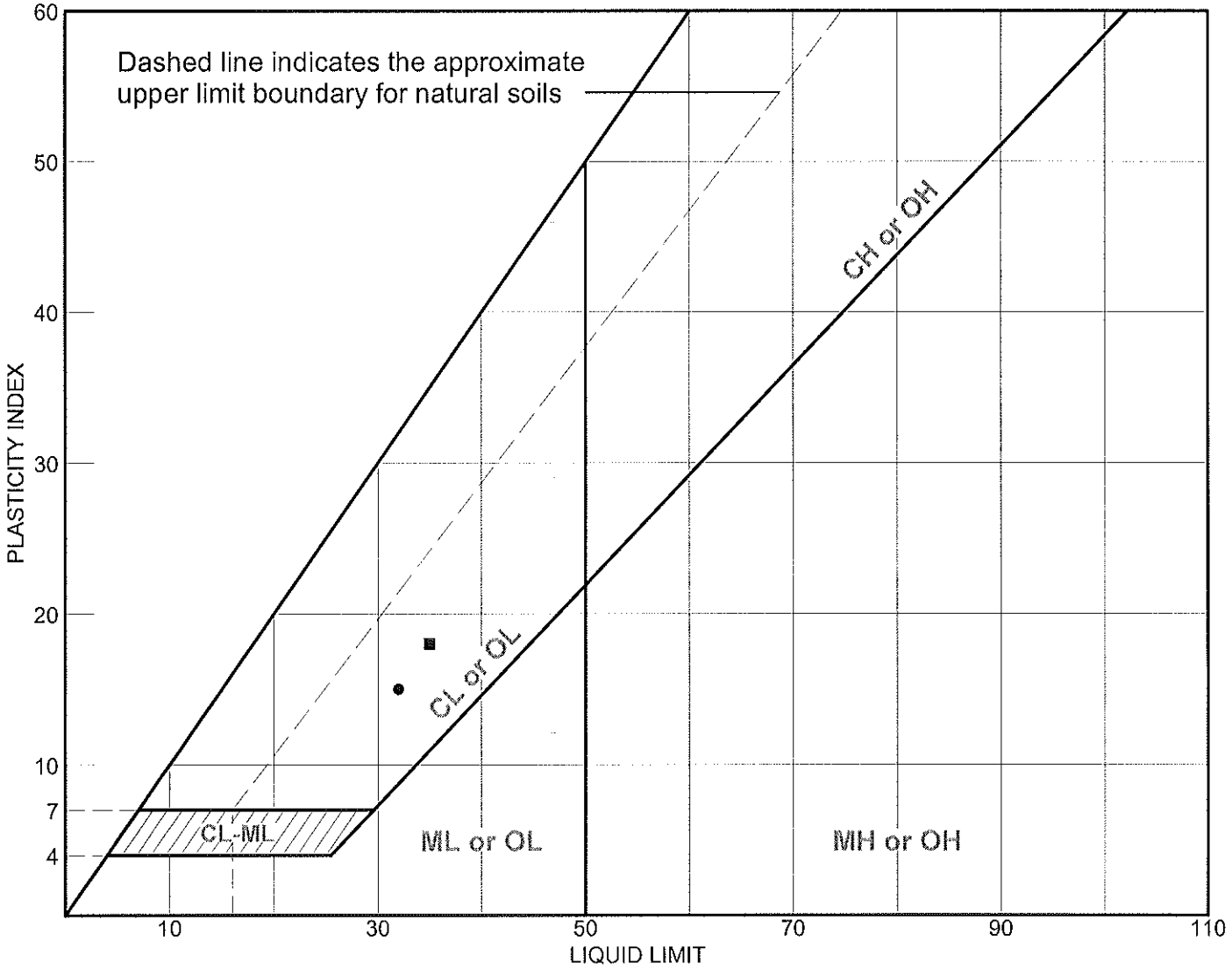


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-06	FS-2	2.5-4 Feet	11.3%	23	60	37	CH
■	2F-11-06	FS-11	20.5-22 Feet	13.9%	22	58	36	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

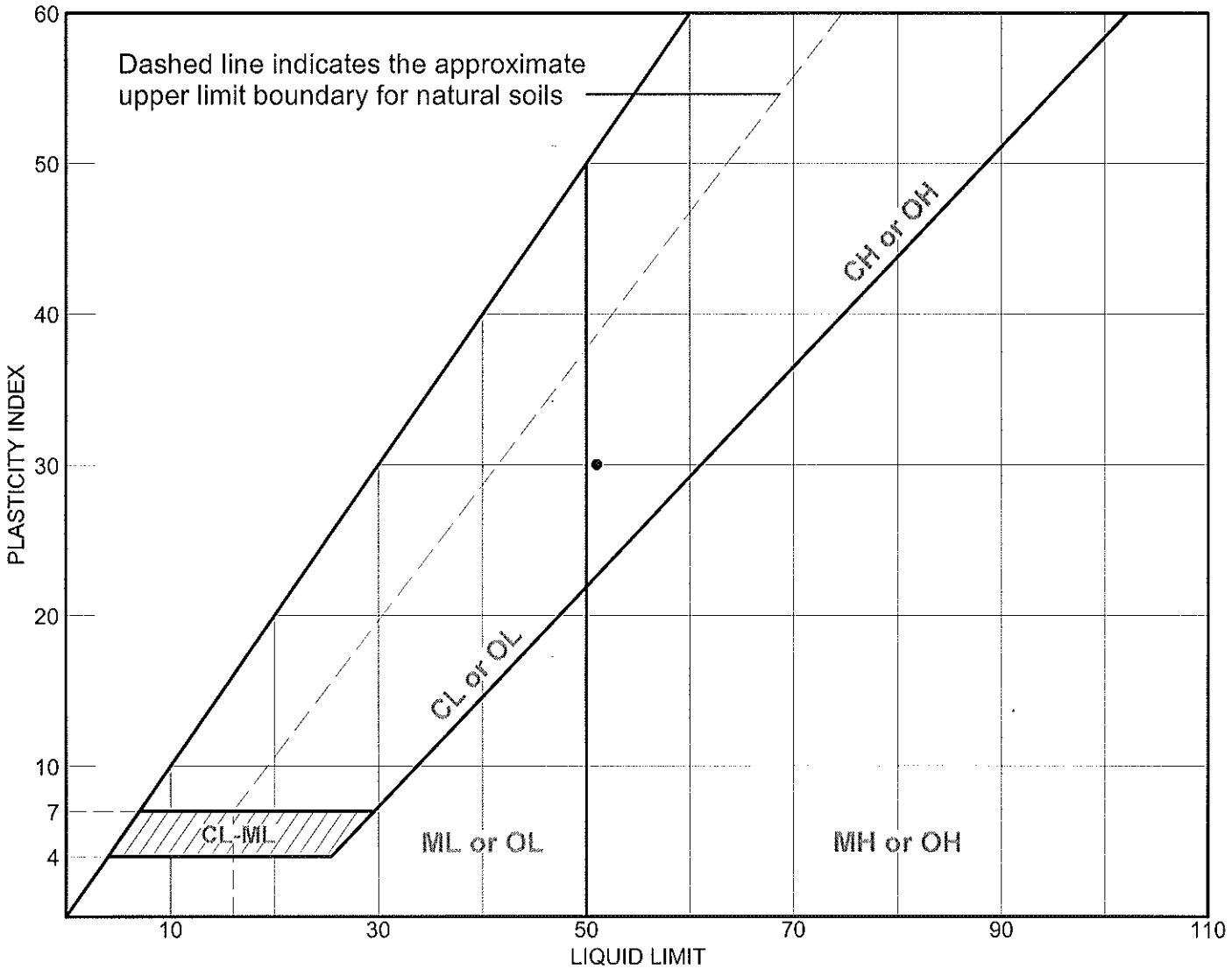
LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-07	FS-6	10.5-12 Feet	18.4%	17	32	15	CL
■	2F-11-07	FS-13	26.5-28 Feet	17.7%	17	35	18	CL

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

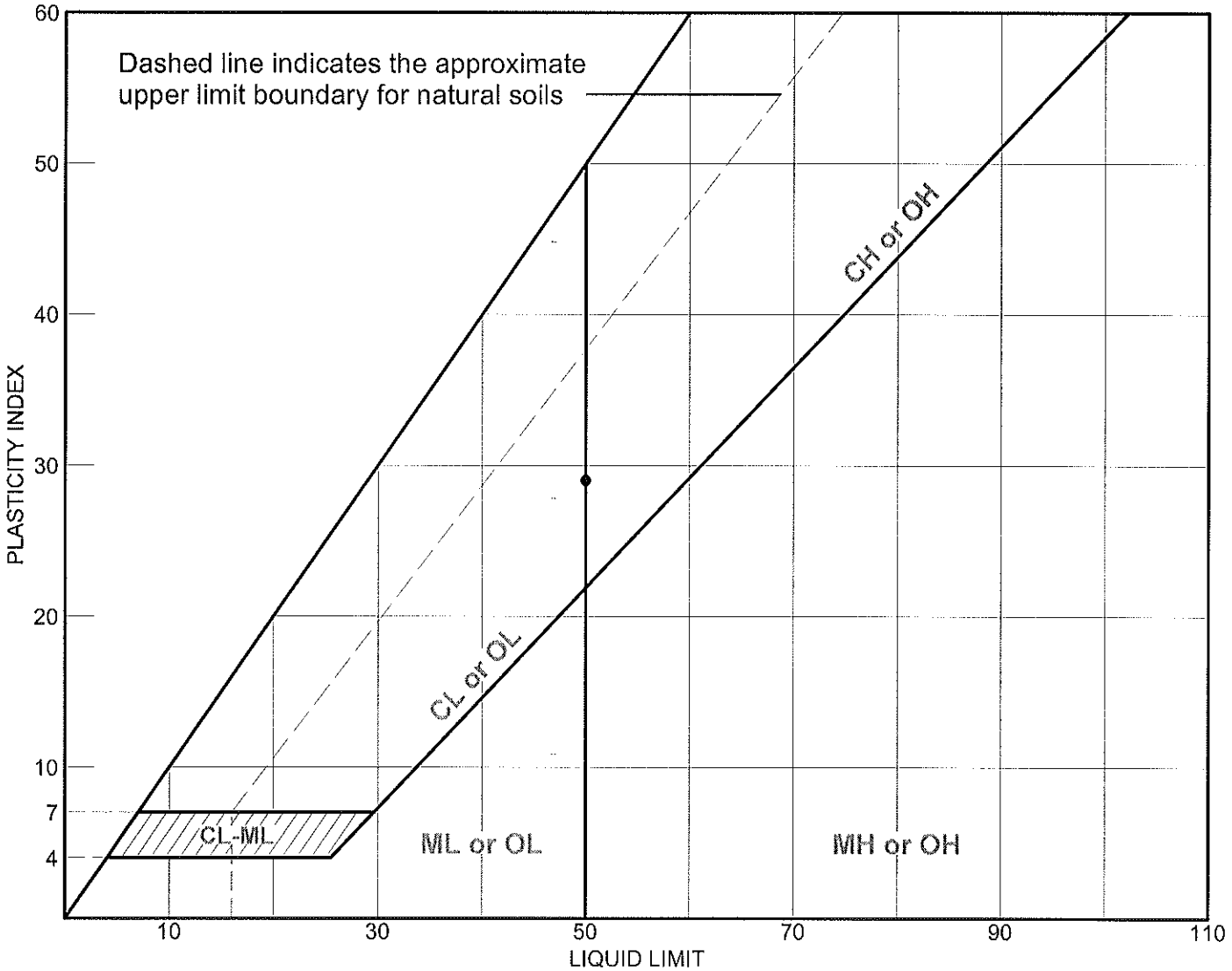
LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-08	FS-3	4.5-6 Feet	12.3%	21	51	30	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

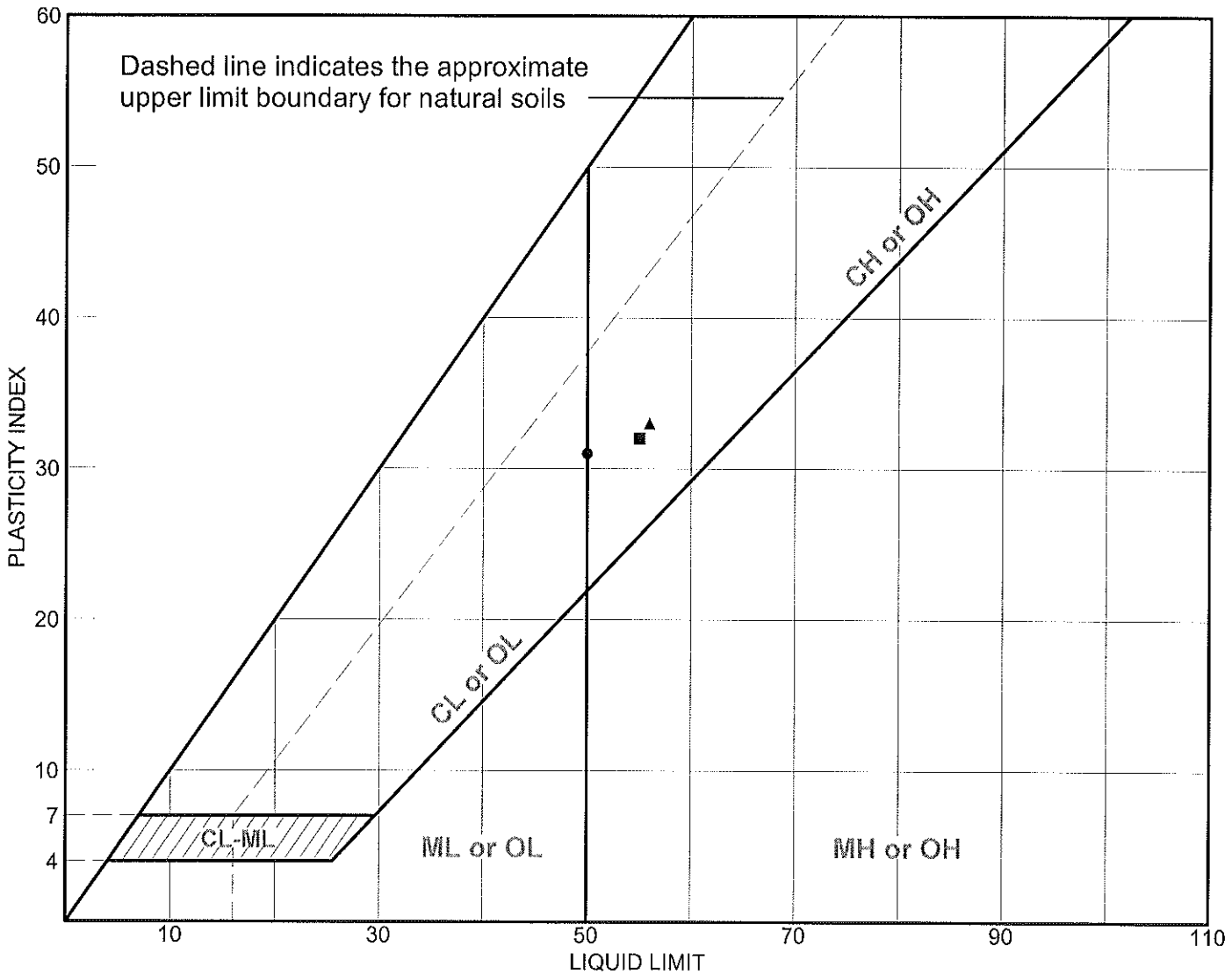


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-09	FS-3	4.5-6 Feet	12.3%	21	50	29	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

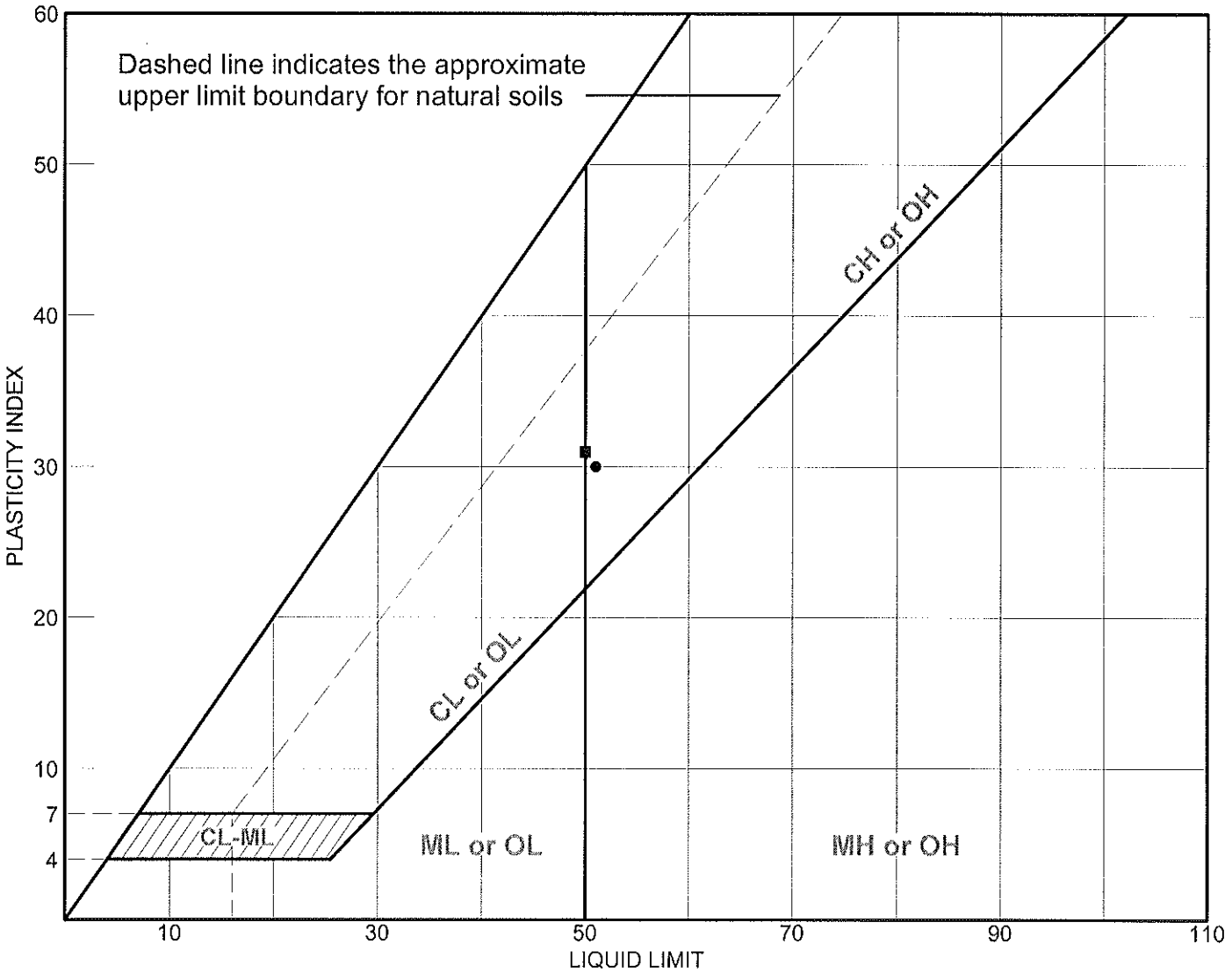
LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-10	FS-3	4.5-6.0 Feet	9.1	19	50	31	CH
■	2F-11-10	FS-13	18.5-20 Feet	20.7	23	55	32	CH
▲	2F-11-10	FS-16	26.5-28 Feet	NA	23	56	33	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

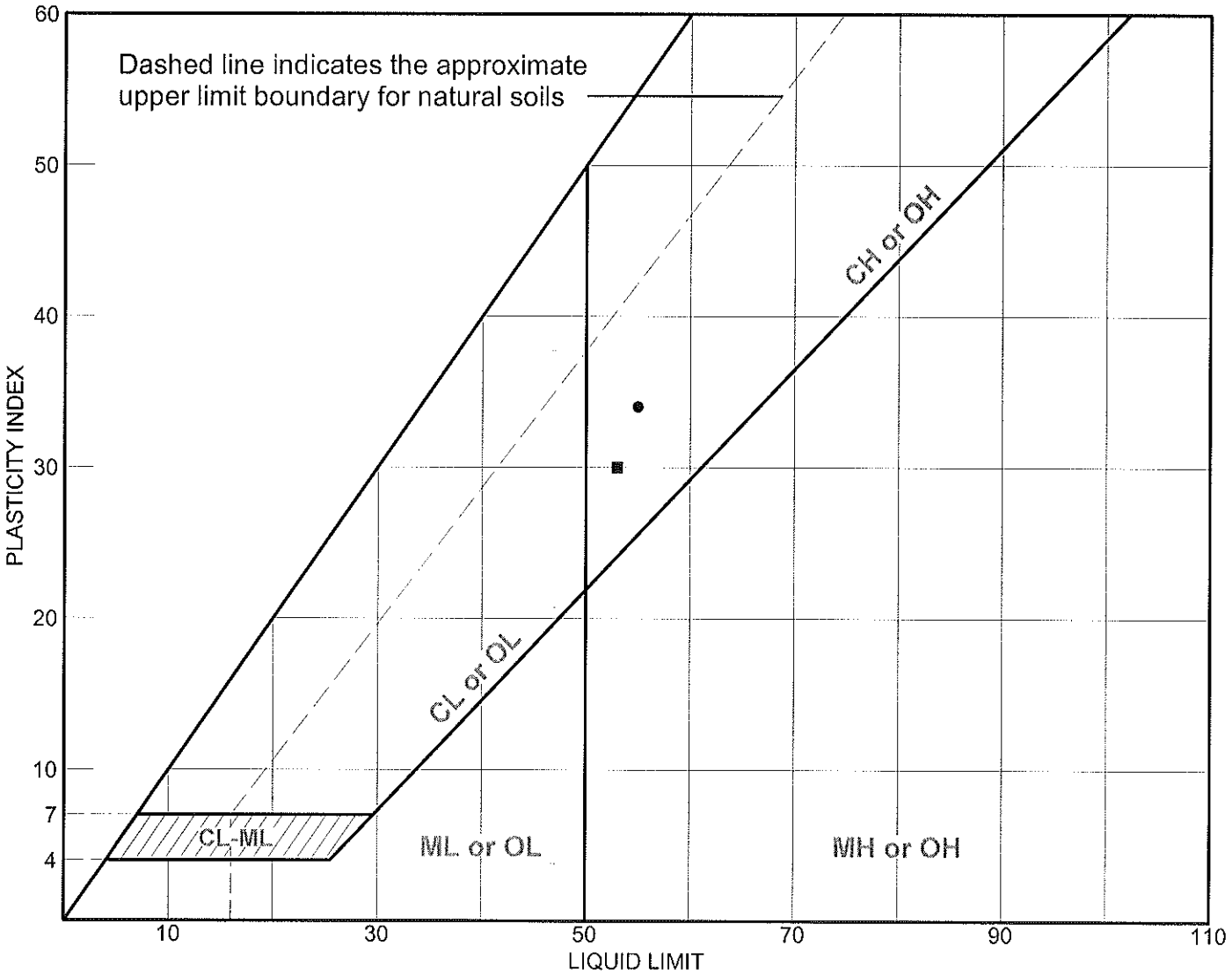
LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-11	FS-1	0.5-2 Feet	8.7	21	51	30	CH
■	2F-11-11	FS-11	18.5-20 Feet	20.5%	19	50	31	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

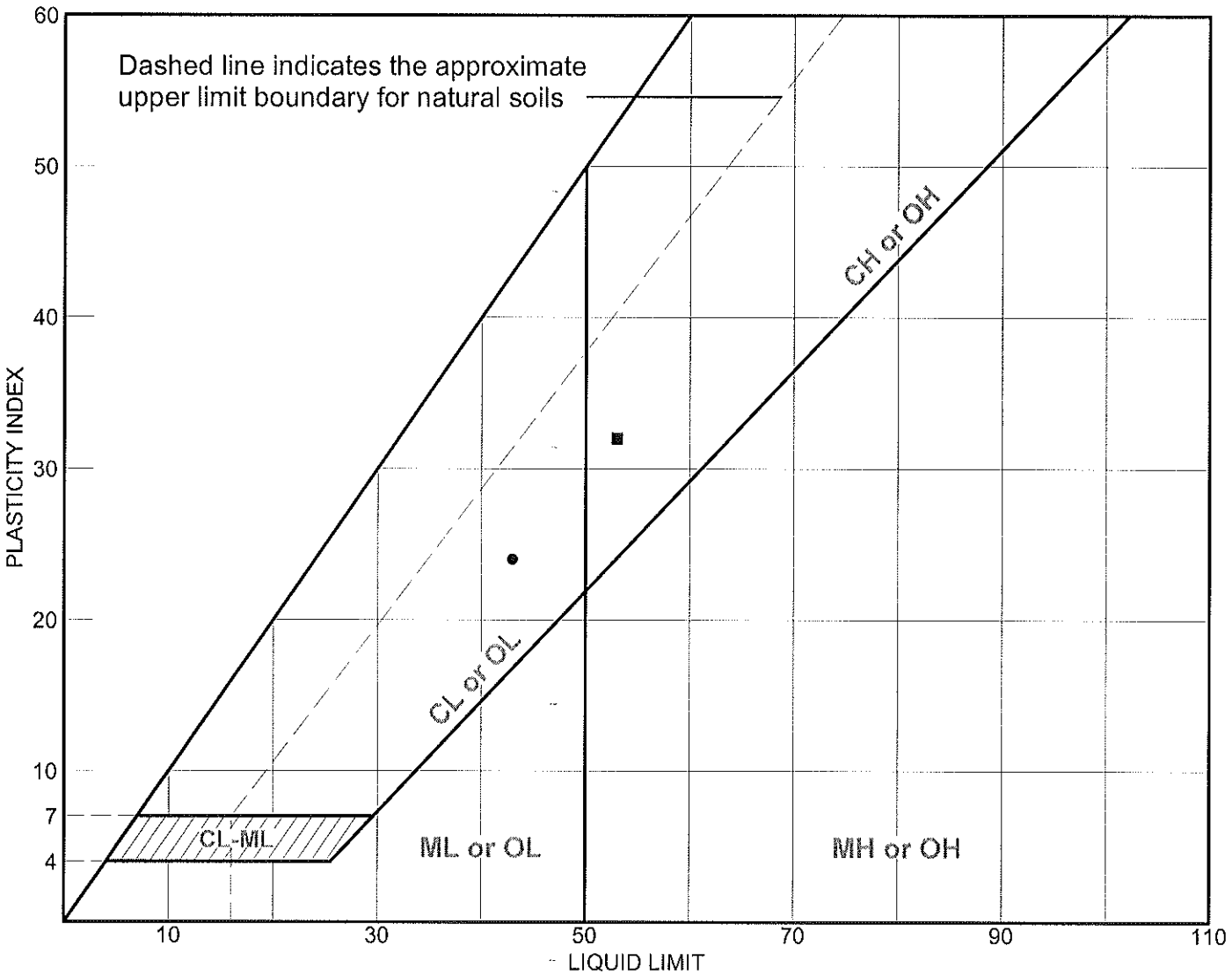


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-12	FS-1	0.5-2.0 Feet	10.4 %	21	55	34	CH
■	2F-11-12	FS-4	6.5-8.0 Feet	15.2 %	23	53	30	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

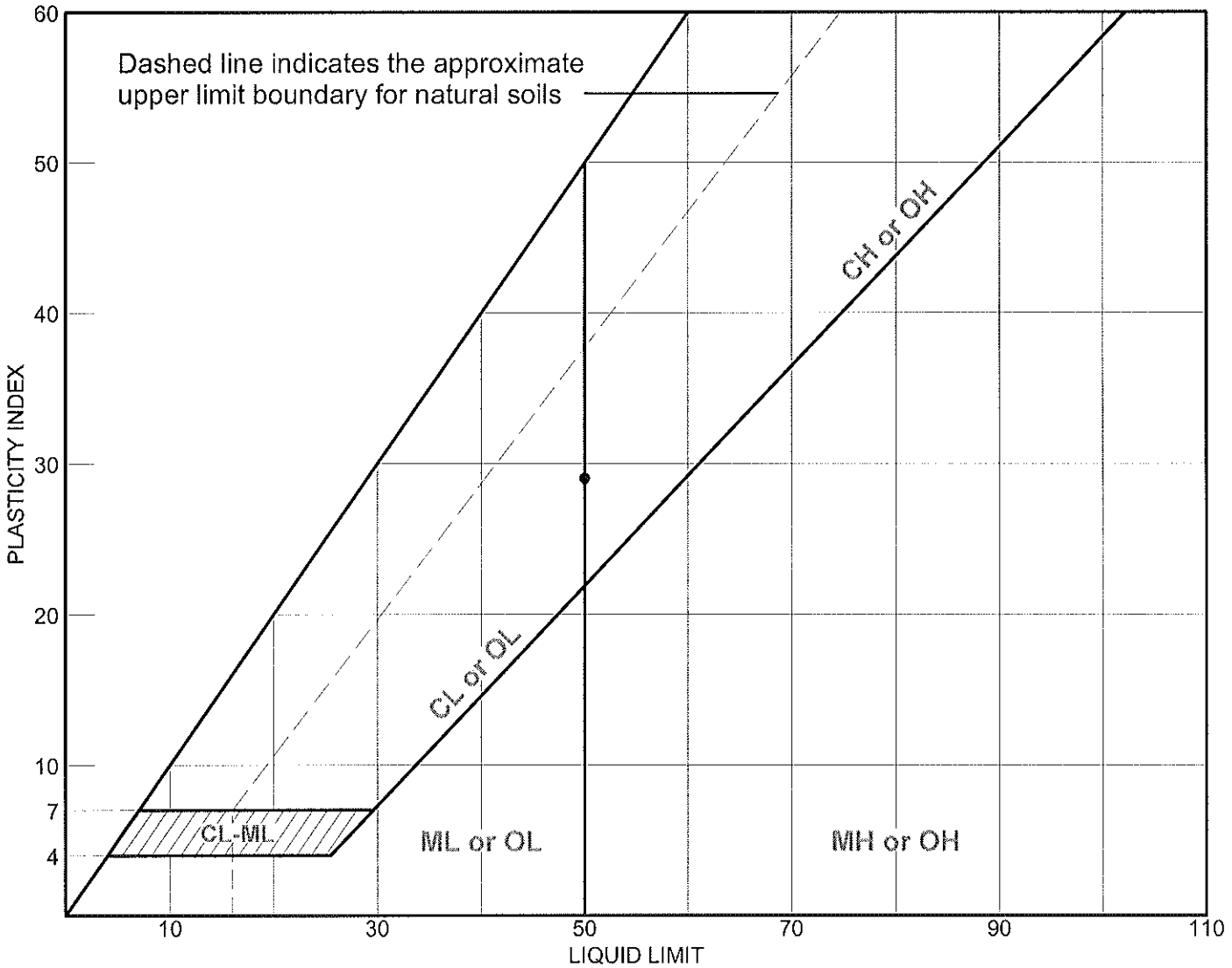


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-13	FS-1	0.5-2.0 Feet	NA	19	43	24	SC
■	2F-11-13	FS-5	10.5-12.0 Feet	9.7 %	21	53	32	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

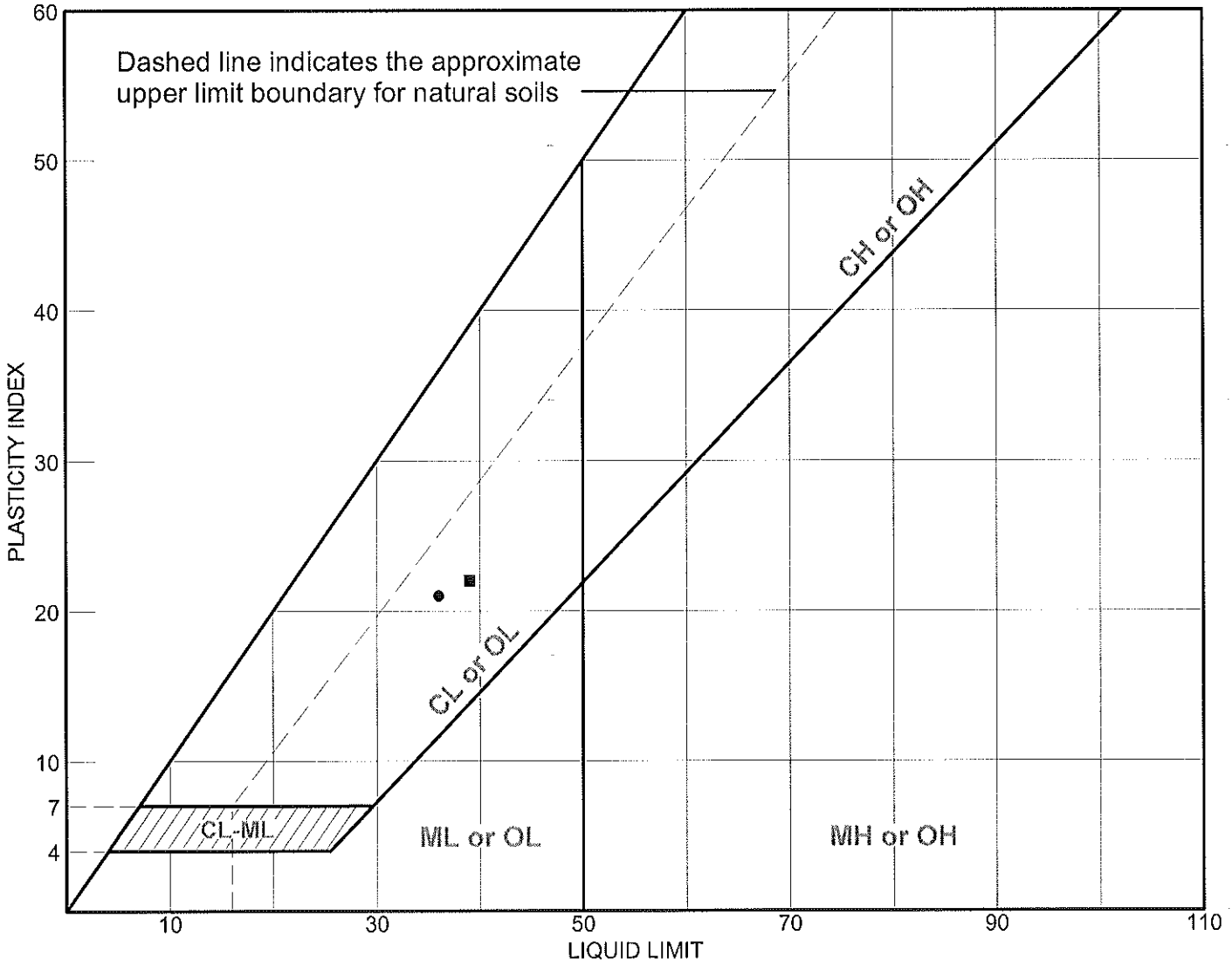


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-14	FS-2	2.5-4.0 Feet	8.9 %	21	50	29	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

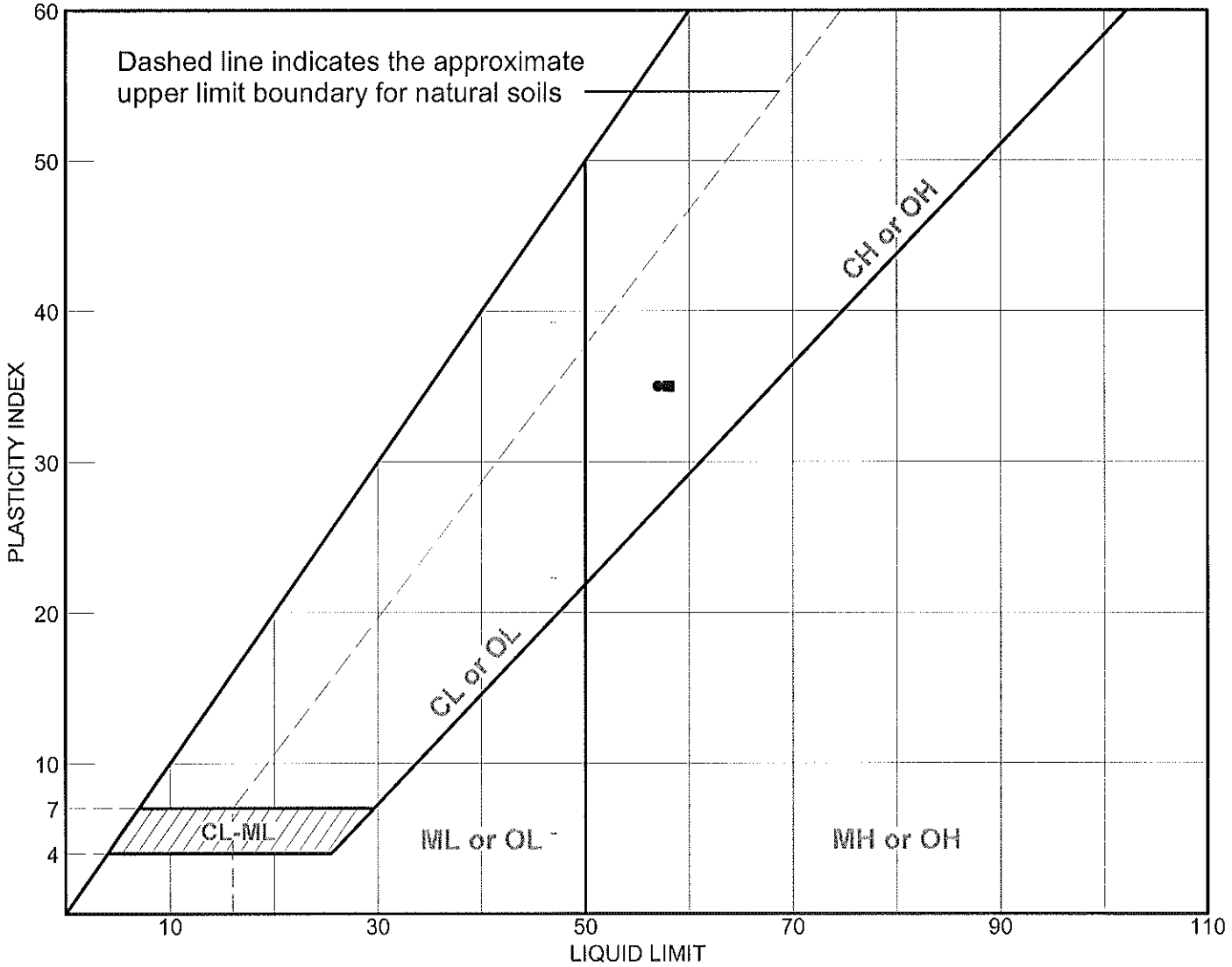


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-15	FS-3	2.5-4 Feet	9.5%	15	36	21	CL
■	2F-11-15	FS-18	41.5-43 Feet	18.8%	17	39	22	CL

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

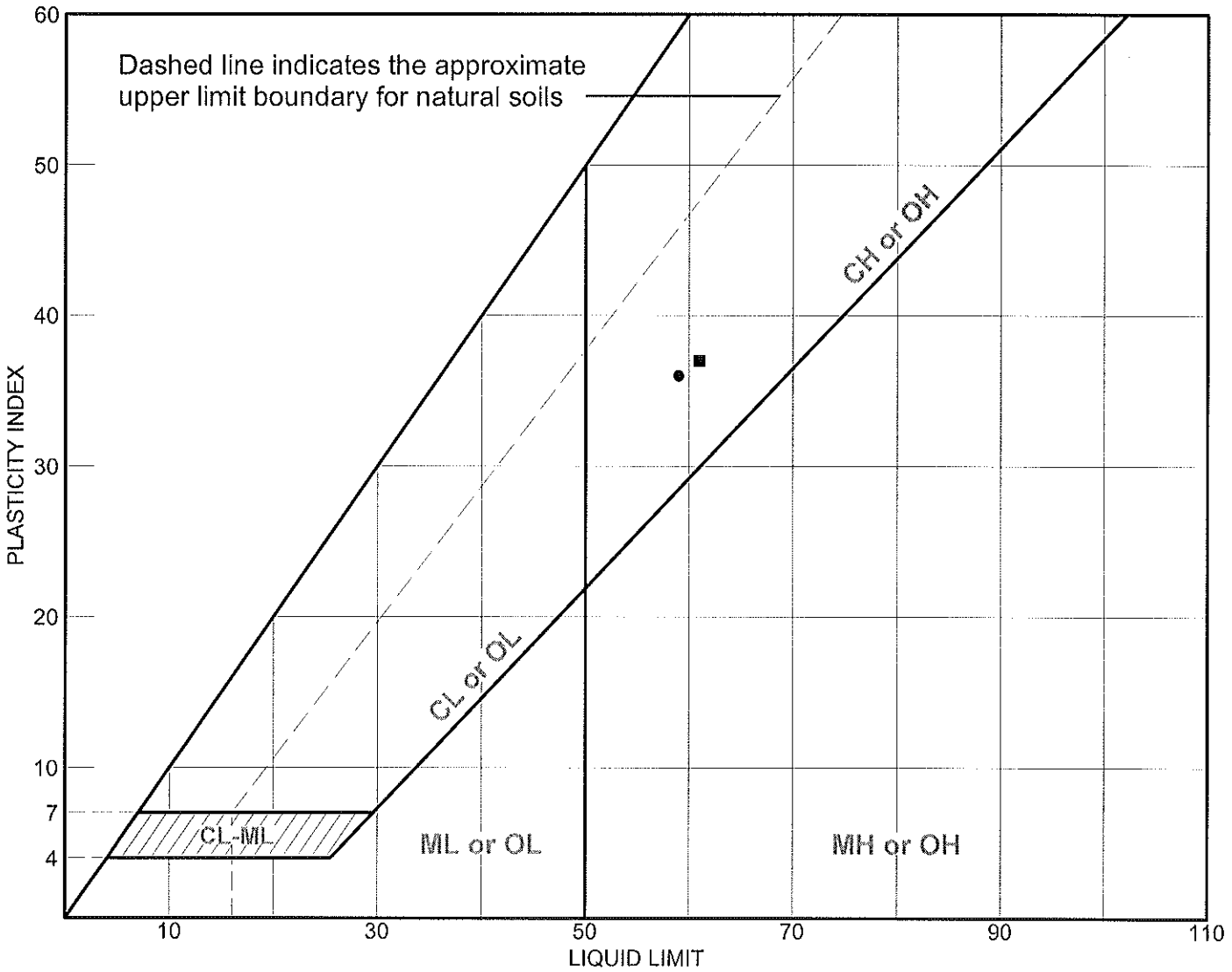
LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-16	FS-2	2.5-4.0 Feet	11.4 %	22	57	35	CH
■	2F-11-16	FS-4	6.5-7.5 Feet	10.9 %	23	58	35	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

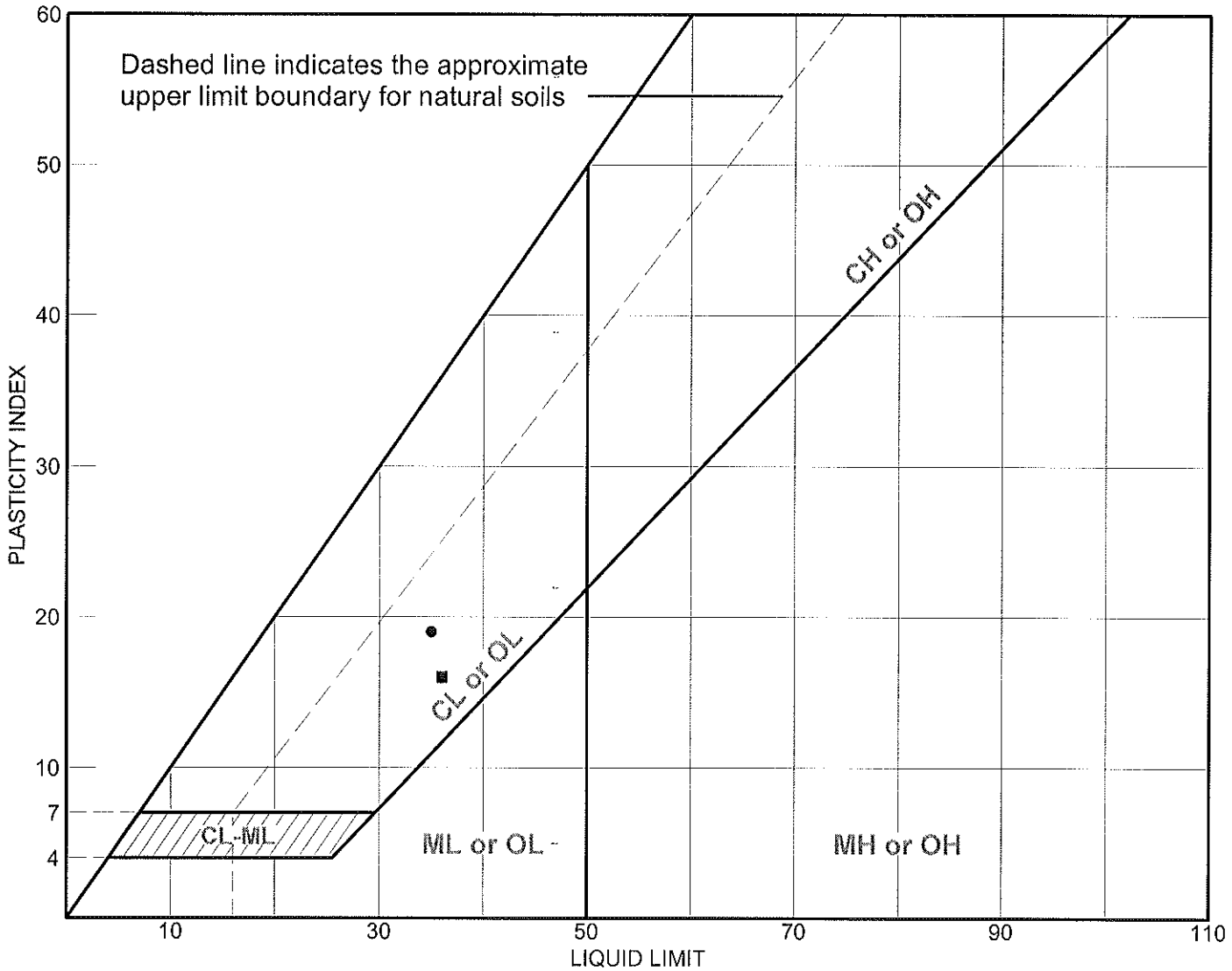
LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-17	FS-2	2.5-4.0 Feet	8.1 %	23	59	36	CH
■	2F-11-17	FS-3	4.5-6.0 Feet	8.2 %	24	61	37	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

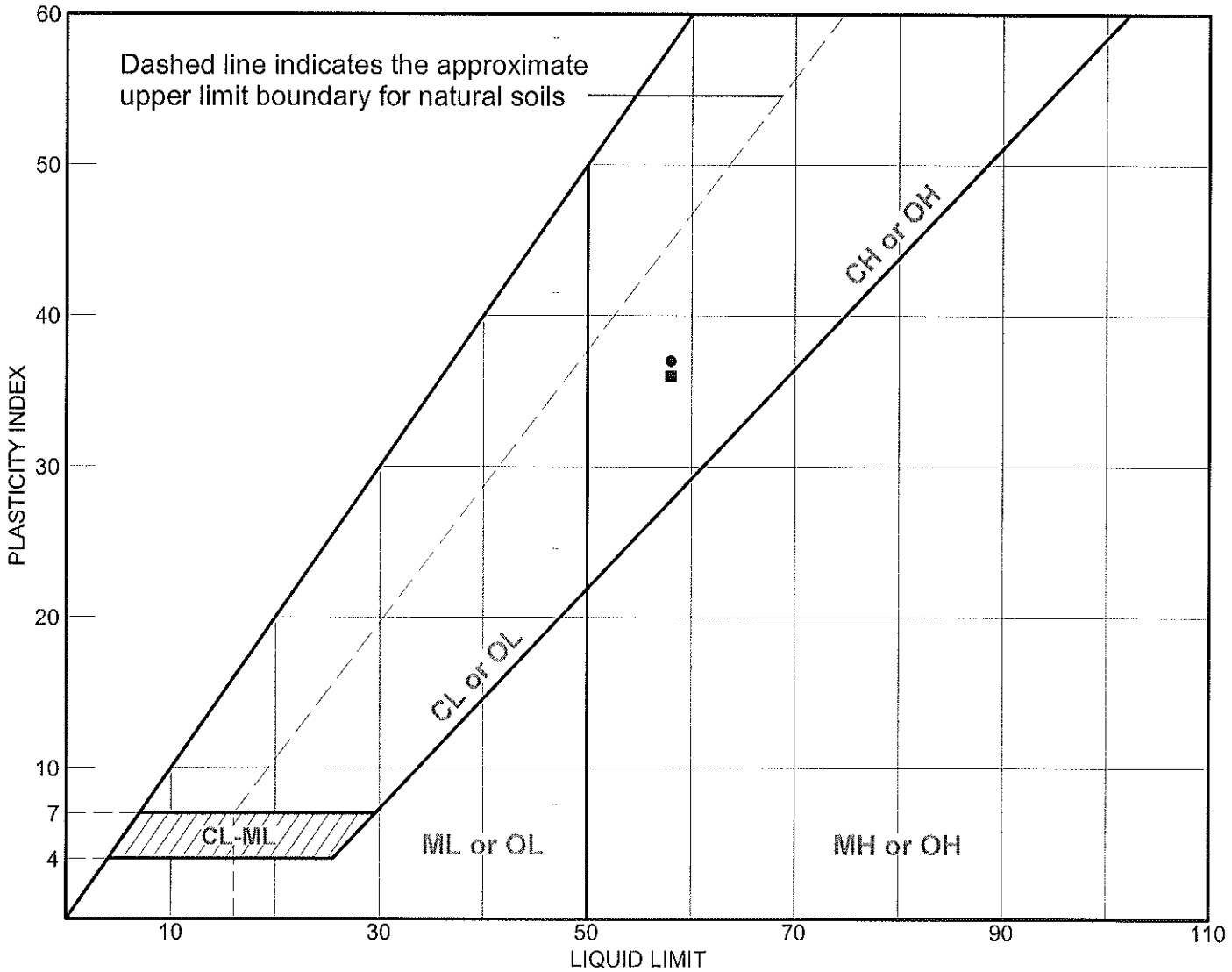


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-19	FS-5	8.5-10 Feet	16.1%	16	35	19	CL
■	2F-11-19	FS-7	12.5-14 Feet	21.1%	20	36	16	CL
▲	2F-11-19	FS-21	44.5-46 Feet	NA	NP	NV	NP	SM

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

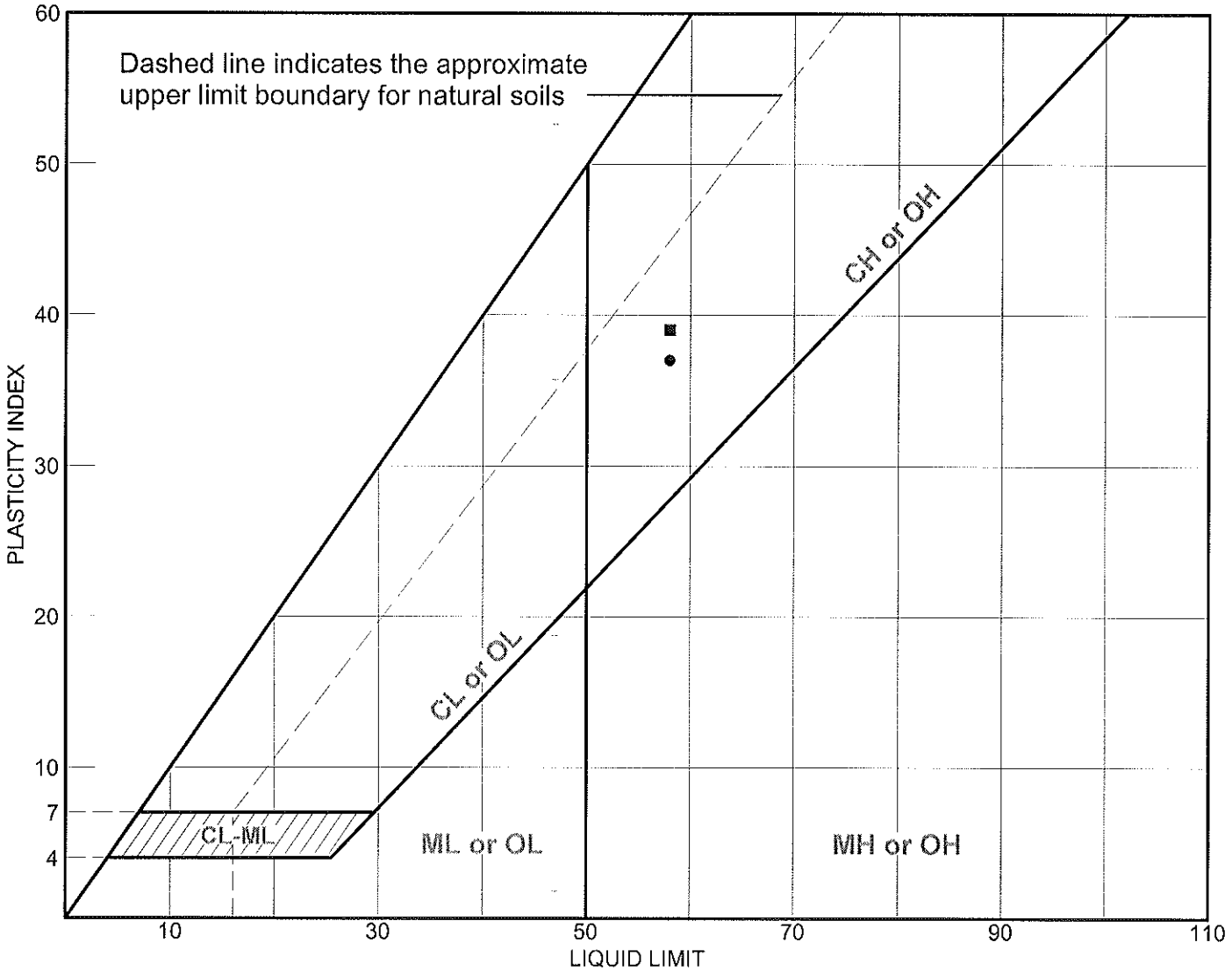


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-20	FS-3	4.5-6.0 Feet	12.7 %	21	58	37	CH
■	2F-11-20	FS-7	12.5-14.0 Feet	22.9 %	22	58	36	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

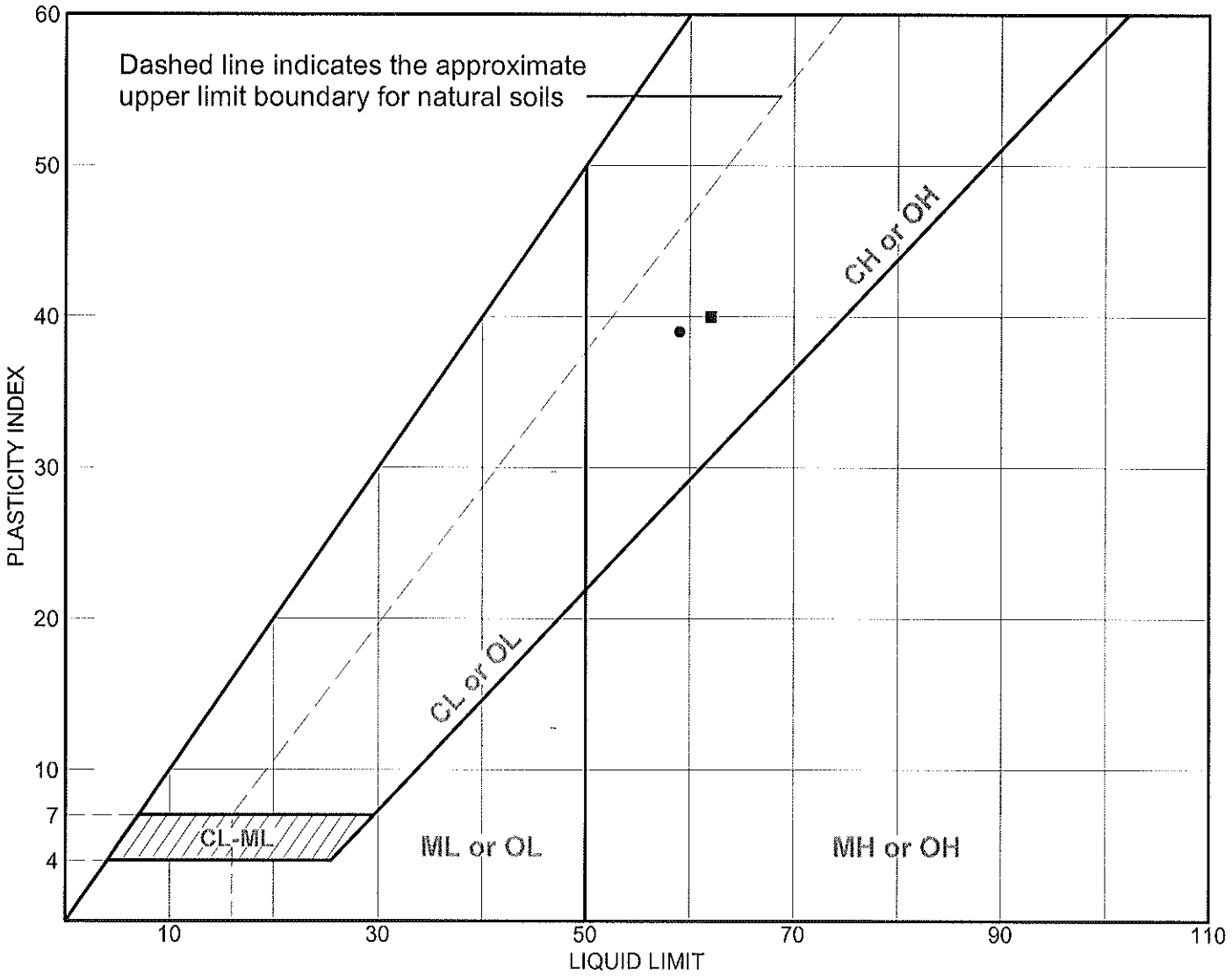


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-21	FS-2	2.5-4.0 Feet	13.0 %	21	58	37	CH
■	2F-11-21	FS-6	10.5-12.0 Feet	13.9 %	19	58	39	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

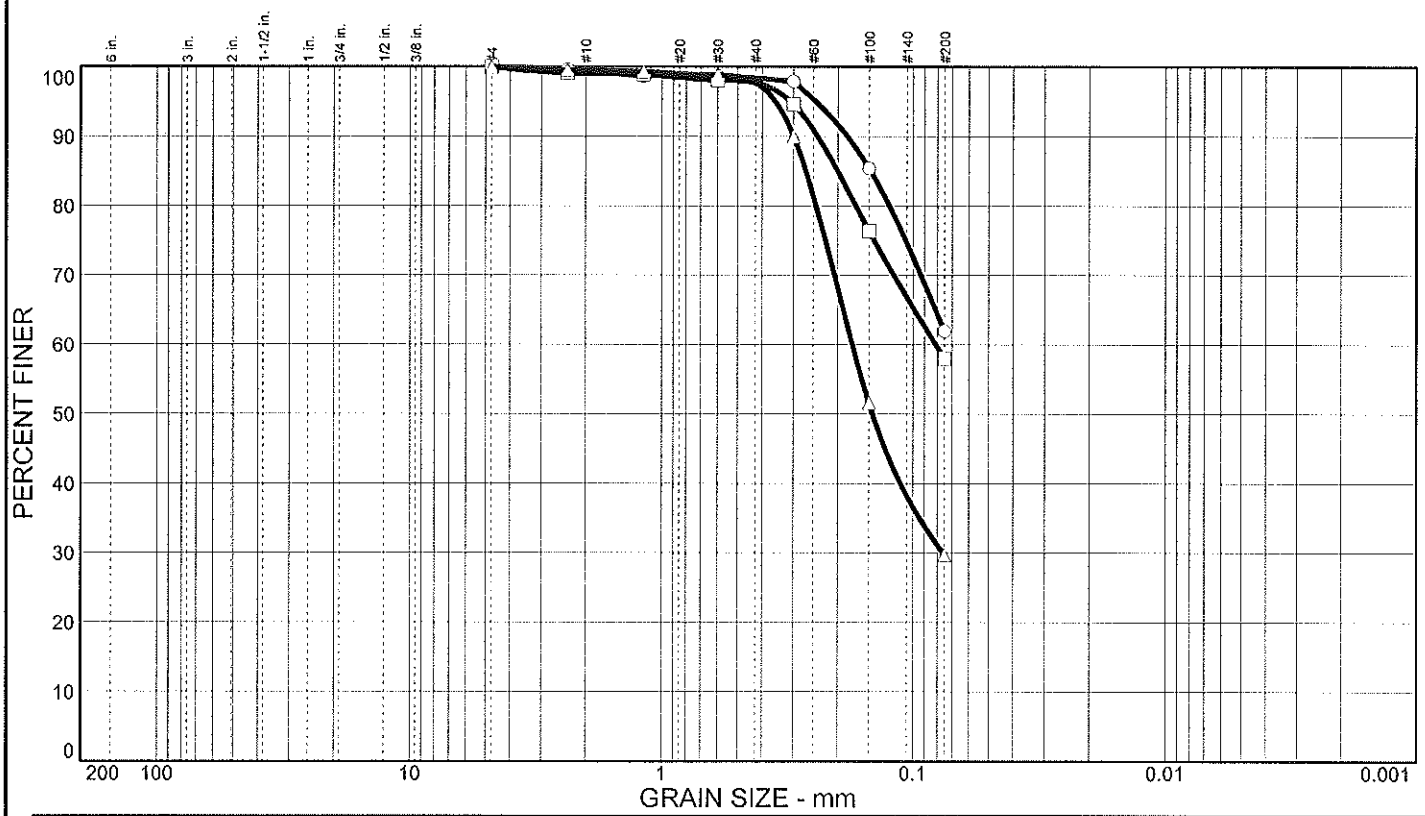


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	2F-11-22	FS-2	2.5-4.0 Feet	13.2 %	20	59	39	CH
■	2F-11-22	FS-10	18.5-20.0 Feet	16.9 %	22	62	40	CH

LIQUID AND PLASTIC LIMITS TEST REPORT **Moore Twining Associates, Inc.** **Fresno, CA**	**Client:** City of Newman Public Works **Project:** Orestimba Feasibility Study - Flood Control Project Drilling **Project No.:** C36002.01 **Figure**

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.6	1.0	36.5	61.9	
□	0.0	0.0	0.0	1.0	1.3	39.7	58.0	
△	0.0	0.0	0.0	0.5	1.7	68.1	29.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	61	22	0.148							
□	58	19	0.200	0.0812						
△			0.268	0.175	0.145	0.0760				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy fat clay	CH	
□ Sandy fat clay	CH	
△ Clayey sand	SC	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-02, FS-3 @ 4.5-6.0 Feet

□ **Location:** Boring Number: 2F-11-02, FS-8 @ 14.5-16.0 Feet

△ **Location:** Boring Number: 2F-11-02, FS-11 @ 20.5-22 Feet

Remarks:

○F.M.=0.20

□F.M.=0.33

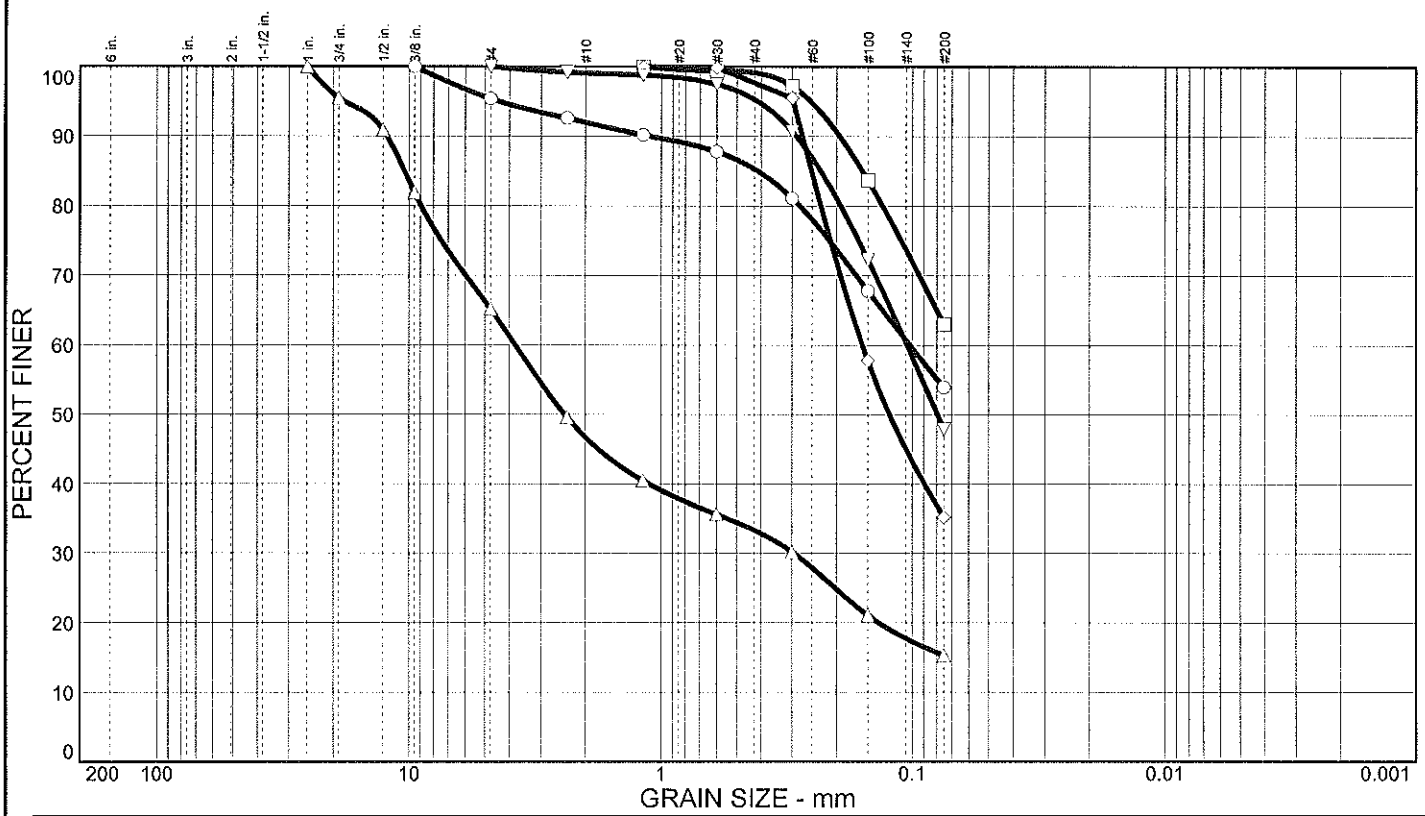
△F.M.=0.61

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	4.6	3.4	6.7	31.4	53.9	
□	0.0	0.0	0.0	0.0	0.8	36.2	63.0	
△	0.0	4.5	30.3	18.4	13.4	18.1	15.3	
◇	0.0	0.0	0.0	0.0	2.3	62.5	35.2	
▽	0.0	0.0	0.0	0.9	3.8	47.4	47.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	37	17	0.411	0.102						
□	28	13	0.158							
△			10.4	3.78	2.41	0.295				
◇	NV	NP	0.251	0.158	0.123					
▽	24	17	0.231	0.105	0.0794					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy lean clay	CL	
□ Sandy lean clay	CL	
△ Silty sand with gravel	SM	
◇ Silty sand	SM	
▽ Silty, clayey sand	SC-SM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-03, FS-1 @ 0.5-2.0 Feet

□ **Location:** Boring Number: 2F-11-03, FS-6 @ 10.5-12.0 Feet

△ **Location:** Boring Number: 2F-11-03, FS-9 @ 14.5-16.0 Feet

◇ **Location:** Boring Number: 2F-11-03, FS-11 @ 18.5-20.0 Feet

▽ **Location:** Boring Number: 2F-11-03, FS-17 @ 35.5-37.0 Feet

Remarks:

○ F.M.=0.85

□ F.M.=0.20

△ F.M.=3.80

◇ F.M.=0.47

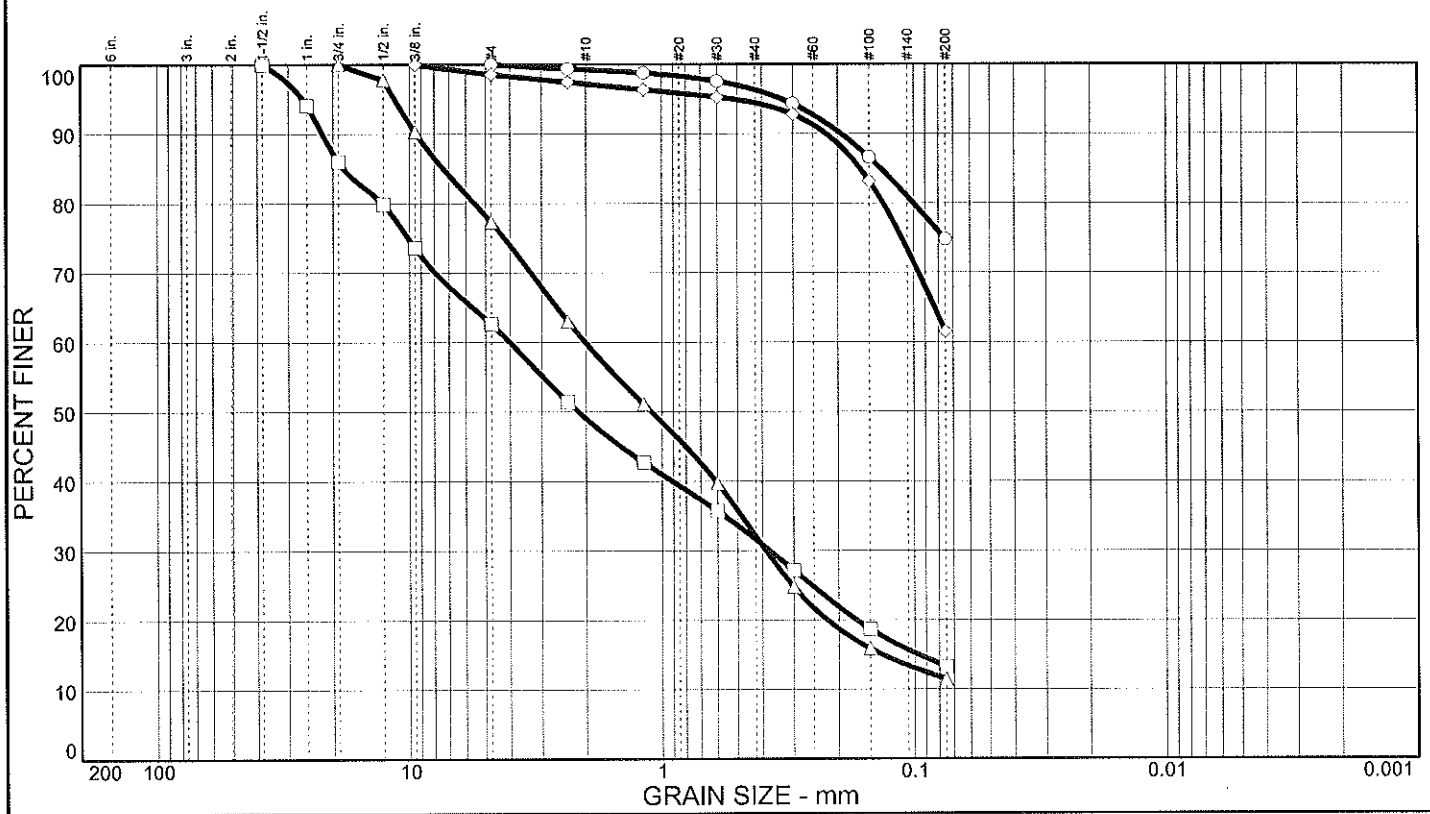
▽ F.M.=0.41

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.7	2.9	21.6	74.8	
□	0.0	14.0	23.4	13.6	17.4	18.3	13.3	
△	0.0	0.0	22.7	17.4	27.7	20.7	11.5	
◇	0.0	0.0	1.4	1.4	2.8	32.9	61.5	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	53	23	0.135							
□			18.2	4.01	2.15	0.373	0.0964			
△			7.37	2.01	1.10	0.386	0.134			
◇	42	19	0.163							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Fat clay with sand	CH	
□ Silty sand with gravel	SM	
△ Poorly graded sand with silt and gravel	SP-SM	
◇ Sandy lean clay	CL	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-04, FS-2 @ 2.5-4 Feet

□ **Location:** Boring Number: 2F-11-04, FS-5 @ 8.5-10 Feet

△ **Location:** Boring Number: 2F-11-04, FS-12 @ 23.5-25 Feet

◇ **Location:** Boring Number: 2F-11-04, FS-15 @ 32.5-34 Feet

Remarks:

○ F.M.=0.23

□ F.M.=4.02

△ F.M.=3.38

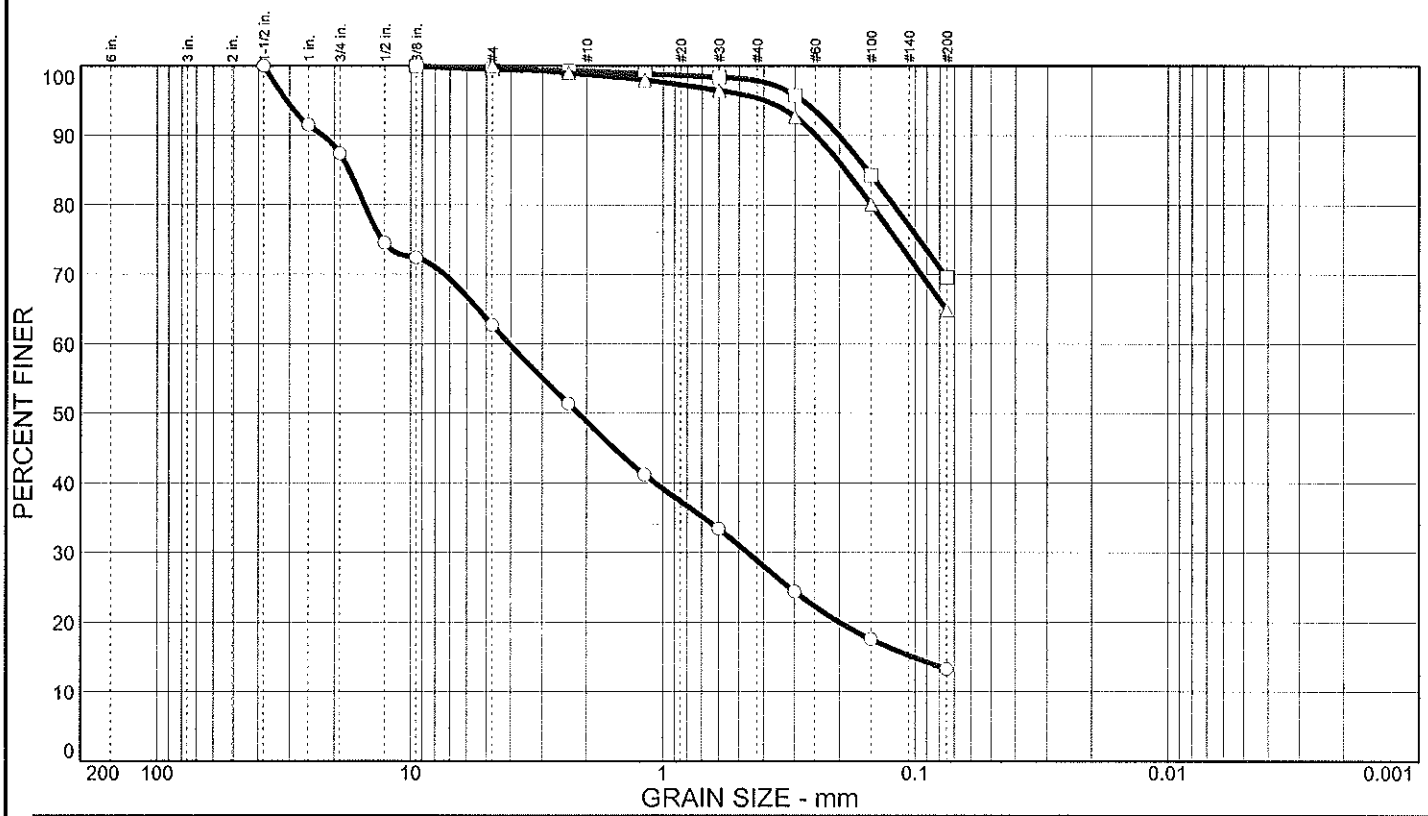
◇ F.M.=0.36

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	12.6	24.7	13.9	19.9	15.6	13.3	
□	0.0	0.0	0.5	0.3	1.3	28.3	69.6	
△	0.0	0.0	0.0	1.2	3.4	30.5	64.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			17.5	4.06	2.16	0.461	0.101			
□	50	19	0.155							
△	58	21	0.189							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand with gravel	SM	
□ Sandy fat clay	CH	
△ Sandy fat clay	CH	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-05, FS-5 @ 8.5-10 Feet

□ **Location:** Boring Number:2F-11-05, FS-8 @ 14.5-16 Feet

△ **Location:** Boring Number: 2F-11-05, FS-13 @ 26.5-28 Feet

Remarks:

○ F.M.=4.09

□ F.M.=0.24

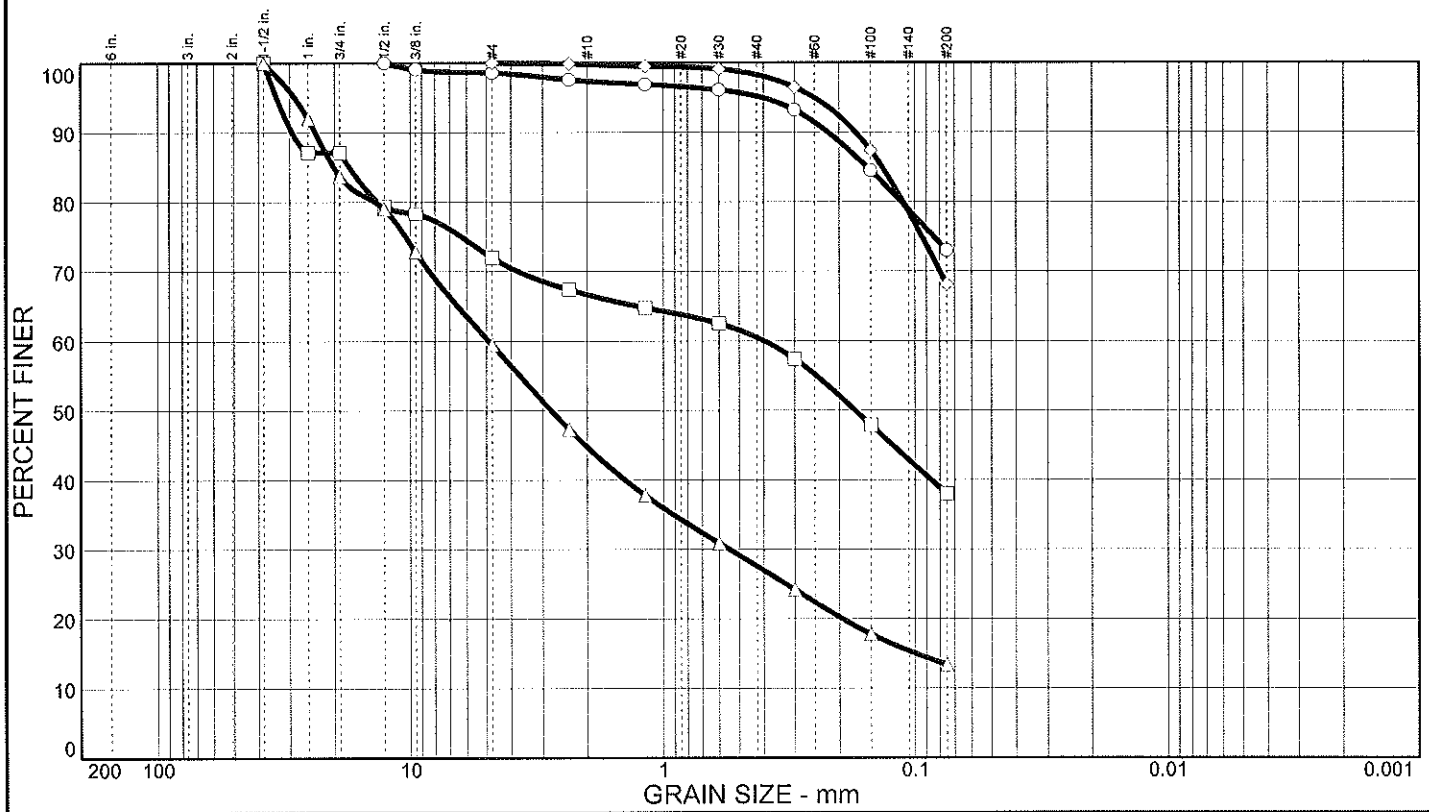
△ F.M.=0.34

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	1.4	1.2	2.2	22.2	73.0	
□	0.0	12.9	15.1	5.3	6.2	22.5	38.0	
△	0.0	16.3	24.2	14.8	17.1	14.2	13.4	
◇	0.0	0.0	0.0	0.2	1.5	30.2	68.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	60	23	0.155							
□			17.4	0.396	0.173					
△			20.1	4.89	2.78	0.546	0.0992			
◇	58	22	0.135							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Fat clay with sand	CH	
□ Clayey sand with gravel	SC	
△ Silty sand with gravel	SM	
◇ Sandy fat clay	CH	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-06, FS-2 @ 2.5-4 Feet

□ **Location:** Boring Number: 2F-11-06, FS-5 @ 8.5-10 Feet

△ **Location:** Boring Number: 2F-11-06, FS-9 @ 16.5-18 Feet

◇ **Location:** Boring Number: 2F-11-06, FS-11 @ 20.5-22 Feet

Remarks:

○ F.M.=0.34

□ F.M.=2.63

△ F.M.=4.26

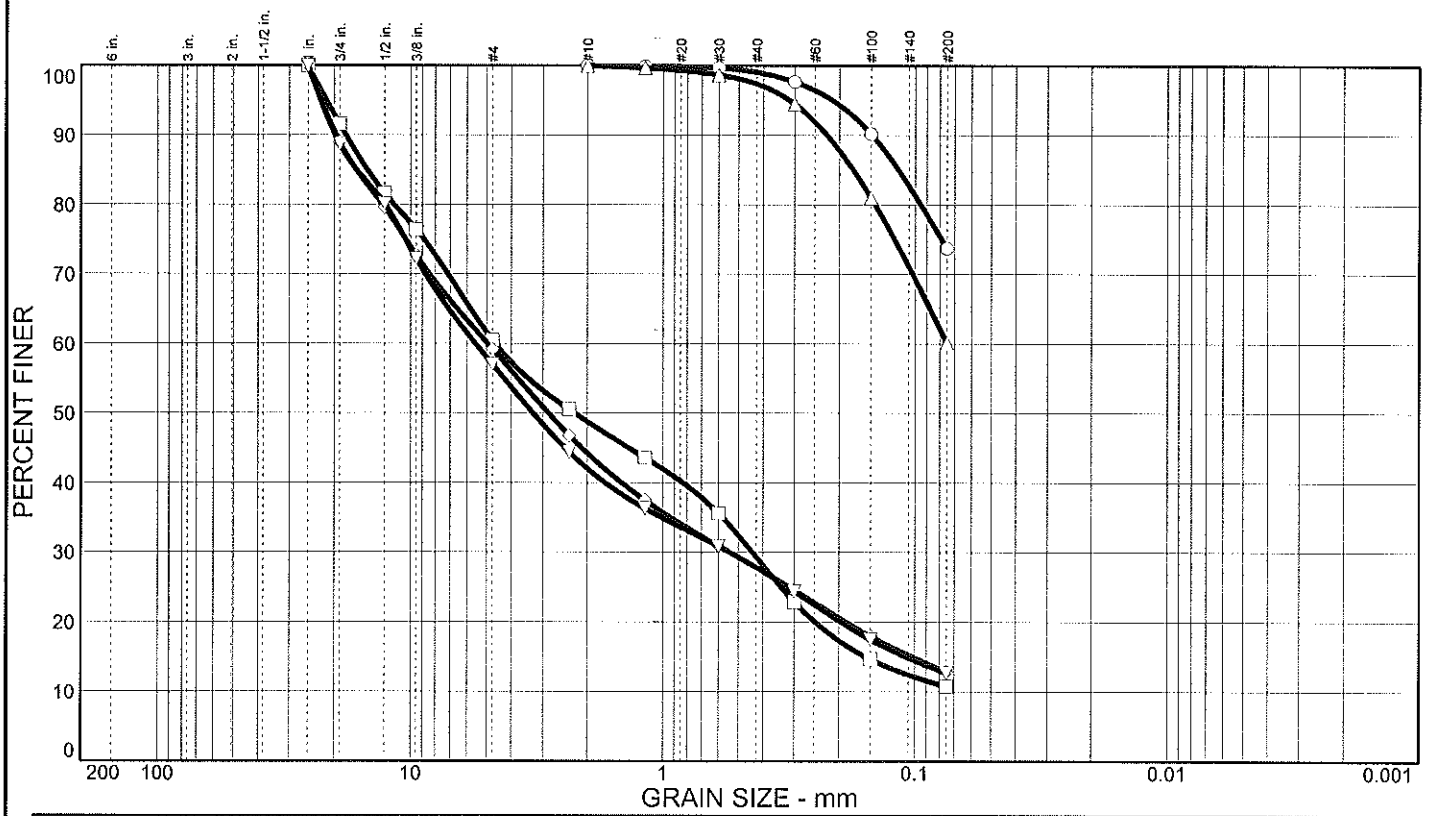
◇ F.M.=0.18

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.0	0.9	25.4	73.7	
□	0.0	8.4	31.1	11.7	19.4	18.6	10.8	
△	0.0	0.0	0.0	0.0	2.6	37.3	60.1	
◇	0.0	11.0	29.8	14.9	16.4	15.0	12.9	
▽	0.0	11.3	31.7	15.0	14.2	15.1	12.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	32	17	0.117							
□			14.8	4.63	2.25	0.440	0.156			
△	35	17	0.176							
◇			16.4	4.97	2.85	0.543	0.102			
▽			16.4	5.55	3.28	0.539	0.108			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Lean clay with sand	CL	
□ Poorly graded sand with silt and gravel	SP-SM	
△ Sandy lean clay	CL	
◇ Silty sand with gravel	SM	
▽ Silty sand with gravel	SM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-07, FS-6 @ 10.5-12 Feet

□ **Location:** Boring Number: 2F-11-07, FS-8 @ 14.5-16.0 Feet

△ **Location:** Boring Number: 2F-11-07, FS-13 @ 26.5-28.0 Feet

◇ **Location:** Boring Number: 2F-11-07, FS-19 @ 41.5-43 Feet

▽ **Location:** Boring Number: 2F-11-07, FS-21 @ 47.5-49 Feet

Remarks:

○F.M.=0.13

□F.M.=4.04

△F.M.=0.26

◇F.M.=4.21

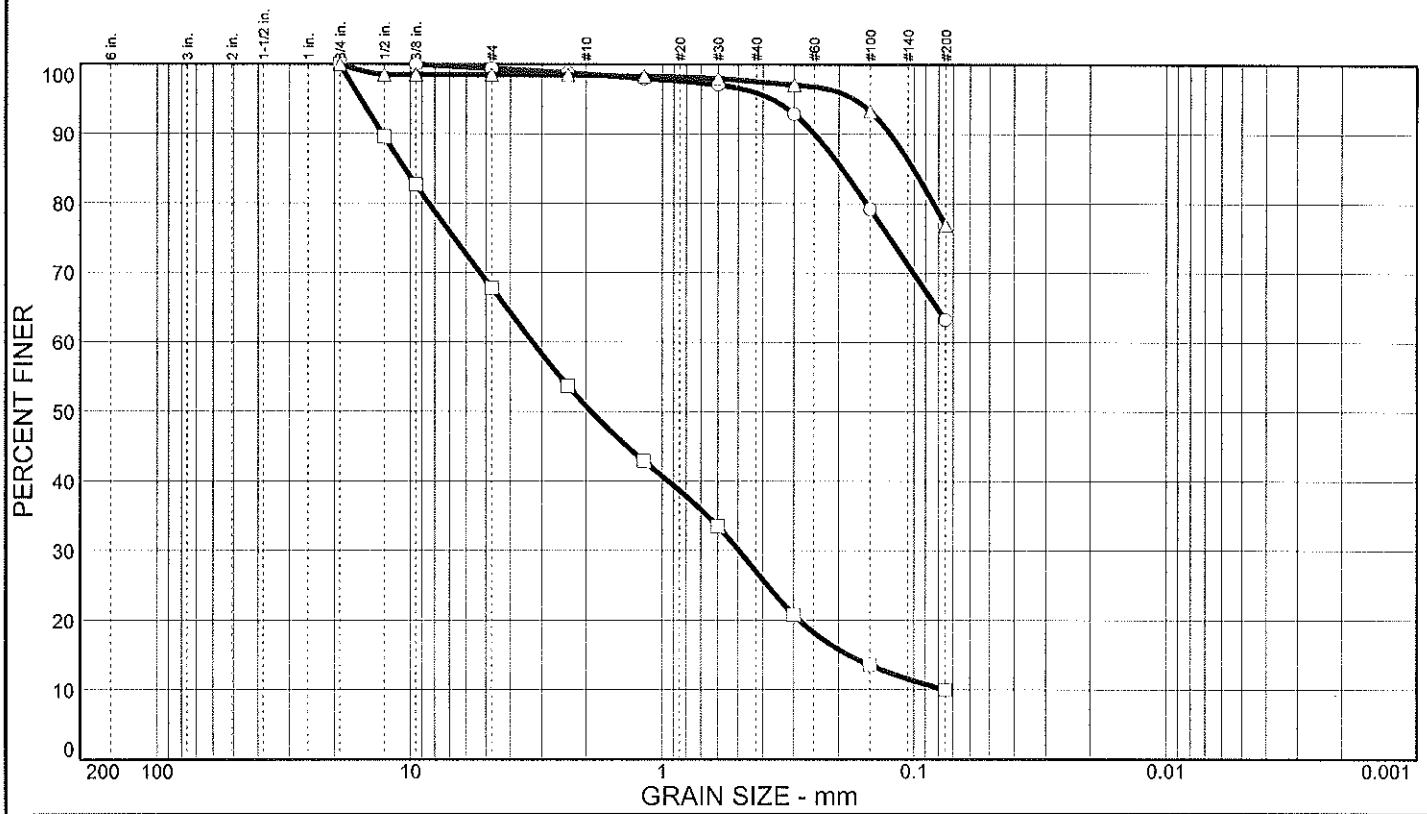
▽F.M.=4.29

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.6	0.8	2.6	32.8	63.2	
□	0.0	0.0	32.2	17.0	23.7	17.1	10.0	
△	0.0	0.0	1.5	0.1	0.9	20.6	76.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	51	21	0.194							
□			10.5	3.26	1.91	0.495	0.181	0.0750	1.00	43.52
△			0.101							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy fat clay	CH	
□ Well-graded sand with silt and gravel	SW-SM	
△ Silty clay with sand	CL-ML	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-08, FS-3 @ FS-3 @ 4.5-6 Feet

□ **Location:** Boring Number: 2F-11-08, FS-11 @ 18.5-20 Feet

△ **Location:** Boring Number: 2F-11-08, FS-17 @ 38.5-40 Feet

Remarks:

○F.M.=0.35

□F.M.=3.85

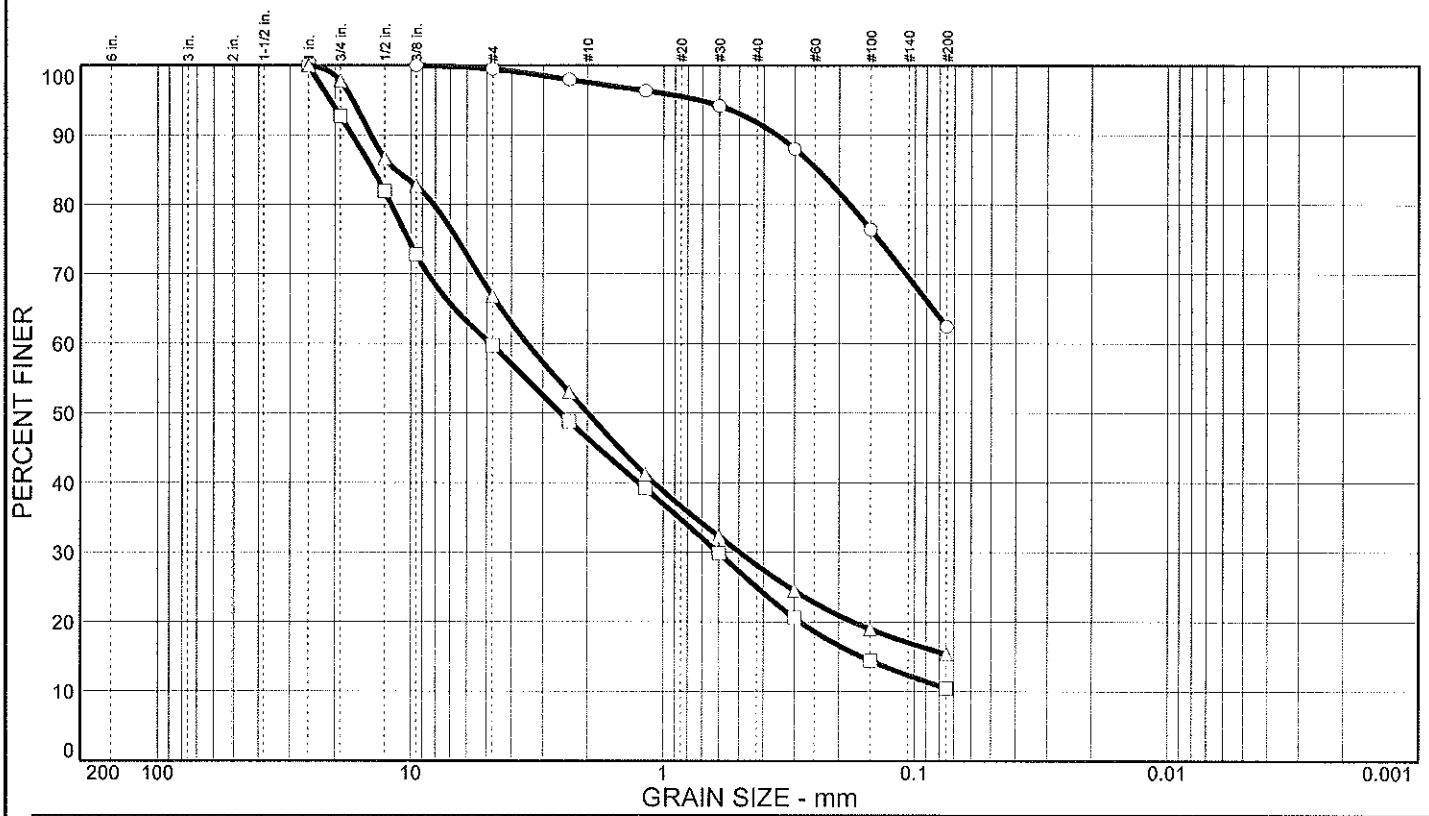
△F.M.=0.18

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.5	1.9	5.8	29.4	62.4	
□	0.0	7.3	33.0	13.3	21.3	14.6	10.5	
△	0.0	2.2	31.0	16.7	21.8	12.9	15.4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	50	21	0.244							
□			14.1	4.85	2.55	0.604	0.161			
△			11.5	3.46	1.99	0.495				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy fat clay	CH	
□ Poorly graded sand with silt and gravel	SP-SM	
△ Silty sand with gravel	SM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-09, FS-3 @ 4.5-6 Feet

□ **Location:** Boring Number: 2F-11-09, FS-8 @ 12.5-14 Feet

△ **Location:** Boring Number: 2F-11-09, FS-13 @ 26.5-28 Feet

Remarks:

○ F.M.=0.47

□ F.M.=4.22

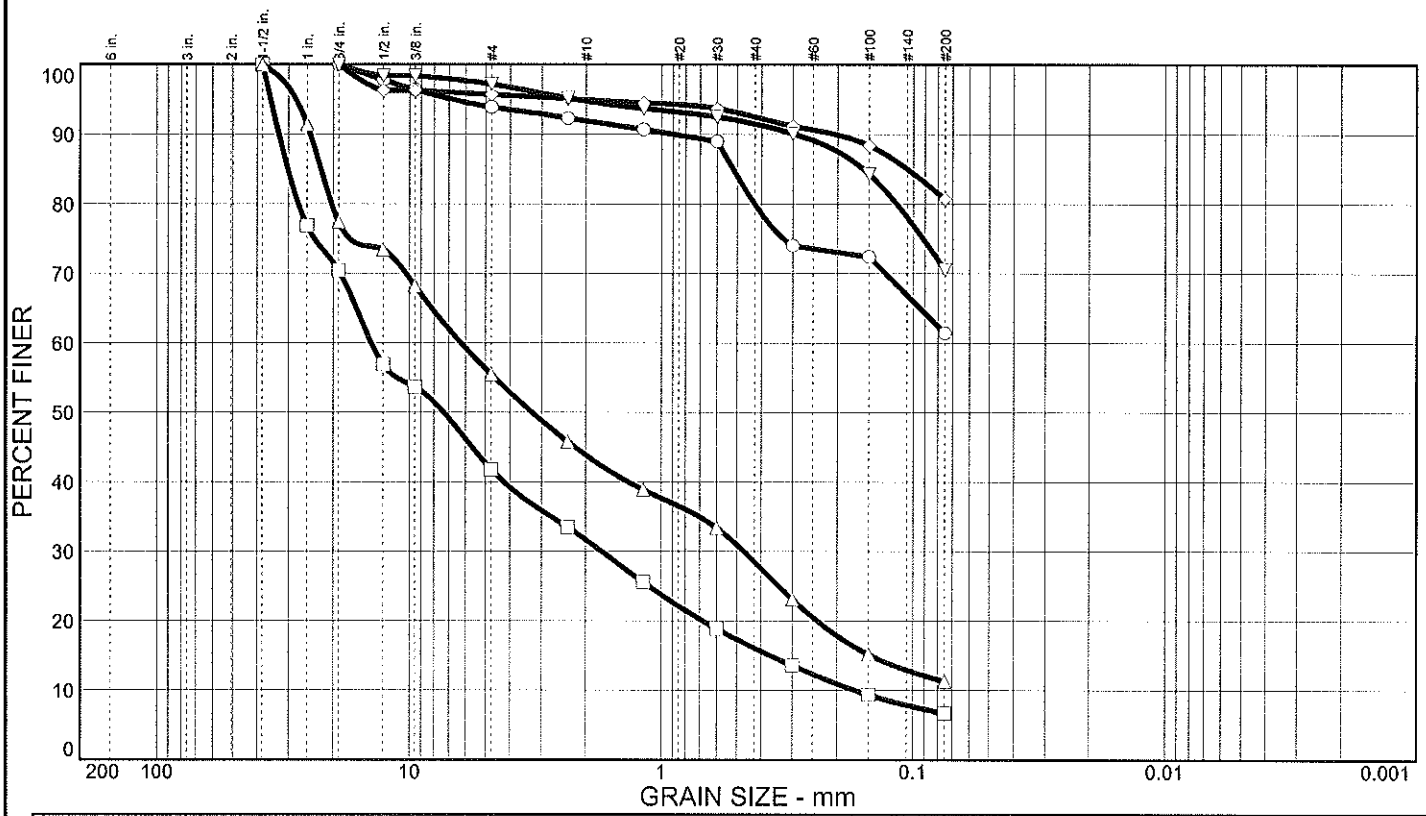
△ F.M.=3.83

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	6.1	2.0	12.0	18.5	61.4	
□	0.0	29.6	28.6	10.1	15.6	9.4	6.7	
△	0.0	22.6	21.9	11.6	15.3	17.3	11.3	
◇	0.0	0.0	4.3	0.8	2.4	11.8	80.7	
▽	0.0	0.0	2.8	2.4	3.3	21.0	70.5	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	50	19	0.518							
□			30.2	14.1	7.31	1.72	0.366	0.169	1.25	83.88
△			22.4	6.25	3.27	0.467	0.146			
◇	55	23	0.106							
▽	56	23	0.158							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy fat clay	CH	
□ Well-graded gravel with silt and sand	GW-GM	
△ Poorly graded gravel with silt and sand	GP-GM	
◇ Fat clay with sand	CH	
▽ Fat clay with sand	CH	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-10, FS-3 @ 4.5-6.0 Feet

□ **Location:** Boring 2F-11-10, FS-6 @ 8.5-10 Feet

△ **Location:** Boring Number: 2F-11-10, FS-10 @ 12.5-14.0 Feet

◇ **Location:** Boring Number: 2F-11-10, FS-13 @ 18.5-20.0 Feet

▽ **Location:** Boring Nummber: 2F-11-10, FS-16 @ 26.5-28.0 Feet

Remarks:

○F.M.=0.91

□F.M.=5.33

△F.M.=4.43

◇F.M.=0.45

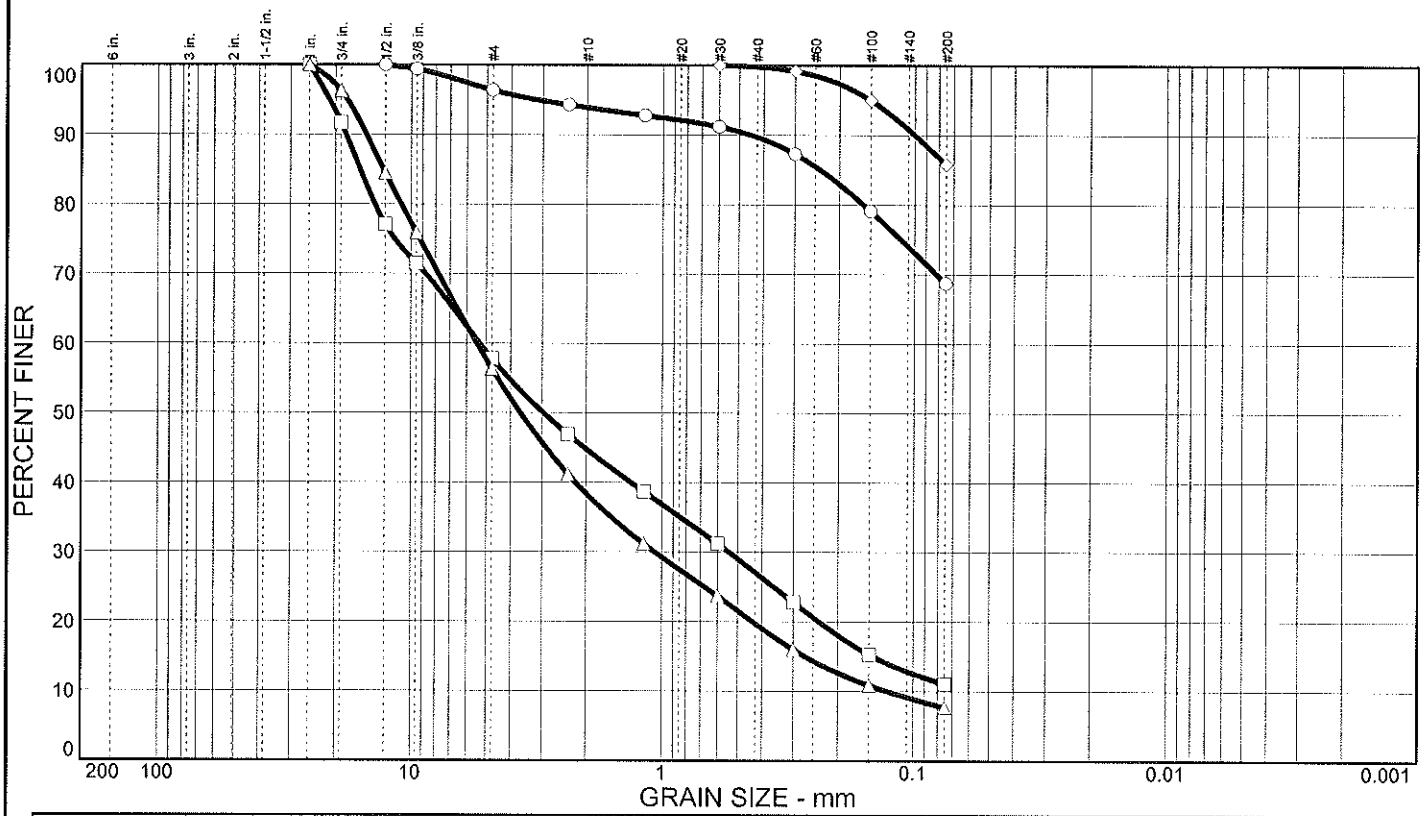
▽F.M.=0.49

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	3.6	2.5	4.2	21.0	68.7	
□	0.0	8.3	33.9	13.0	17.7	16.0	11.1	
△	0.0	3.7	40.0	17.9	18.7	12.0	7.7	
◇	0.0	0.0	0.0	0.0	0.2	14.0	85.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	51	21	0.238							
□			15.9	5.31	2.96	0.542	0.145			
△			12.9	5.46	3.66	1.06	0.269	0.126	1.64	43.29
◇	50	19								

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy fat clay	CH	
□ Poorly graded sand with silt and gravel	SP-SM	
△ Well-graded sand with silt and gravel	SW-SM	
◇ Fat clay	CH	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-11, FS-1 @ 0.5-2.0 Feet

□ **Location:** Boring Number: 2F-11-11, FS-3 @ 4.5-6.0 Feet

△ **Location:** Boring Number: 2F-11-11, FS-7 @ 10.5-12.0 Feet

◇ **Location:** Boring Number: 2F-11-11, FS-11 @ 18.5-20.0 Feet

Remarks:

○ F.M.=0.60

□ F.M.=4.24

△ F.M.=4.49

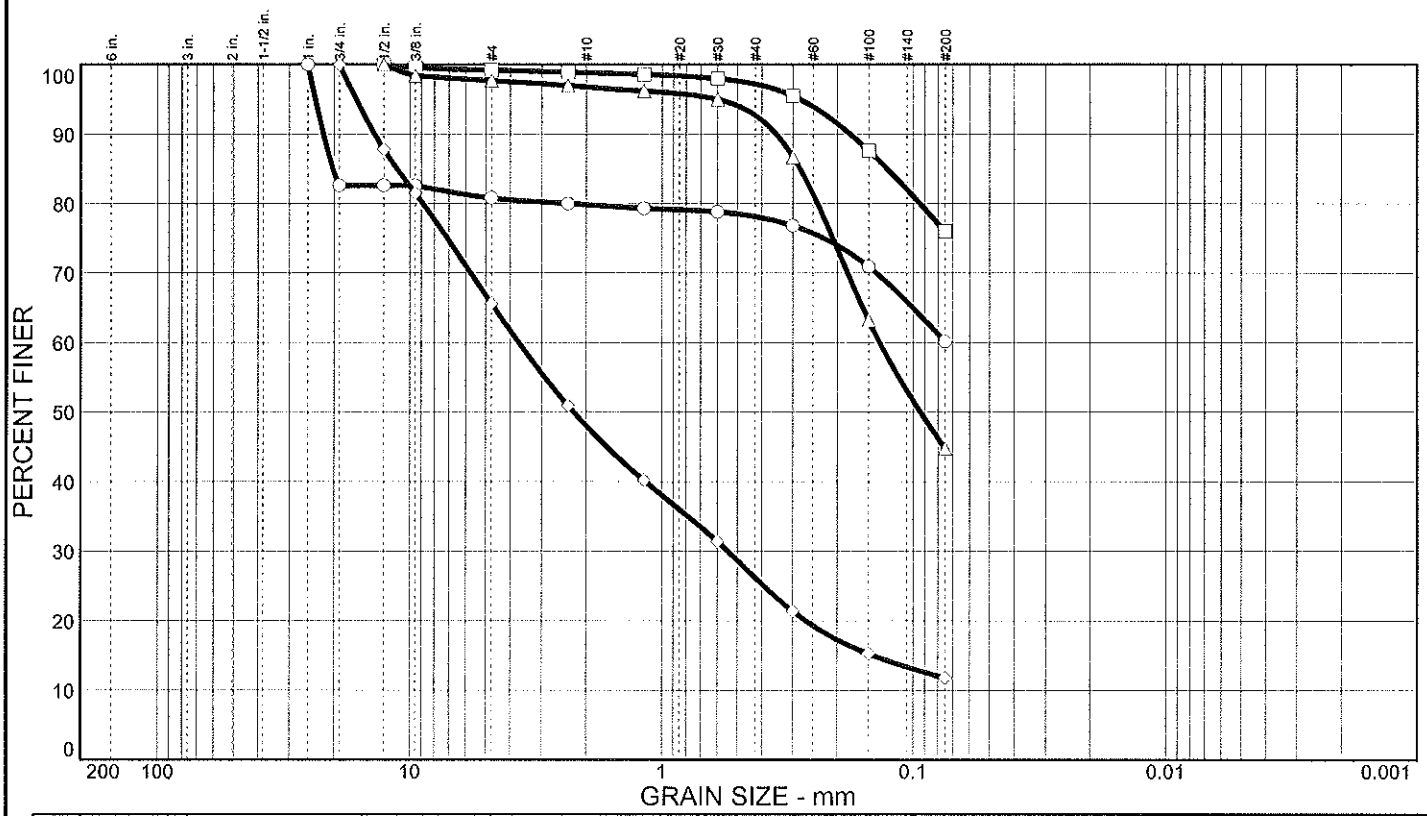
◇ F.M.=0.06

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	17.4	1.8	1.0	1.7	18.0	60.1	
□	0.0	0.0	0.8	0.4	1.6	21.2	76.0	
△	0.0	0.0	2.3	0.9	4.1	48.0	44.7	
◇	0.0	0.0	34.4	17.6	21.7	14.5	11.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	55	21	20.2							
□	53	23	0.127							
△			0.282	0.136	0.0938					
◇			11.3	3.70	2.24	0.545	0.143			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy fat clay with gravel	CH	
□ Fat clay with sand	CH	
△ Silty sand	SM	
◇ Poorly graded sand with silt and gravel	SP-SM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-12, FS-1 @ 0.5-2.0 Feet

□ **Location:** Boring Number: 2F-11-12, FS-4 @ 6.5-8.0 Feet

△ **Location:** Boring Number: 2F-11-12, FS-6 @ 10.5-12.0 Feet

◇ **Location:** Boring Number: 2F-11-12, FS-12 @ 20.5-22.0 Feet

Remarks:

○ F.M.=1.68

□ F.M.=0.23

△ F.M.=0.66

◇ F.M.=3.94

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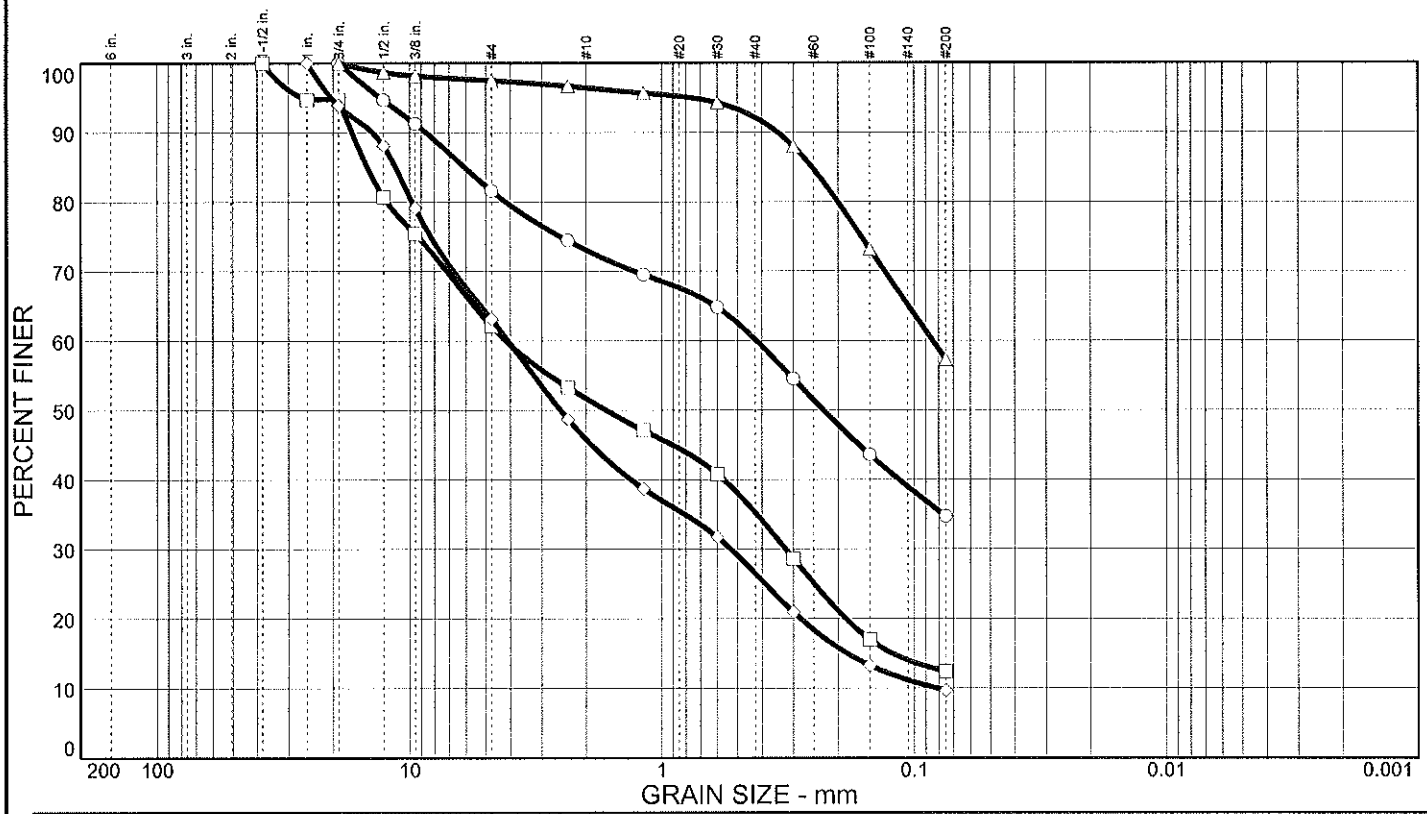
Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	18.4	8.5	12.9	25.5	34.7	
□	0.0	5.2	32.7	10.4	16.4	22.9	12.4	
△	0.0	0.0	2.5	1.0	4.3	34.9	57.3	
◇	0.0	6.1	30.8	17.3	19.3	16.8	9.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	43	19	6.07	0.420	0.228					
□			14.7	4.17	1.66	0.322	0.122			
△	53	21	0.254	0.0845						
◇			11.4	4.09	2.53	0.531	0.184	0.0807	0.86	50.64

MATERIAL DESCRIPTION	USCS	AASHTO
○ Clayey sand with gravel	SC	
□ Silty sand with gravel	SM	
△ Sandy fat clay	CH	
◇ Poorly graded sand with silt and gravel	SP-SM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-13, FS-1 @ 0.5-2.0 Feet

□ **Location:** Boring Number: 2F-11-13, FS-2 @ 2.5-4.0 Feet

△ **Location:** Boring Number: 2F-11-13, FS-5 @ 10.5-12.0 Feet

◇ **Location:** Boring Number: 2F-11-13, FS-8 @ 16.5-18.0 Feet

Remarks:

○F.M.=2.20

□F.M.=3.81

△F.M.=0.56

◇F.M.=4.11

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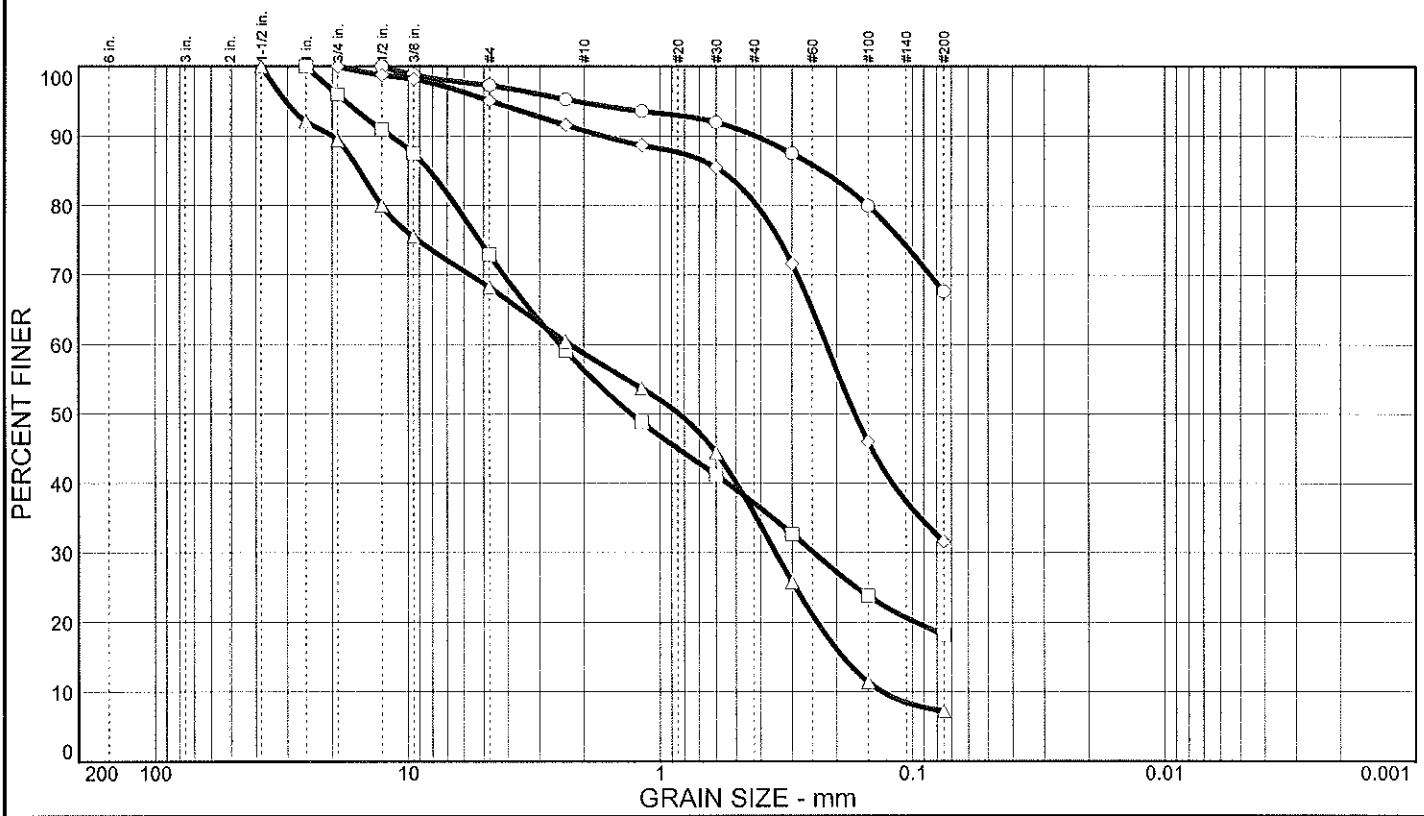
Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	2.7	2.5	4.7	22.5	67.6	
□	0.0	4.0	23.1	16.6	19.2	18.9	18.2	
△	0.0	10.6	21.2	9.5	23.0	28.5	7.2	
◇	0.0	0.0	4.9	4.3	10.2	49.0	31.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	50	21	0.227							
□			8.20	2.49	1.30	0.246				
△			15.5	2.27	0.840	0.348	0.189	0.132	0.41	17.22
◇			0.571	0.219	0.169					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy fat clay	CH	
□ Silty sand with gravel	SM	
△ Poorly graded sand with silt and gravel	SP-SM	
◇ Clayey sand	SC	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-14, FS-2 @ 2.5-4.0 Feet

□ **Location:** Boring Number: 2F-11-14, FS-7 @ 10.5-12.0 Feet

△ **Location:** Boring Number: 2F-11-14, FS-12 @ 20.5-22.0 Feet

◇ **Location:** Boring Number: 2F-11-14, FS-15 @ 29.5-31.0 Feet

Remarks:

○ F.M.=0.56

□ F.M.=3.38

△ F.M.=3.71

◇ F.M.=1.23

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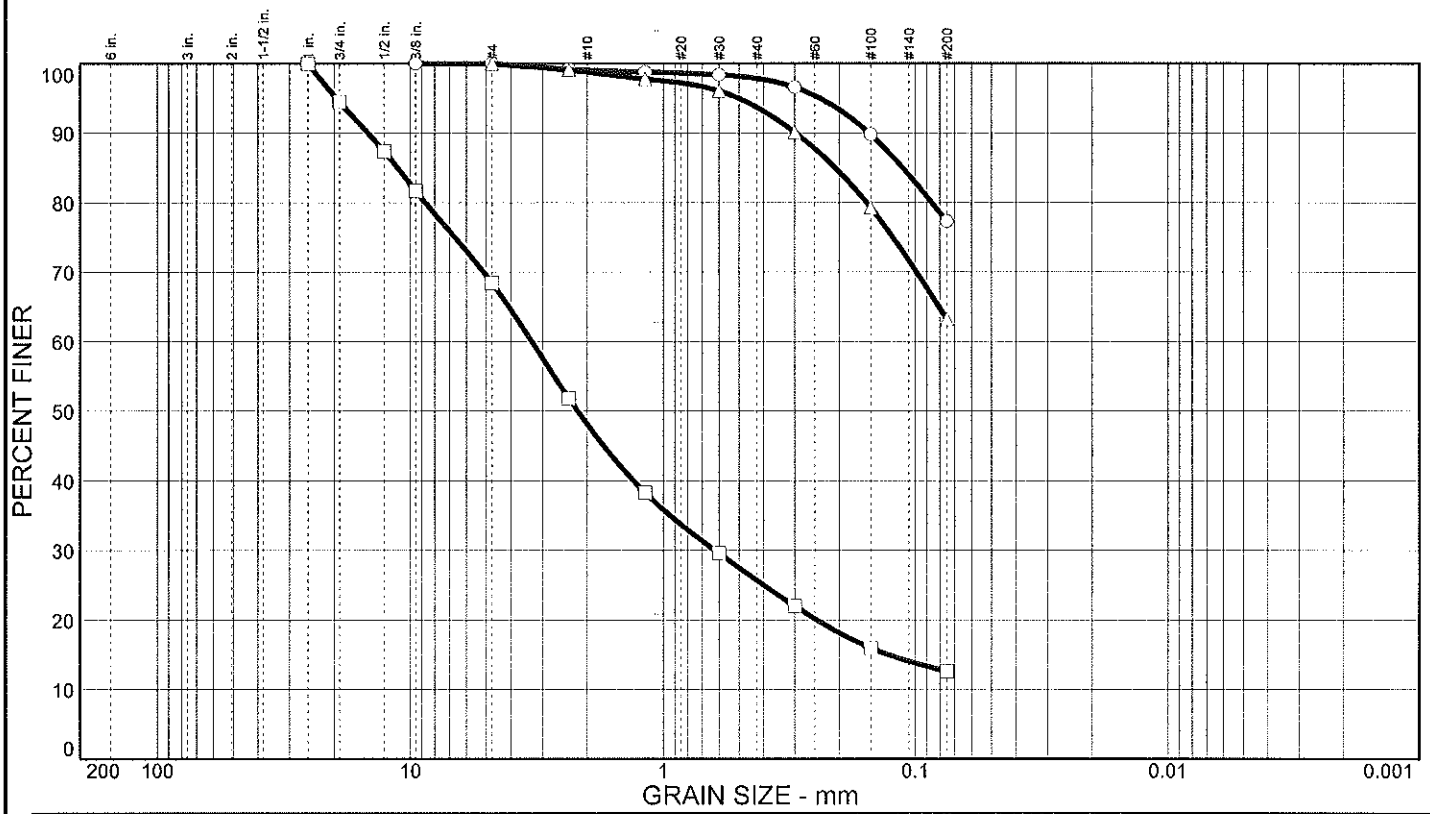
Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.9	1.2	20.6	77.3	
□	0.0	5.5	26.1	20.3	22.4	13.1	12.6	
△	0.0	0.0	0.0	1.2	5.1	30.5	63.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	36	15	0.112							
□			11.2	3.31	2.18	0.621	0.127			
△	39	17	0.207							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Lean clay with sand	CL	
□ Silty sand with gravel	SM	
△ Sandy lean clay	CL	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-15, FS-3 @ 2.5-4.0 Feet

□ **Location:** Boring Number: 2F-11-15, FS-7 @ 12.5-14 Feet

△ **Location:** Boring Number: 2F-11-15, FS-18 @ 41.5-43 Feet

Remarks:

○ F.M.=0.17

□ F.M.=3.98

△ F.M.=0.38

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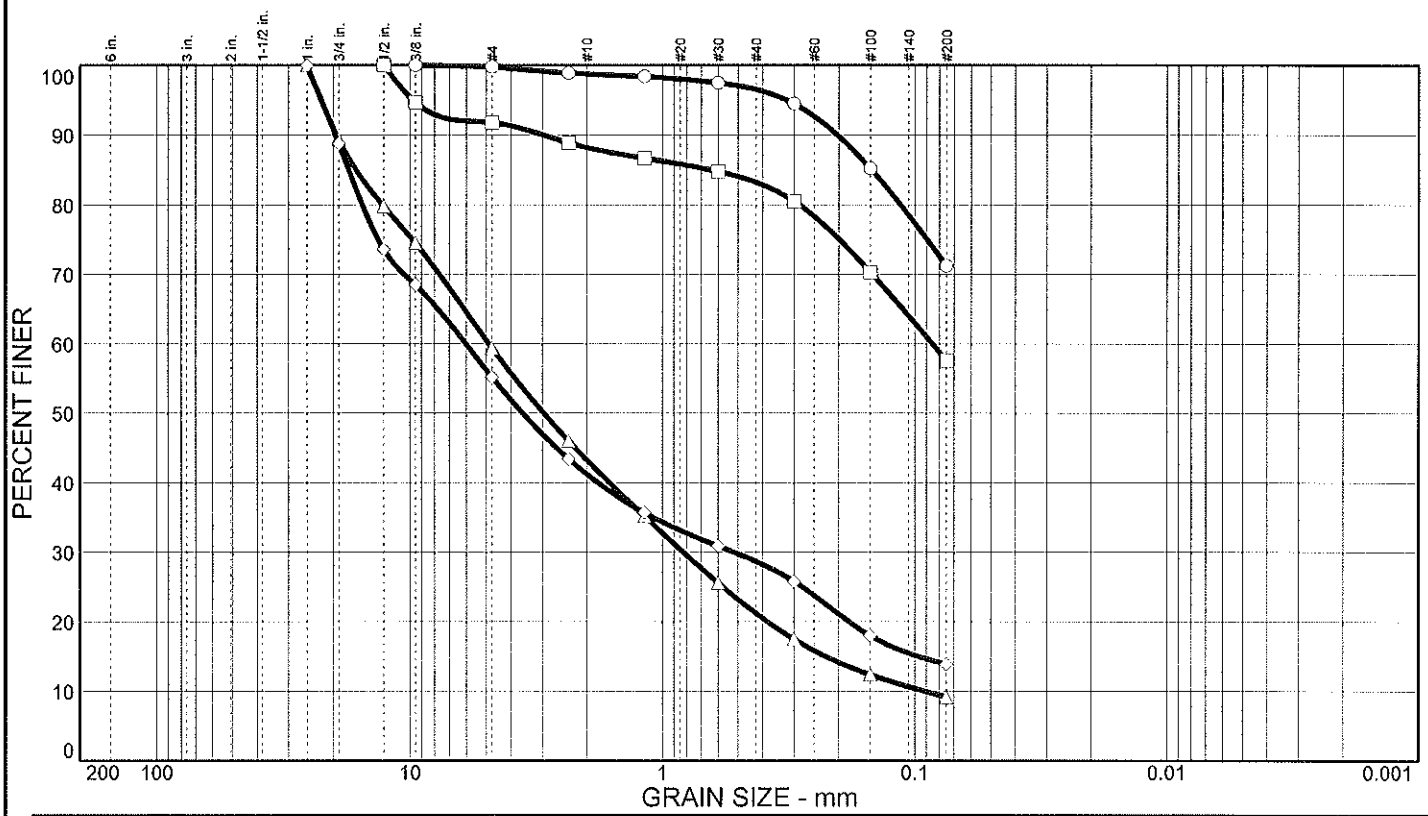
Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.2	1.0	2.2	25.4	71.2	
□	0.0	0.0	8.2	3.6	5.0	25.6	57.6	
△	0.0	10.6	30.0	16.1	22.0	12.1	9.2	
◇	0.0	11.2	33.6	14.0	12.5	14.8	13.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	57	22	0.148							
□	58	23	0.636	0.0853						
△			16.3	4.88	2.96	0.825	0.224	0.0908	1.54	53.78
◇			17.4	6.02	3.59	0.518	0.0961			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Fat clay with sand	CH	
□ Sandy fat clay	CH	
△ Well-graded sand with silt and gravel	SW-SM	
◇ Silty gravel with sand	GM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-16, FS-2 @ 2.5-4.0 Feet

□ **Location:** Boring Number: 2F-11-16, FS-4 @ 6.5-7.5 Feet

△ **Location:** Boring Number: 2F-11-16, FS-7 @ 10.5-12.0 Feet

◇ **Location:** Boring Number: 2F-11-16, FS-11 @ 18.5-20.0 Feet

Remarks:

○F.M.=0.26

□F.M.=1.02

△F.M.=4.40

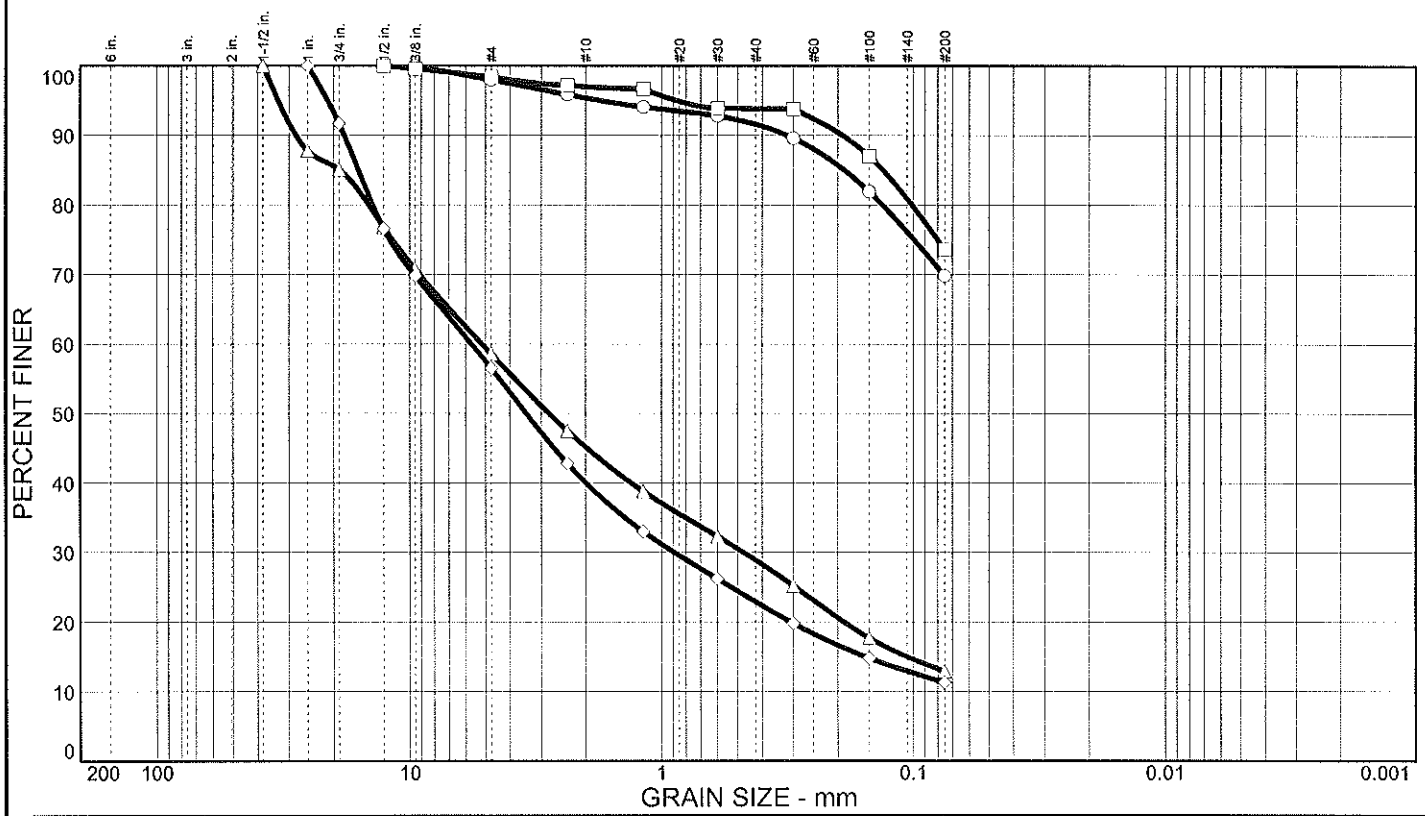
◇F.M.=4.34

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	2.0	2.6	3.8	21.8	69.8	
□	0.0	0.0	1.6	1.4	3.2	20.2	73.6	
△	0.0	14.9	26.5	13.4	16.3	16.0	12.9	
◇	0.0	8.3	35.2	16.4	17.1	11.7	11.3	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	59	23	0.188							
□	61	24	0.132							
△			18.9	5.17	2.79	0.473	0.106			
◇			16.0	5.69	3.44	0.890	0.155			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy fat clay	CH	
□ Fat clay with sand	CH	
△ Silty sand with gravel	SM	
◇ Poorly graded sand with silt and gravel	SP-SM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-17, FS-2 @ 2.5-4.0 Feet

□ **Location:** Boring Number: 2F-11-17, FS-3 @ 4.5-6.0 Feet

△ **Location:** Boring Number: 2F-11-17, FS-6 @ 10.5-12.0 Feet

◇ **Location:** Boring Number: 2F-11-17, FS-8 @ 14.5-16.0 Feet

Remarks:

○ F.M.=0.48

□ F.M.=0.33

△ F.M.=4.24

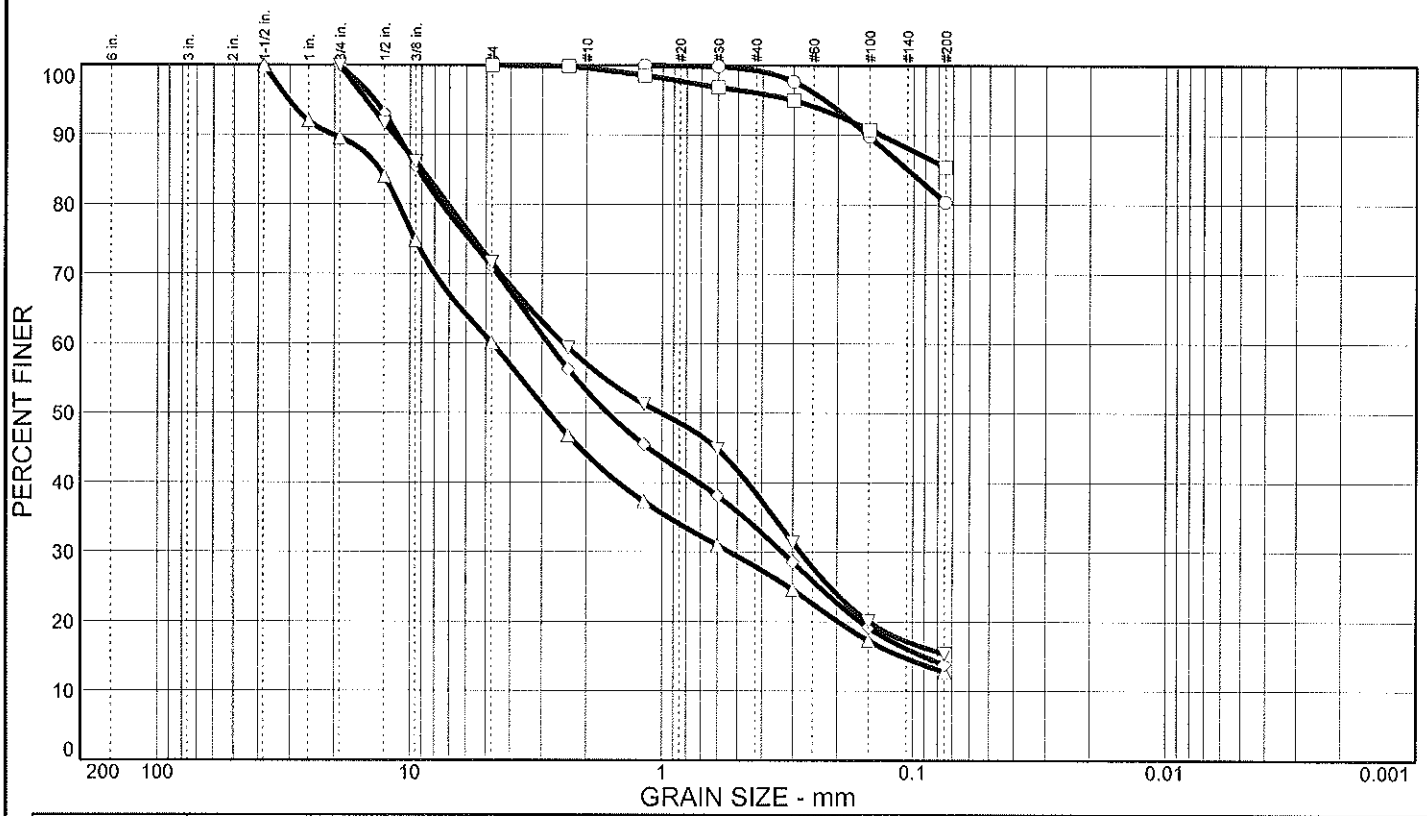
◇ F.M.=4.45

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.0	0.7	19.0	80.3	
□	0.0	0.0	0.0	0.4	3.5	10.7	85.4	
△	0.0	10.4	29.5	16.0	16.1	15.2	12.8	
◇	0.0	0.0	29.0	17.8	19.6	19.8	13.8	
▽	0.0	0.0	28.4	14.5	18.4	23.3	15.4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	35	16	0.106							
□	36	20								
△			13.2	4.72	2.81	0.534	0.110			
◇			9.34	2.83	1.64	0.330	0.0904			
▽	NV	NP	9.02	2.46	1.01	0.280				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Lean clay with sand	CL	
□ Lean clay with sand	CL	
△ Silty sand with gravel	SM	
◇ Silty sand with gravel	SM	
▽ Silty sand with gravel	SM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-19, FS-5 @ 8.5-10 Feet

□ **Location:** Boring Number: 2F-11-19, FS-7 @ 12.5-14 Feet

△ **Location:** Boring Number: 2F-11-19, FS-11 @ 18.5-20.0 Feet

◇ **Location:** Boring Number: 2F-11-19, FS-16 @ 32.5-34 Feet

▽ **Location:** Boring Number: 2F-11-19, FS-21 @ 44.5-46 Feet

Remarks:

○ F.M.=0.13

□ F.M.=0.19

△ F.M.=4.18

◇ F.M.=3.56

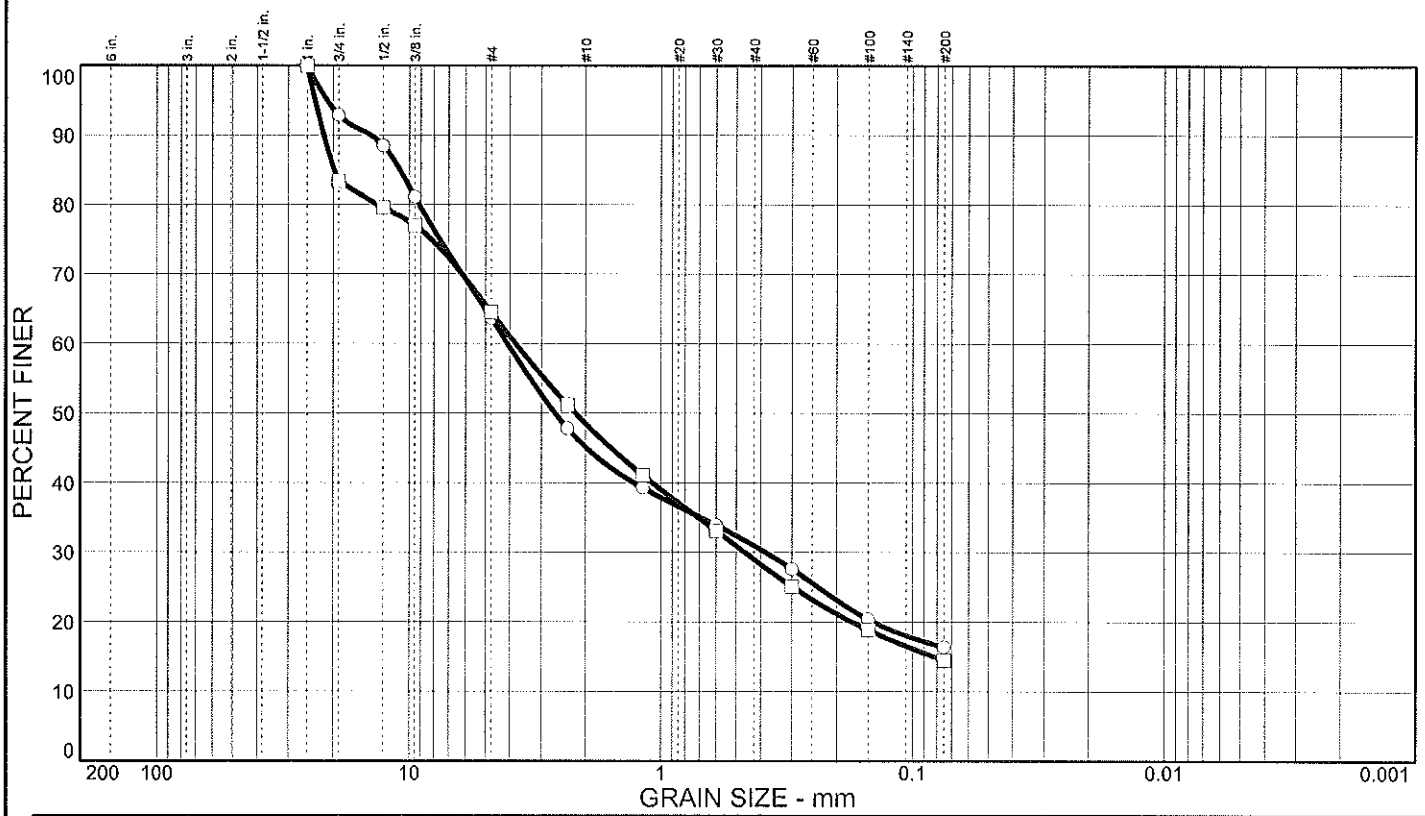
▽ F.M.=3.35

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	7.1	29.3	18.5	14.1	14.6	16.4	
□	0.0	16.6	18.9	16.0	19.5	14.5	14.5	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			10.9	4.10	2.65	0.382				
□			19.8	3.80	2.20	0.462	0.0817			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Clayey sand with gravel	SC	
□ Silty sand with gravel	SM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-19, FS-23 @ 60-61.5 Feet

□ **Location:** Boring Number: 2F-11-19, FS-24 @ 65-66.5 Feet

Remarks:

○ F.M.=3.93

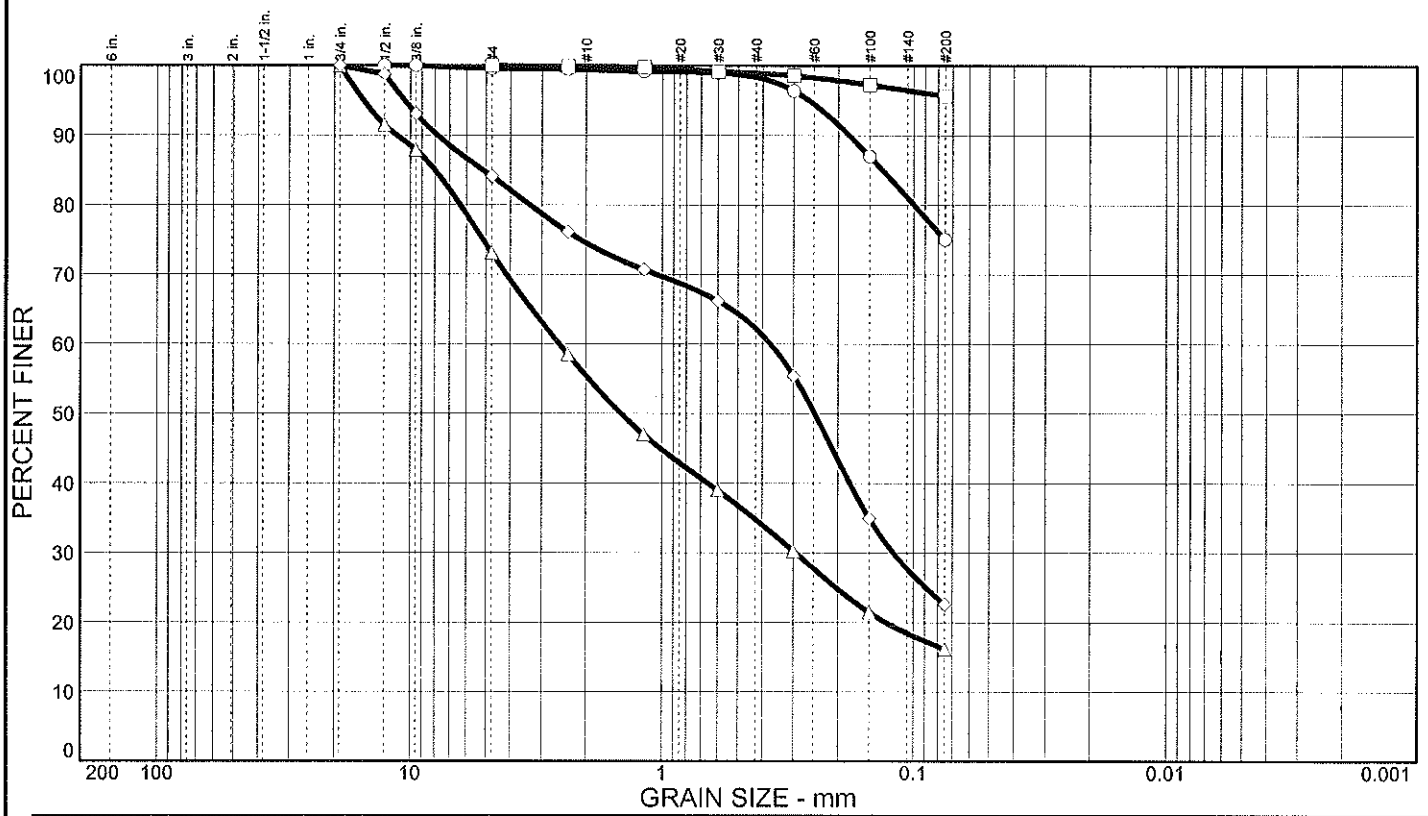
□ F.M.=4.06

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.4	0.2	1.1	23.3	75.0	
□	0.0	0.0	0.0	0.1	0.9	3.3	95.7	
△	0.0	0.0	26.9	17.6	20.6	18.7	16.2	
◇	0.0	0.0	15.9	9.6	12.3	39.6	22.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	58	21	0.133							
□	58	22								
△			8.01	2.55	1.45	0.293				
◇			5.15	0.371	0.247	0.120				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Fat clay with sand	CH	
□ Fat clay	CH	
△ Silty sand with gravel	SM	
◇ Silty sand with gravel	SM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-20, FS-3 @ 4.5-6.0 Feet

□ **Location:** Boring Number: 2F-11-20, FS-7 @ 12.5-14.0 Feet

△ **Location:** Boring Number: 2F-11-20, FS-11 @ 18.5-20.0 Feet

◇ **Location:** Boring Number: 2F-11-20, FS-16 @ 32.5-34.0 Feet

Remarks:

○ F.M.=0.19

□ F.M.=0.05

△ F.M.=3.43

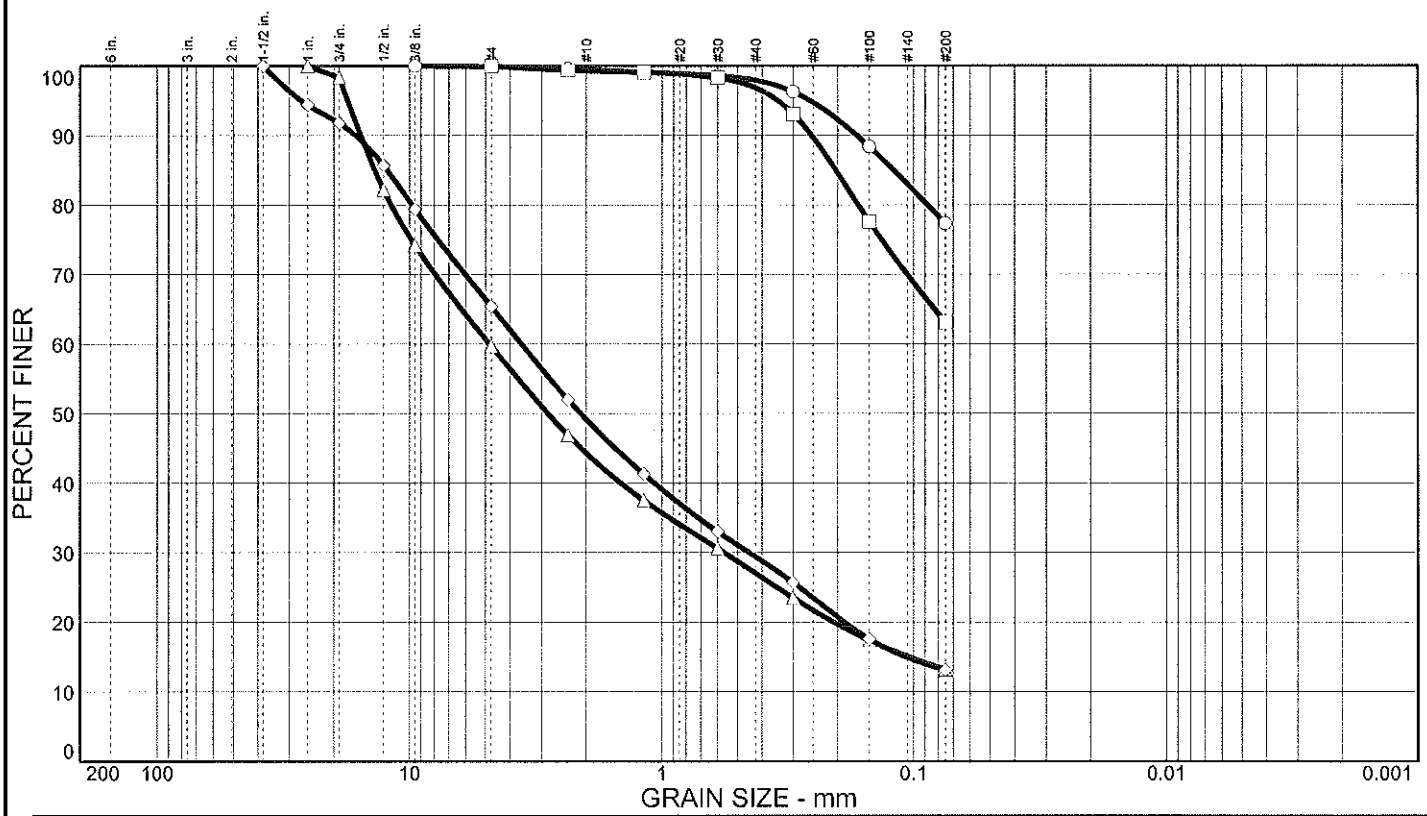
◇ F.M.=2.19

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.1	0.4	1.5	20.7	77.3	
□	0.0	0.0	0.0	0.7	2.4	33.8	63.1	
△	0.0	1.6	38.7	15.4	17.3	13.8	13.2	
◇	0.0	8.2	26.4	16.2	19.7	16.4	13.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	58	21	0.120							
□	58	19	0.203							
△			13.8	4.82	2.83	0.565	0.104			
◇			12.3	3.61	2.10	0.449	0.107			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Fat clay with sand	CH	
□ Sandy fat clay	CH	
△ Silty sand with gravel	SM	
◇ Silty sand with gravel	SM	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-21, FS-2 @ 2.5-4.0 Feet

□ **Location:** Boring Number: 2F-11-21, FS-6 @ 10.5-12.0 Feet

△ **Location:** Boring Number: 2F-11-21, FS-13 @ 26.5-28.0 Feet

◇ **Location:** Boring Number: 2F-11-21, FS-14 @ 29.5-31.0 Feet

Remarks:

○ F.M.=0.18

□ F.M.=0.32

△ F.M.=4.12

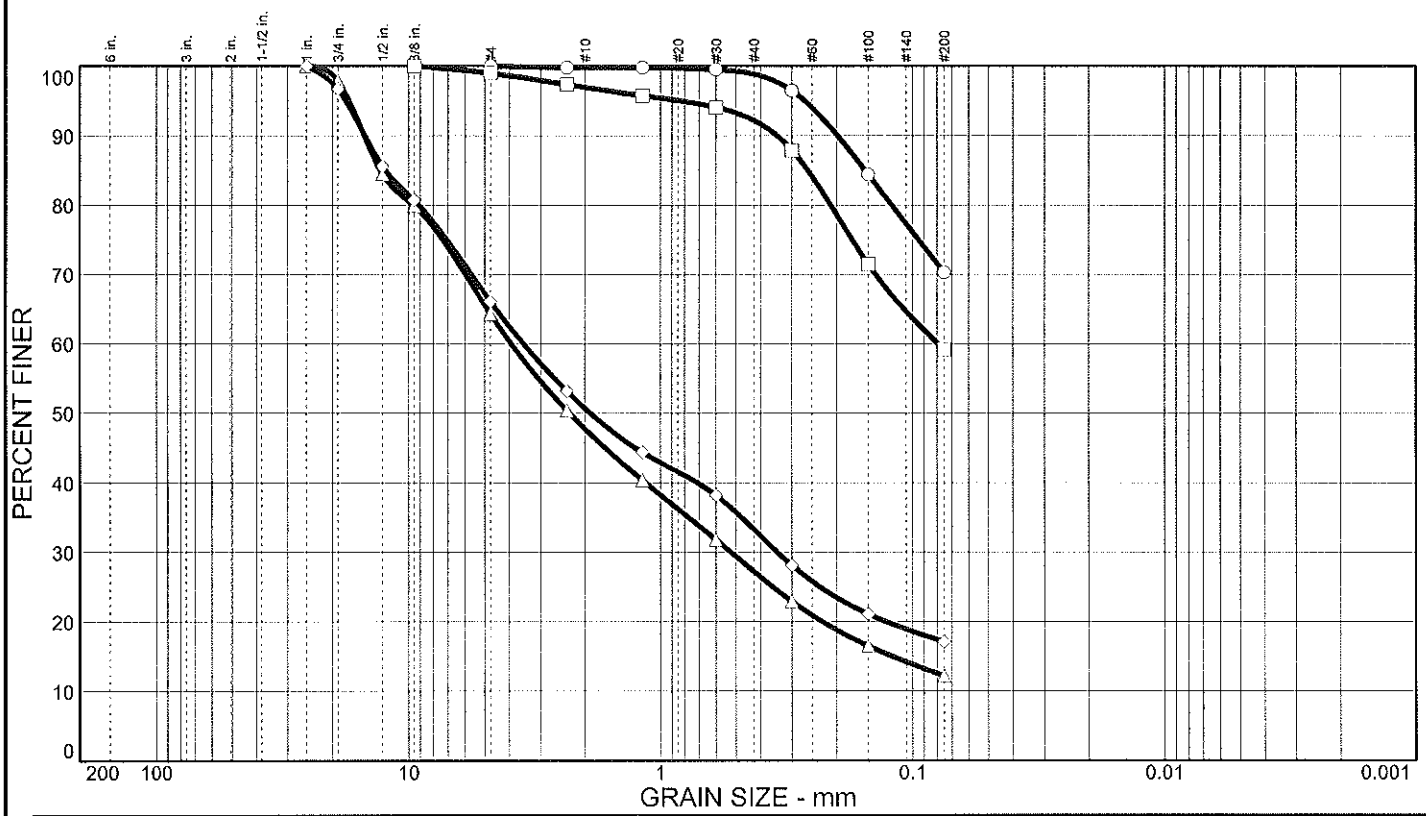
◇ F.M.=3.94

Moore Twining Associates, Inc.

Fresno, CA

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.2	0.9	28.6	70.3	
□	0.0	0.0	1.0	2.0	4.7	33.1	59.2	
△	0.0	2.1	33.6	16.5	20.5	15.1	12.2	
◇	0.0	3.3	30.6	15.4	17.4	16.2	17.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	59	20	0.154							
□	62	22	0.260	0.0790						
△			12.9	3.93	2.30	0.523	0.120			
◇			12.4	3.51	1.90	0.342				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy fat clay	CH	
□ Sandy fat clay	CH	
△ Silty sand with gravel	SM	
◇ Clayey sand with gravel	SC	

Project No. C36002.01 **Client:** City of Newman Public Works

Project: Orestimba Feasibility Study - Flood Control Project Drilling

○ **Location:** Boring Number: 2F-11-22, FS-2 @ 2.5-4.0 Feet

□ **Location:** Boring Number: 2F-11-22, FS-10 @ 18.5-20.0 Feet

△ **Location:** Boring Number: 2F-11-22, FS-12 @ 23.5-25.0 Feet

◇ **Location:** Boring Number: 2F-11-22, FS-15 @ 32.5-34.0 Feet

Remarks:

○F.M.=0.20

□F.M.=0.54

△F.M.=3.96

◇F.M.=3.71

Moore Twining Associates, Inc.

Fresno, CA

Figure

APPENDIX D

Standard Penetration Test Energy Measurements and Calibrations Report, prepared by GRL Engineers, Inc., dated September 22, 2010

GRL engineers, inc.
Dynamic Measurements and Analyses

September 22, 2010

Mr. Sean Riley
Moore Twining Associates, Inc.
2527 Fresno St.
Fresno, CA 93721

Re: Standard Penetration Test Energy Measurements and Calibrations
Vehicle No. 39, Fresno, CA
GRL Job No. 108094-1

Dear Mr. Riley:

This report presents results of energy measurements and related calculations made on September 20, 2010 during Standard Penetration Tests (SPT) performed on one automatic hammer. Dynamic tests were performed on AW-J drill rods. GRL Engineers, Inc. obtained the dynamic measurements with an instrumented AW-J subsection and a Model PAK Pile Driving Analyzer®.

PURPOSE AND SCOPE OF WORK

At the request of Moore Twining Associates, Inc., GRL has carried out SPT energy measurements on one automatic hammer.

Our scope of work included the following:

- Strain and acceleration measurements during Standard Penetration Tests (SPT) on September 20, 2010 using an AW-J instrumented rod and a Pile Driving Analyzer (PDA).
- Energy Calculations using strain and acceleration measurements.

Los Angeles Office: 516 Crane Boulevard • Los Angeles, CA 90065 USA • 323.441.0965 • fax 323.441.0975
Corporate Office: 30725 Aurora Road • Cleveland, OH 44139 USA • 216.831.6131 • fax 216.831.0916 • www.pile.com

Colorado	Illinois	Florida	Louisiana	North Carolina	Ohio	Pennsylvania
303.666.6127	847.221.2750	407.826.9539	985.640.7961	704.593.0992	216.831.6131	610.459.0278

EQUIPMENT

Drilling and SPT Hammer Equipment

SPT energy measurements were made on one automatic hammer. This hammer was reported as the hammer mounted on Vehicle No. 39 and was mounted on a CME 75. The SPT energy measurement tests were performed at different penetrations.

Instrumentation

A Model PAX Pile Driving Analyzer (PDA) data acquisition system was used to collect and process the dynamic measurements of strain and acceleration. A two foot long section of AW-J rod (subsection) was instrumented with two full bridge foil resistance strain gages and two piezoresistive accelerometers mounted approximately in the center of the rod.

Analog signals from the strain gages and accelerometers were conditioned, digitized, stored and processed with the PDA. Selected output from the PDA for each recorded impact included the maximum calculated rod top force, maximum rod top velocity, energy transfer calculated by two methods and the hammer operating rate. Appendix A provides an introduction to dynamic SPT testing methods.

MEASUREMENTS AND CALCULATIONS

The primary purpose of testing was the measurement of energy transfer from the automatic SPT hammer to the AW-J drill rod. The PDA measurements of rod force and velocity were reviewed in the office after field testing, and then analyzed to calculate the energy by the following two methods:

- The Fv method (EMX) which uses force and velocity measurements.
- The F2 method (EF2) which uses force measurements only.

Fv method (EMX)

Energy transfer past the gage location, EMX, was computed by the PDA using force and velocity records as follows:

$$EMX = \int_a^b F(t) \cdot v(t) dt$$

The time "a" corresponds to the start of the record which is when the energy transfer begins and "b" is the time at which energy transferred to the rod reaches a maximum value.

F2 method (EF2)

In addition to the EMX energy calculation, we computed a value for energy transfer, EF2, using only force measurements as follows:

$$EF2 = \int_a^w F^2(t)/Z \, dt$$

where E, A and c are the Modulus of Elasticity, cross-sectional area, and compression stress wave speed of the rod, respectively. Integration begins at time "a", which is equal to the time of impact, and ends at cut-off time, "w", which is at the first occurrence of a zero force after impact. According to ASTM D 4633-86, the cut-off time must be compared with time 2L/c, where L is the distance between the measurement location and the end of the sampler. If "w" is less than 0.9*2L/c or greater than 1.2*2L/c, the EF2 result may not be used to evaluate energy. In practice, the time of zero force may fall outside these limits due to the effects of rod cross-sectional changes, connector conditions, end conditions, rod length, and other factors.

According to the expired ASTM D4633-86 standard, the Force-Squared energy computation (EF2) may be multiplied by three correction factors to obtain the desired energy result. The first two factors are a function of the rod length and the distance between the impact surface and the force measurement location, and are greater than or equal to unity. The third factor, Kc, is simply the ratio of the actual cutoff time, w, to the theoretical cut-off time, 2L/c. No correction factors were applied to the results reported here, because the EF2 computation is included only for completeness.

Discussion

Any cross-sectional area difference between the GRL sub-section and the drill rods, any loose connections or changes in area at section joints, or any cross-sectional area differences between the drill rod sections will result in stress wave reflections that can affect the calculation of energy transfer. The EF2 method, using only the force record, does not correctly calculate transferred energy in these situations. Fortunately the EMX transferred energy calculation method, utilizing both force and velocity records, is theoretically correct and the energy

results are not adversely affected by cross-sectional area changes or loose connectors.

The transferred energy calculations by the EMX method holds theoretically correct in these cases when the EF2 method does not, and EMX is therefore considered a more accurate and reliable representation of energy transfer from the SPT hammer. The EF2 results are not included in the Summary of Field Results (Table 1), but are included for general reference in the PDA Case Method output in Appendix B.

A general introduction to dynamic SPT testing methods is included in this report as Appendix A. References for more detailed descriptions of our testing and analysis methods are available upon request.

RESULTS

Table 1 summarizes the average calculated transferred energies for the reliable and theoretically correct EMX method. The results presented are the average rod top values for the PDA data collected for each sampling event (i.e., test location/depth). The transfer efficiency (ETR) is defined as the ratio of maximum transferred energy divided by the theoretical hammer potential energy of 350 lb-ft (from the 140 lb SPT hammer falling the standard 2.5 ft). The average hammer operating rate is reported in blows-per-minute (BPM).

Appendix B contains plots and tables of PDA results for all selected hammer blows, for each sampling. The plots and tables present selected measured and calculated results as a function of blow number. The results include EMX (transferred energy by the EMX method), ETR (energy transfer efficiency for the EMX method), BPM (hammer operating rate), FMX (maximum rod top force), VMX (maximum rod top velocity) and EF2 (transferred energy by the EF2 method).

To adjust SPT N values for hammer performance, the following correction for N value adjustment to 60% transfer efficiency can be used:

$$N_{60} = \left(\frac{E_m}{60}\right) N_m$$

where:

N60 = Corrected N value
Em = ETR(%)
Nm = Measured N value

Additional corrections such as overburden and non conventional samplers are not considered and are the responsibility of the geotechnical engineer of this project.

CONCLUSIONS

One automatic hammer was monitored during sampling events to determine its average energy transfer ratio on September 20, 2010. Table 1 summarizes the average calculated transferred energies for the reliable and theoretically correct Fv method (EMX). **The average energy transfer efficiency of all testing events for the hammer mounted on Vehicle No. 39 was 80% at an average hammer rate of 47 blows per minute.**

The average operating hammer rate ranged between 38 and 55 blows per minute with an average of 47 blows per minute. It is important to notice that the rate at which the hammer is operated is very important for its performance. For this rig, lower blow rate will account for lower energies, while higher blow rates will account for a higher energy delivered. ***Consistency during SPT energy collections is fundamental to apply energy corrections***. All testing results are summarized in Table 1 and complete results are included in Appendix B.

It was a pleasure to work with Moore Twining on this project. Please do not hesitate to contact us if you have any questions about this report, require additional information, or if we may be of further service.

Sincerely,
GRL Engineers, Inc.

REGISTERED PROFESSIONAL ENGINEER
Camilo A Alvarez
No. 67938
Exp. 6/30/11
Civil
STATE OF CALIFORNIA

Camilo Alvarez, P.E.
Senior Engineer

Anna Klesney, MSCE
Project Engineer

CA:AK:dms

TABLE 1: Summary of Field Results
Energy Measurement for Dynamic Penetrometer

Rig Serial No.	Penetration Depth(s)	Blow Counts (1)	Average Hammer Rate (BPM)	Average Transferred Energy (EMX) (2)	Energy Transfer Ratio (ETR) (2)	Impact Force (FMX) (3)
	ft	blows	bpm	ft-lbs	%	kips
CME 75-Atomatic Vehicle No. 39	15	5, 8, 8	38	253	72	29
	20	3, 3, 6	54	285	81	30
	25	3, 6, 9	42	266	76	26
	30	10, 11, 18	44	272	78	27
	35	7, 13, 20	50	294	84	28
	40	5, 11, 11	49	293	84	28
	45	7, 10, 17	55	300	86	29
	Overall System Performance		47	280	80	28

Notes

1. Number of hammer blows reported by Moore Twining.
2. Average transferred energy at transducer location; ratio of (EMX) to theoretical potential energy of hammer.
3. Average Maximum computed driving compression Force at transducer location.

Appendix A

An Introduction into SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

The following has been written by GRL Engineers, Inc. and may only be copied with its written permission.

1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m [E_m / (0.6E_r)] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a "High Strain Method". The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the "Wave Equation Analysis" which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_0^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v Z \tag{5}$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v (E/c) \tag{6}$$

or strain

$$\epsilon = \sigma/E = v / c \tag{7}$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

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APPENDIX B

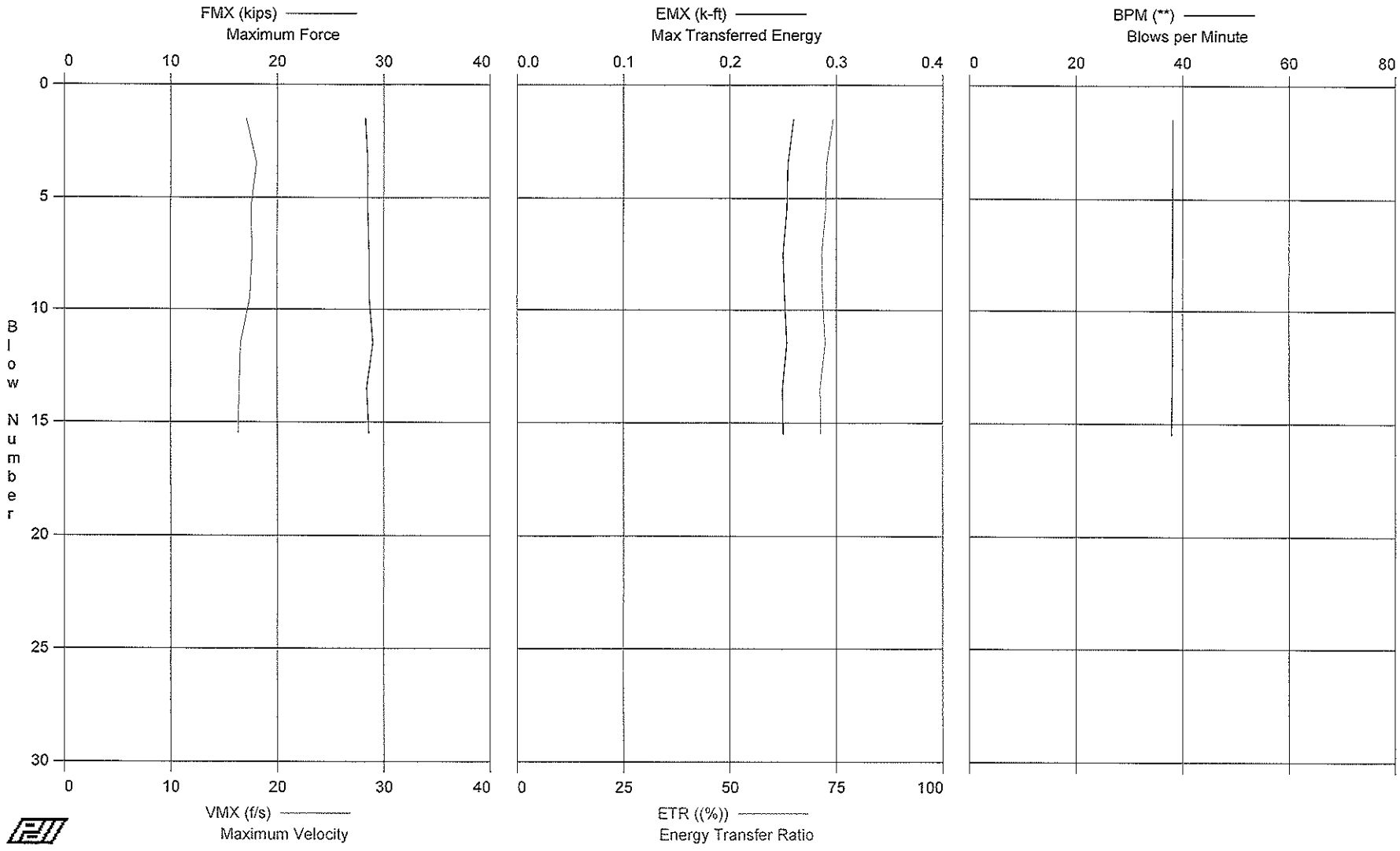
SPT Energy Measurements

GRL Engineers, Inc. - Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

Test date: 20-Sep-2010

VEHICLE #39 - AS-5 AT 15FT



GRL Engineers, Inc.
Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

VEHICLE #39 - AS-5 AT 15FT
OP: OPERATOR NAME

CME 75 AUTO
Test date: 20-Sep-2010

AR: 1.19 in^2
LE: 17.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

FMX: Maximum Force
VMX: Maximum Velocity
EMX: Max Transferred Energy

EF2: Energy of F^2
ETR: Energy Transfer Ratio
BPM: Blows per Minute

BL#	FMX kips	VMX f/s	EMX k-ft	EF2 k-ft	ETR (%)	BPM **
1	28	17.1	0.256	0.247	73	38
2	28	16.9	0.264	0.247	75	38
3	28	17.9	0.255	0.248	73	38
4	29	18.1	0.254	0.251	72	38
5	28	17.0	0.253	0.249	72	38
6	29	17.9	0.254	0.248	73	38
7	29	17.6	0.249	0.247	71	38
8	29	17.6	0.251	0.250	72	38
9	29	17.4	0.250	0.247	71	38
10	29	17.3	0.253	0.246	72	38
11	29	16.4	0.255	0.250	73	38
12	29	16.6	0.252	0.249	72	38
13	28	16.3	0.253	0.249	72	38
14	28	16.5	0.246	0.247	70	38
15	29	16.4	0.249	0.248	71	38
16	28	16.2	0.251	0.247	72	38
Average	29	17.1	0.253	0.248	72	38
Std. Dev.	0	0.6	0.004	0.001	1	0

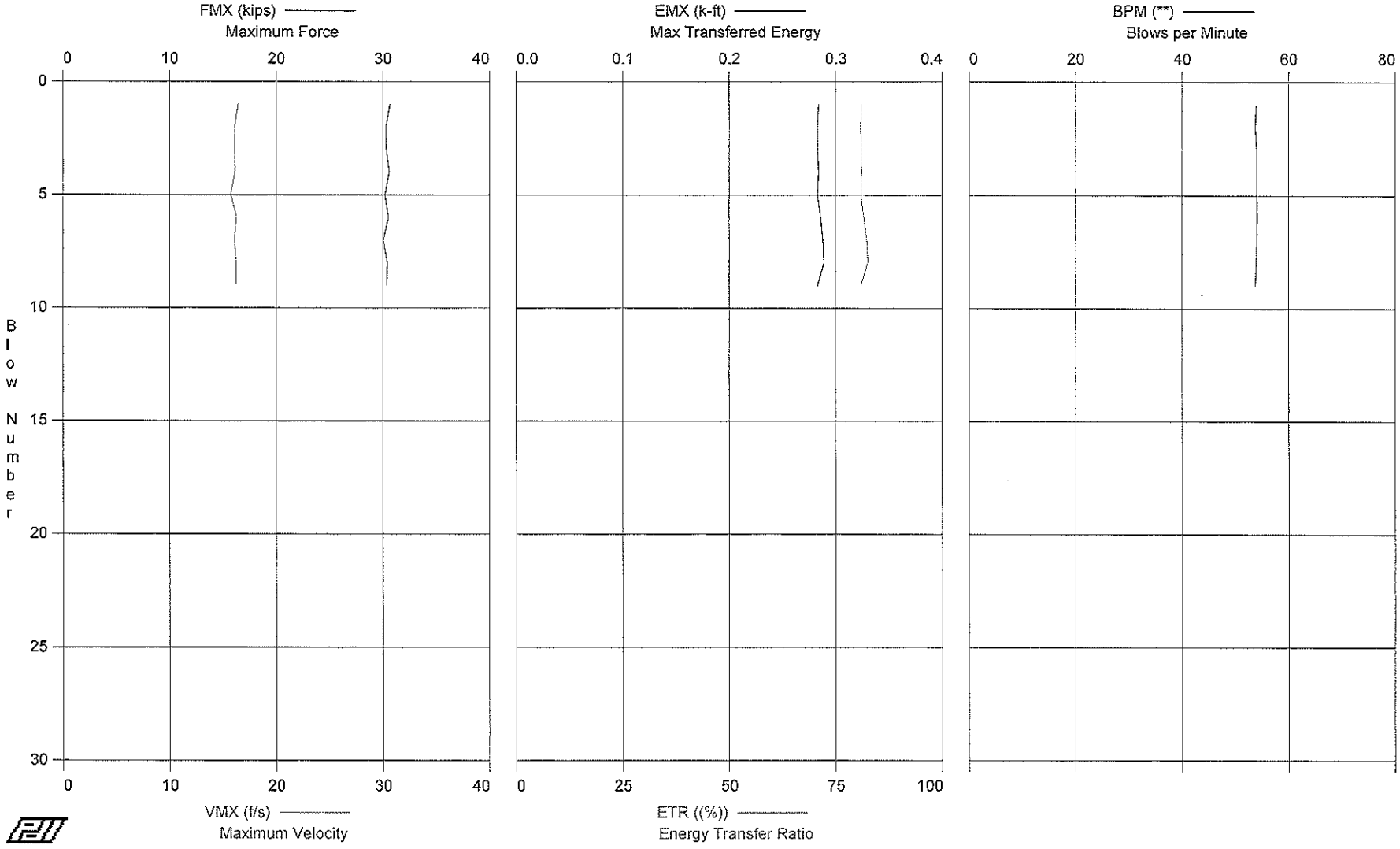
Total number of blows analyzed: 16

GRL Engineers, Inc. - Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

Test date: 20-Sep-2010

VEHICLE #39 - AS-5 AT 20FT



GRL Engineers, Inc.
Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

VEHICLE #39 - AS-5 AT 20FT
OP: OPERATOR NAME

CME 75 AUTO
Test date: 20-Sep-2010

AR: 1.19 in^2
LE: 22.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

FMX: Maximum Force
VMX: Maximum Velocity
EMX: Max Transferred Energy

EF2: Energy of F^2
ETR: Energy Transfer Ratio
BPM: Blows per Minute

BL#	FMX kips	VMX f/s	EMX k-ft	EF2 k-ft	ETR (%)	BPM **
1	31	16.4	0.284	0.290	81	54
2	30	16.1	0.283	0.292	81	54
3	30	16.0	0.283	0.289	81	54
4	31	16.1	0.284	0.292	81	54
5	30	15.7	0.283	0.290	81	54
6	31	16.2	0.286	0.292	82	54
7	30	16.1	0.288	0.291	82	54
8	30	16.2	0.289	0.294	83	54
9	30	16.2	0.283	0.290	81	54
Average	30	16.1	0.285	0.291	81	54
Std. Dev.	0	0.2	0.002	0.001	1	0

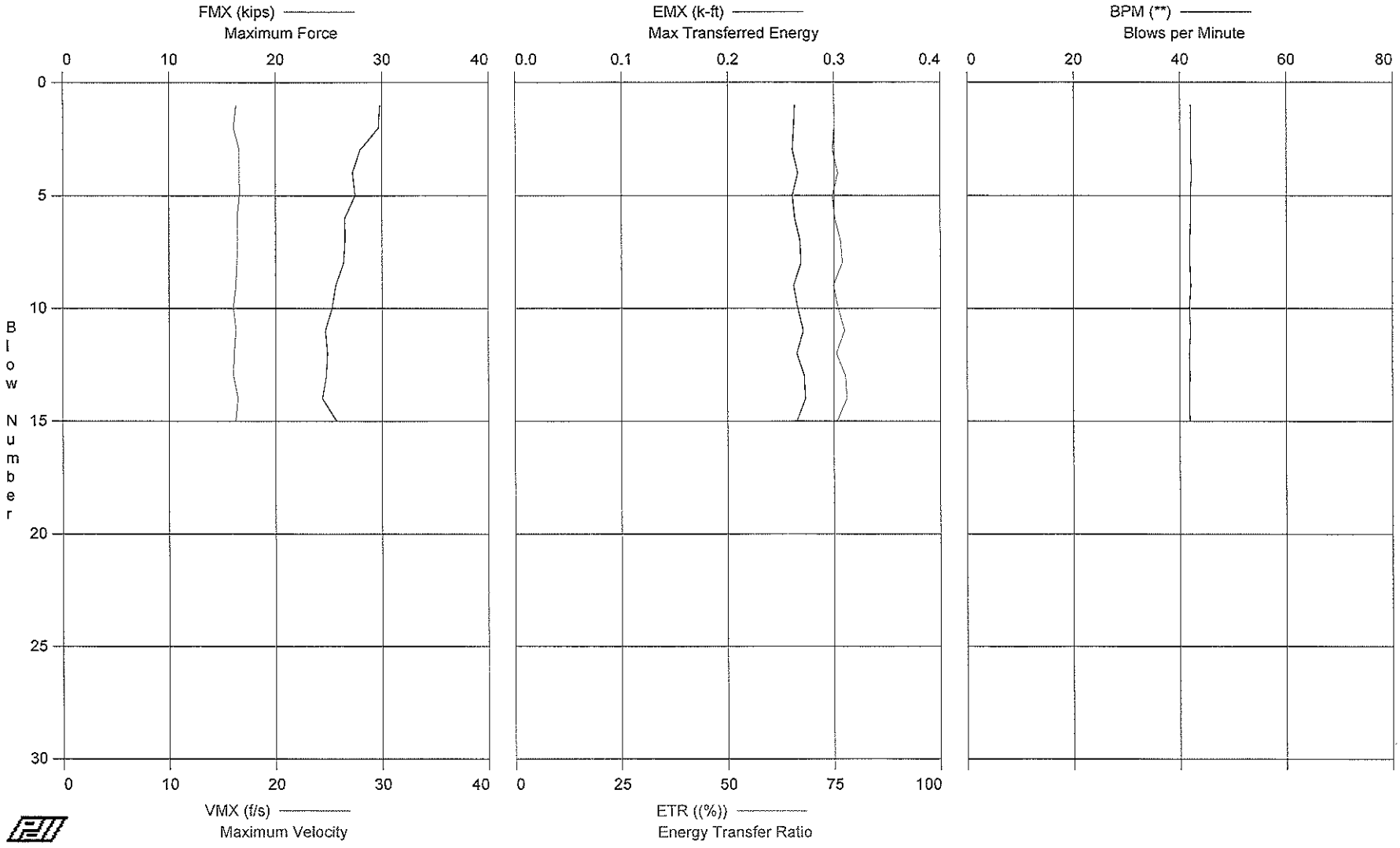
Total number of blows analyzed: 9

GRL Engineers, Inc. - Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

Test date: 20-Sep-2010

VEHICLE #39 - AS-5 AT 25FT



GRL Engineers, Inc.
Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

VEHICLE #39 - AS-5 AT 25FT
OP: OPERATOR NAME

CME 75 AUTO
Test date: 20-Sep-2010

AR: 1.19 in^2
LE: 27.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

FMX: Maximum Force
VMX: Maximum Velocity
EMX: Max Transferred Energy

EF2: Energy of F^2
ETR: Energy Transfer Ratio
BPM: Blows per Minute

BL#	FMX kips	VMX f/s	EMX k-ft	EF2 k-ft	ETR (%)	BPM **
1	30	16.2	0.263	0.261	75	42
2	30	16.0	0.262	0.263	75	42
3	28	16.5	0.261	0.259	75	42
4	27	16.6	0.266	0.253	76	42
5	27	16.6	0.261	0.257	75	42
6	27	16.4	0.263	0.255	75	42
7	27	16.4	0.268	0.254	77	42
8	26	16.3	0.269	0.255	77	42
9	26	16.2	0.262	0.251	75	42
10	25	16.0	0.266	0.256	76	42
11	25	16.2	0.271	0.250	77	42
12	25	16.1	0.265	0.251	76	42
13	25	16.0	0.272	0.252	78	42
14	24	16.4	0.273	0.253	78	42
15	26	16.2	0.265	0.253	76	42
Average	26	16.3	0.266	0.255	76	42
Std. Dev.	2	0.2	0.004	0.004	1	0

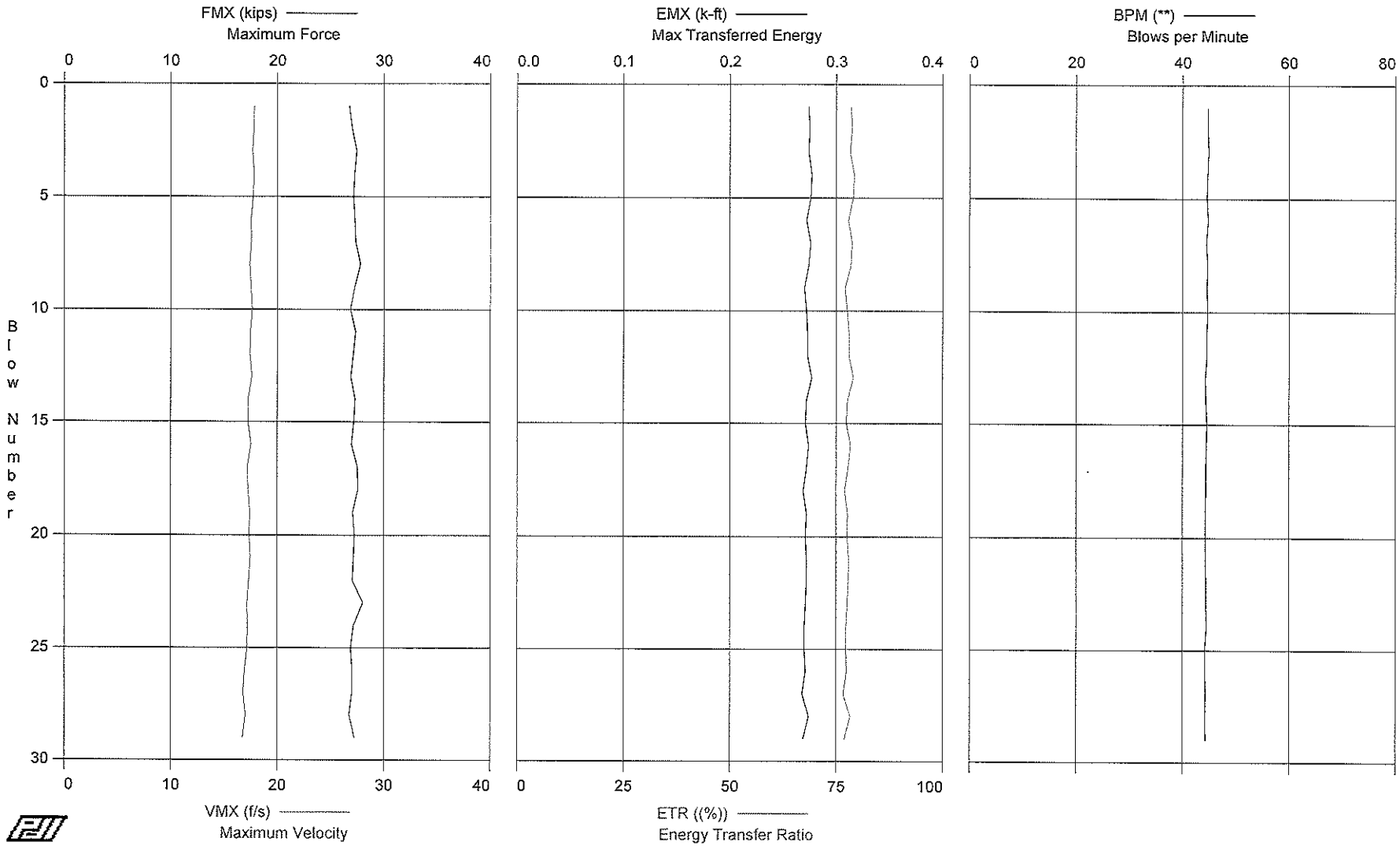
Total number of blows analyzed: 15

GRL Engineers, Inc. - Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

Test date: 20-Sep-2010

VEHICLE #39 - AS-5 AT 30FT



GRL Engineers, Inc.
Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

VEHICLE #39 - AS-5 AT 30FT
OP: OPERATOR NAME

CME 75 AUTO
Test date: 20-Sep-2010

AR: 1.19 in^2
LE: 32.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

FMX: Maximum Force
VMX: Maximum Velocity
EMX: Max Transferred Energy

EF2: Energy of F^2
ETR: Energy Transfer Ratio
BPM: Blows per Minute

BL#	FMX kips	VMX f/s	EMX k-ft	EF2 k-ft	ETR (%)	BPM **
1	27	17.8	0.274	0.264	78	45
2	27	17.7	0.275	0.269	79	45
3	27	17.6	0.274	0.268	78	45
4	27	17.7	0.277	0.266	79	45
5	27	17.7	0.276	0.270	79	45
6	27	17.5	0.272	0.269	78	45
7	27	17.5	0.276	0.266	79	45
8	28	17.4	0.274	0.270	78	45
9	27	17.5	0.270	0.266	77	45
10	27	17.6	0.272	0.262	78	45
11	27	17.4	0.273	0.270	78	45
12	27	17.4	0.273	0.267	78	45
13	27	17.6	0.277	0.263	79	44
14	27	17.2	0.272	0.268	78	44
15	27	17.2	0.271	0.266	77	45
16	27	17.5	0.274	0.265	78	45
17	28	17.1	0.272	0.267	78	44
18	28	17.2	0.269	0.266	77	44
19	27	17.4	0.272	0.261	78	44
20	27	17.3	0.271	0.263	78	44
21	27	17.4	0.272	0.265	78	44
22	27	17.3	0.272	0.262	78	44
23	28	17.1	0.271	0.267	78	44
24	27	17.2	0.270	0.266	77	45
25	27	17.1	0.270	0.263	77	44
26	27	16.9	0.271	0.265	77	44
27	27	16.7	0.268	0.268	77	44
28	27	17.0	0.274	0.263	78	44
29	27	16.7	0.269	0.265	77	44
Average	27	17.3	0.272	0.266	78	44
Std. Dev.	0	0.3	0.002	0.002	1	0

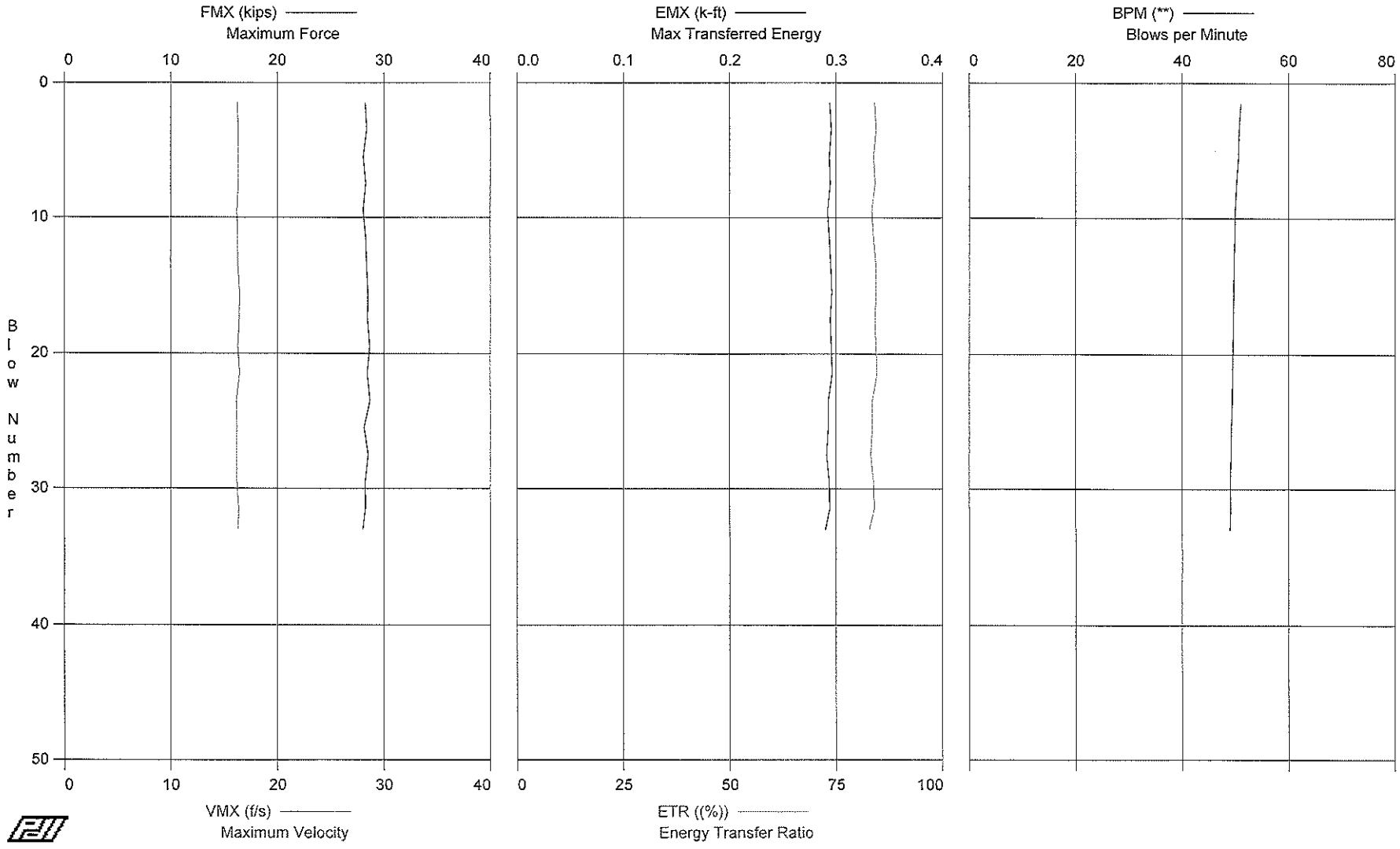
Total number of blows analyzed: 29

GRL Engineers, Inc. - Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

Test date: 20-Sep-2010

VEHICLE #39 - AS-5 AT 35FT



GRL Engineers, Inc.
Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

VEHICLE #39 - AS-5 AT 35FT
OP: OPERATOR NAME

CME 75 AUTO
Test date: 20-Sep-2010

AR: 1.19 in^2
LE: 37.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

FMX: Maximum Force
VMX: Maximum Velocity
EMX: Max Transferred Energy

EF2: Energy of F^2
ETR: Energy Transfer Ratio
BPM: Blows per Minute

BL#	FMX kips	VMX f/s	EMX k-ft	EF2 k-ft	ETR (%)	BPM **
1	28	16.2	0.294	0.294	84	51
2	28	16.2	0.294	0.291	84	51
3	28	16.3	0.297	0.291	85	51
4	28	16.2	0.294	0.290	84	51
5	28	16.3	0.292	0.287	83	51
6	28	16.3	0.295	0.287	84	50
7	28	16.2	0.294	0.289	84	50
8	28	16.4	0.295	0.286	84	50
9	28	16.2	0.292	0.288	83	50
10	28	16.1	0.292	0.290	83	50
11	28	16.2	0.292	0.287	83	50
12	28	16.3	0.295	0.287	84	50
13	28	16.3	0.295	0.289	84	50
14	29	16.3	0.295	0.289	84	50
15	29	16.5	0.297	0.287	85	50
16	28	16.4	0.295	0.290	84	50
17	29	16.2	0.290	0.290	83	50
18	28	16.6	0.299	0.287	85	50
19	29	16.2	0.295	0.289	84	50
20	28	16.4	0.296	0.290	85	50
21	28	16.5	0.297	0.287	85	50
22	29	16.4	0.296	0.288	84	49
23	29	16.3	0.293	0.291	84	49
24	29	16.0	0.292	0.289	83	49
25	28	16.1	0.292	0.288	83	49
26	28	16.2	0.293	0.290	84	49
27	29	16.2	0.289	0.285	83	49
28	28	16.2	0.293	0.287	84	49
29	28	16.0	0.287	0.283	82	49
30	28	16.4	0.300	0.289	86	49
31	28	16.4	0.296	0.284	85	49
32	28	16.3	0.292	0.287	83	49
33	28	16.3	0.290	0.283	83	49
Average	28	16.3	0.294	0.288	84	50
Std. Dev.	0	0.1	0.003	0.002	1	1

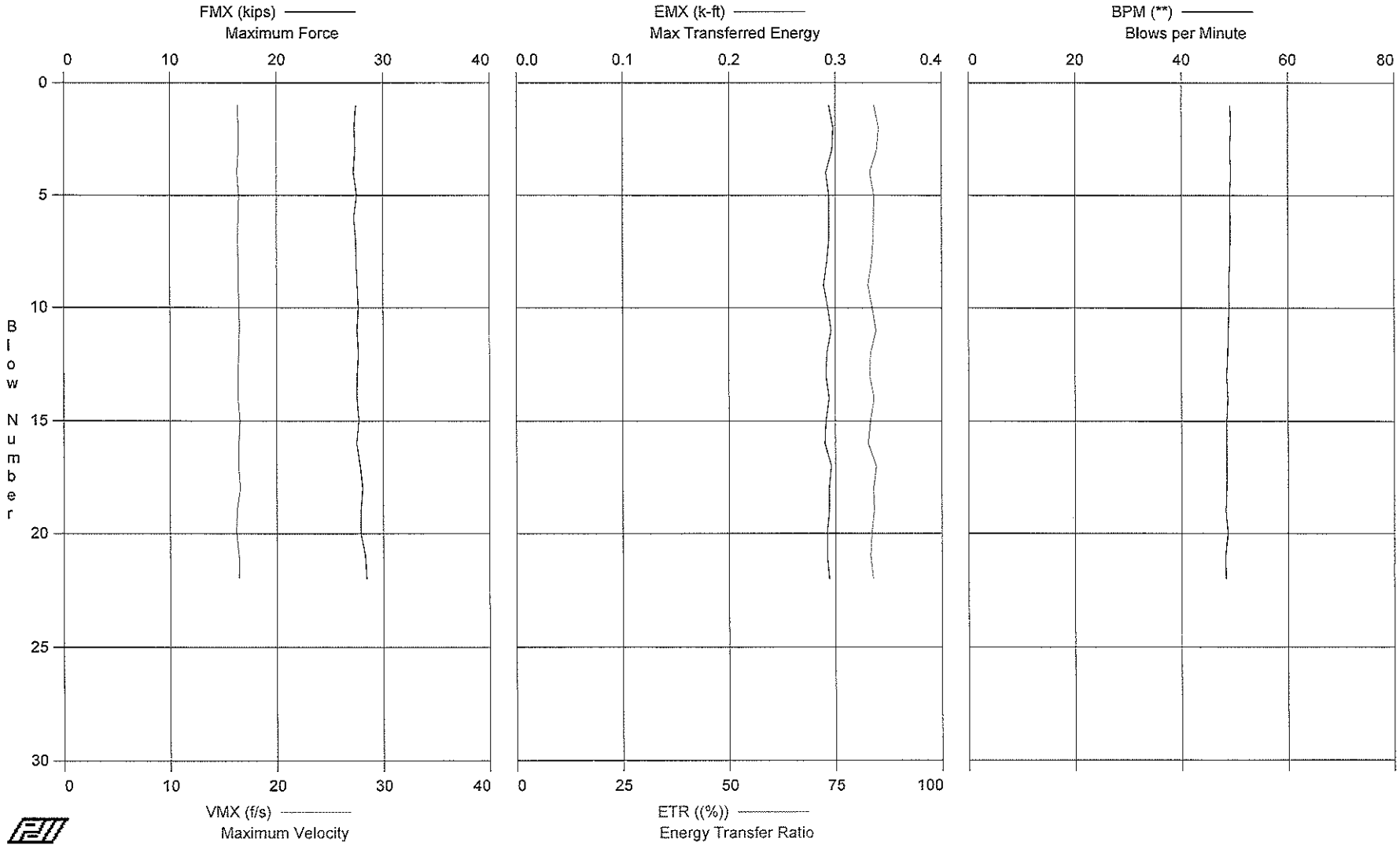
Total number of blows analyzed: 33

GRL Engineers, Inc. - Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

Test date: 20-Sep-2010

VEHICLE #39 - AS-5 AT 40FT



GRL Engineers, Inc.
Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

VEHICLE #39 - AS-5 AT 40FT
OP: OPERATOR NAME

CME 75 AUTO
Test date: 20-Sep-2010

AR: 1.19 in^2
LE: 42.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

FMX: Maximum Force
VMX: Maximum Velocity
EMX: Max Transferred Energy

EF2: Energy of F^2
ETR: Energy Transfer Ratio
BPM: Blows per Minute

BL#	FMX kips	VMX f/s	EMX k-ft	EF2 k-ft	ETR (%)	BPM **
1	27	16.3	0.294	0.283	84	49
2	27	16.4	0.298	0.280	85	49
3	27	16.4	0.297	0.280	85	49
4	27	16.2	0.291	0.281	83	49
5	28	16.4	0.294	0.279	84	49
6	27	16.4	0.294	0.278	84	49
7	27	16.3	0.294	0.278	84	49
8	27	16.3	0.292	0.279	83	49
9	28	16.4	0.289	0.278	83	49
10	28	16.5	0.293	0.276	84	49
11	28	16.5	0.296	0.279	85	49
12	28	16.4	0.292	0.275	83	49
13	28	16.3	0.291	0.278	83	49
14	28	16.3	0.294	0.278	84	49
15	28	16.5	0.291	0.276	83	49
16	28	16.4	0.290	0.275	83	49
17	28	16.4	0.296	0.283	85	49
18	28	16.5	0.294	0.277	84	49
19	28	16.2	0.294	0.282	84	48
20	28	16.2	0.292	0.280	84	49
21	28	16.4	0.292	0.281	83	48
22	28	16.4	0.294	0.282	84	48
Average	28	16.4	0.293	0.279	84	49
Std. Dev.	0	0.1	0.002	0.002	1	0

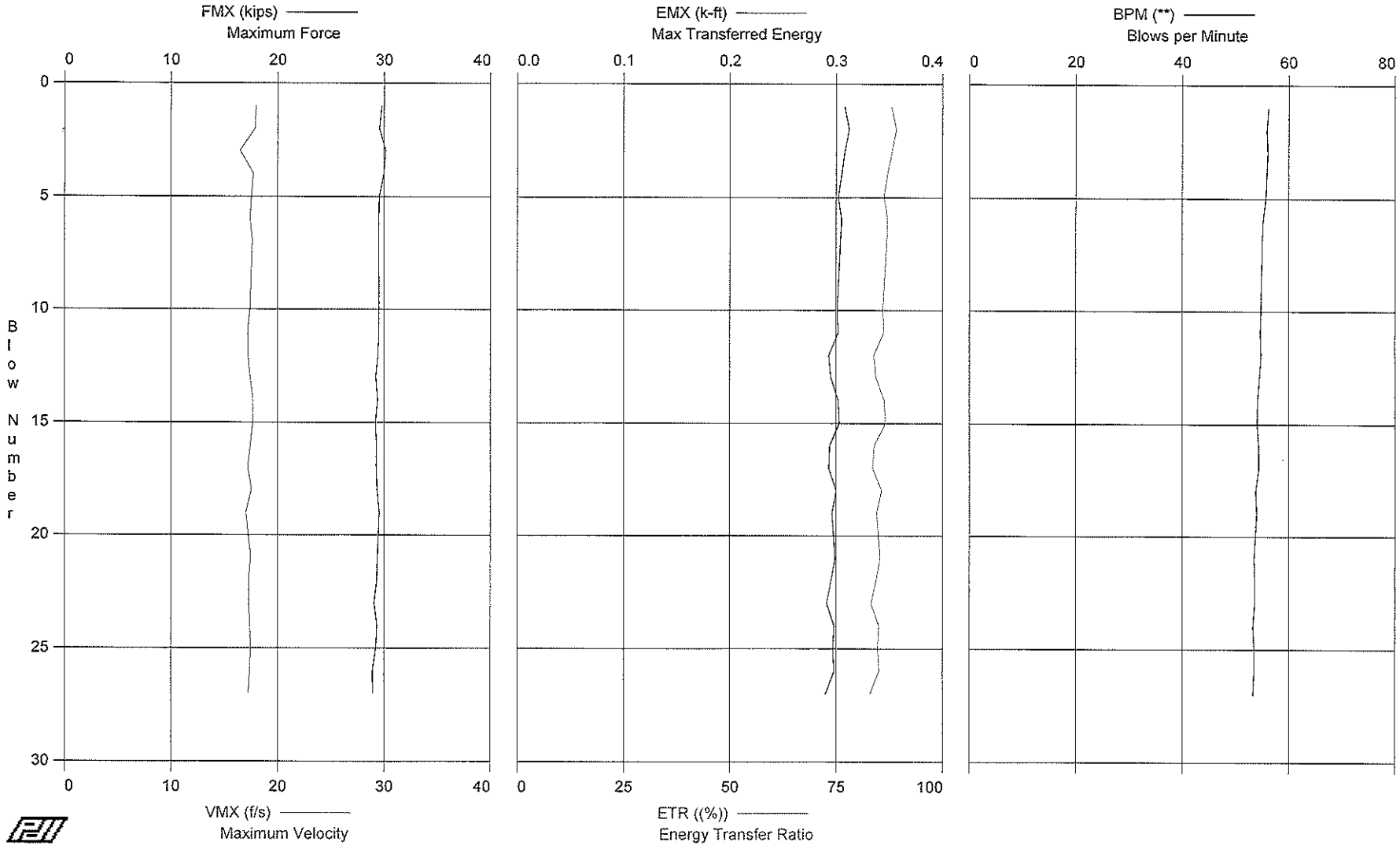
Total number of blows analyzed: 22

GRL Engineers, Inc. - Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

Test date: 20-Sep-2010

VEHICLE #39 - AS-5 AT 45FT



GRL Engineers, Inc.
Case Method Results

PDIPLOT Ver. 2009.1 - Printed: 22-Sep-2010

VEHICLE #39 - AS-5 AT 45FT
OP: OPERATOR NAME

CME 75 AUTO
Test date: 20-Sep-2010

AR: 1.19 in^2
LE: 47.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

FMX: Maximum Force
VMX: Maximum Velocity
EMX: Max Transferred Energy

EF2: Energy of F^2
ETR: Energy Transfer Ratio
BPM: Blows per Minute

BL#	FMX kips	VMX f/s	EMX k-ft	EF2 k-ft	ETR (%)	BPM **
1	30	17.9	0.308	0.306	88	56
2	30	17.8	0.312	0.311	89	56
3	30	16.4	0.308	0.308	88	56
4	30	17.7	0.305	0.308	87	56
5	30	17.5	0.302	0.304	86	56
6	29	17.4	0.305	0.307	87	55
7	30	17.6	0.304	0.305	87	55
10	30	17.4	0.301	0.303	86	55
11	30	17.2	0.302	0.307	86	55
12	29	17.2	0.293	0.306	84	55
13	29	17.4	0.295	0.302	84	55
14	29	17.6	0.302	0.307	86	54
15	29	17.6	0.303	0.307	87	54
16	29	17.4	0.294	0.304	84	54
17	29	17.2	0.293	0.299	84	54
18	29	17.5	0.300	0.304	86	54
19	30	17.0	0.296	0.303	84	54
21	29	17.4	0.299	0.303	85	54
22	29	17.2	0.295	0.303	84	54
23	29	17.3	0.291	0.300	83	54
24	29	17.4	0.298	0.302	85	53
25	29	17.4	0.297	0.302	85	54
26	29	17.3	0.298	0.303	85	54
27	29	17.2	0.290	0.298	83	53
Average	29	17.4	0.300	0.304	86	55
Std. Dev.	0	0.3	0.006	0.003	2	1

Total number of blows analyzed: 24

REVISED BORING LOGS

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 1 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-01	LOCATION COORDINATES: N 1930195.208 E 6397849.518	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 4
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/10/10	COMPLETED: 11/10/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 6.5	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 6.5			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY with Sand (CL); Moist,10yr4/3 Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 20% Fine Sand, No HCL Reaction										
	▼	5 6 4	10	13			28	FS#1								PP=3.5
2																
	▼	7 10 15	25	33		Same as above except; 10yr4/4 Dark Yellow Brown, Weak HCL Reaction	67	FS#2								PP>4.5
4																
	▼	8 11 15	26	35		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 40% Fine Sand, Trace Coarse Sand, Trace Sub Rounded Fine Gravel to 0.5 inches, No HCL Reaction	44	FS#3 FS#4								PP>4.5
6						SAND Poorly Graded with Silt (SP-SM), Moist, 10yr5/4, Yellow Brown, 90% Fine to Coarse Sand, 10% Non Plastic Fines, No HCL Reaction										
						Bottom of Boring at 6.5 Feet BSG										
8																
10																
12																

DRILLING LOG	DIVISION South Pacific	INSTALLATION Sacramento District	SHEET 1 OF 3 SHEETS

1. PROJECT Orestimba, Newman	9. COORDINATE SYSTEM State Plane CA Zone 2 NAD83
	10. SIZE AND TYPE OF BIT 6 5/8" HSA
2. HOLE NO. 2F-11-02 — LOCATION COORDINATES N 1931232.885 E 6397855.762	11. MANUFACTURER'S DESIGNATION OF DRILL CME 75
3. DRILLING AGENCY Moore Twining Associates, Inc.	12. TOTAL SAMPLES — DISTURBED NA — UNDISTURBED 18
4. NAME OF DRILLER A. Bushey	13. TOTAL NUMBER CORE BOXES NA
	14. DEPTH TO GROUND WATER ENCOUNTERED 35 Feet BSG
5. DIRECTION OF HOLE VERTICAL ☒ _____ DEG. FROM VERT INCLINED ☐	15. DATE HOLE — STARTED 11/10/10 — COMPLETED 11/10/10
	16. ELEVATION TOP OF HOLE NA
6. THICKNESS OF OVERBURDEN 40	17. TOTAL CORE RECOVERY FOR BORING NA
7. DEPTH DRILLED INTO ROCK NE	18. LOGGED BY D. Ledgerwood — CHECKED BY R. Andersen
8. TOTAL DEPTH OF HOLE 40	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr3/4, Dark Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium to High Toughness, 5% Fine Sand, No HCL Reaction										
		3 3 5	8	11			28	FS#1								PP=3.5
2																
		3 2 5	7	9		Same as above except; 10yr4/4 Dark Yellow Brown, Weak HCL Reaction	67	FS#2								PP>4.5
4																
		2 5 6	11	15		FAT CLAY, Sandy (CH); Moist, 10yr6/8 Brownish Yellow, High Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand, Weak HCL Reaction	44	FS#3	0	38	62	61	39	15.5	CH	PP=2.25
6																
		5 7 12	19	25		Same as above except; Trace Coarse Sand, No HCL Reaction	39	FS#4								PP=4.0
8																
		7 9 9	18	24		LEAN CLAY with Sand (CL); Moist, 10yr5/4 Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 20% Fine Sand, Strong HCL Reaction	56	FS#5								PP>4.5
10																
		4 5 8	13	17		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 55% Low Plastic Fines, Medium to High Dry Strength, None Dilatency, Low to Medium Tough, 45% Fine Sand, Strong HCL Reaction	67	FS#6								PP=2.5
12																
						SAND, Clayey (SC); Moist, 10yr5/4 Yellow Brown, 55% Fine to Medium Sand, 45% Low Plastic Fines, High Dry Strength, None										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-02
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1931232.885 E 6397855.762	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		14 13 13	26	35		Dilatency, Low to Medium Tough, No HCL Reaction	72	FS#7								
16		8 9 15	24	32		FAT CLAY, Sandy (CH); Moist, 10yr5/4 Yellow Brown, Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand, Strong HCL Reaction	83	FS#8	0	42	58	58	39	12.1	CH	PP=4.0
18		9 11 15	26	35		SAND, SILTY (SM); Moist, 10yr5/4 Yellow Brown, 65% Fine to Medium Sand, 35% None to Low Plastic Fines, No HCL Reaction	89	FS#9								
20		12 16 20	36	48		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 30% Fine Sand, Trace Medium to Coarse Sand, Weak HCL Reaction	83	FS#10								PP>4.5
22		6 12 15	27	36		SAND, Clayey (SC); Moist, 10yr5/8 Yellow Brown, 70% Fine to Medium Sand, 30% Low Plastic Fines, High Dry Strength, None Dilatency, Low to Medium Tough, No HCL Reaction	83	FS#11	0	70	30					
24		12 20 25	45	60		LEAN CLAY with Sand (CL); Moist, 7.5yr5/6 Strong Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 15% Fine to Coarse Sand, Trace Coarse Subrounded Gravel to 1 inch, No HCL Reaction	83	FS#12								PP>4.5
26																
28		12 16 15	31	41		LEAN Clay, Sandy (CL); Moist, 10yr6/6 Brownish Yellow, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 30% Fine to Coarse Sand, Trace Coarse Subrounded Gravel to 1 inch, No HCL Reaction	67	FS#13								PP>4.5
30		5 8 8	16	21		SAND, Silty (SM); Moist, 2.5yr6/6 Olive Yellow, 60% Fine Sand, 40% Non Plastic Fines, No HCL Reaction	100	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-02	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1931232.885 E 6397855.762	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	2 6 6	12	16		SILT, Sandy (ML); Moist, 5yr5/4 Pale Olive, 70% Non Plastic Fines, No Dry Strength, Slow Dilatency, No Thread, 30% Fine Sand, No HCL Reaction	100	FS#15								PP=1.5
34																
36	■	8 10 14	24	32		SILT, Clayey (ML/CL); Wet, 5yr5/4 Olive, 90% Non to Low Plastic Fines, No Dry Strength, None Dilatency, Low Toughness, No Thread, 10% Fine Sand, No HCL Reaction	100	FS#16								
38																
	■	2 3 4	7	9		Same as Above	100	FS#17								
40						SAND, Poorly Graded (SP), Wet, 10yr6/8 Brownish Yellow, 100% Fine to Medium Sand, No HCL Reaction		FS#18								
						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 4 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	8" HSA / 4" Mud Rotary
2. HOLE NO.	2F-11-03
LOCATION COORDINATES	N 1932408.891 E 6398473.671
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 25
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	44.5 Feet BSG
5. DIRECTION OF HOLE	VERTICAL ☒ INCLINED ☐ _____ DEG. FROM VERT
15. DATE HOLE	STARTED 11/29/10; COMPLETED 11/29/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	60
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	60

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY, Sandy, (CL); Moist, 10yr5/6, Yellow Brown, 70% Low Plastic Fines, High Dry Strength, Non Dilatency, Medium Tough, 30% Fine Sand, Trace Fine Subangular Gravel to 0.3 inch, No HCL Reaction										
	■	11 11 7	18	24			44	FS#1	5	41	54					PP=3.0
2						Same as Above										
	■	6 5 5	10	13			33	FS#2				37	20			PP=3.5
4						Same as Above Except; 80% Fines, 20% Fine to Medium Sand, No Gravel										
	■	7 9 10	19	25			33	FS#3								PP>4.5
6						LEAN CLAY, With Sand (CL); Moist, 10yr4/6 Dark Yellow Brown, 90% Low Plastic Fines, High Dry Strength, Non Dilatency, Medium Toughness, 10% Fine Sand, No HCL Reaction										
	■	7 10 11	21	28			33	FS#4								PP>4.5
8						Same as Above										
	■	8 9 13	22	29			44	FS#5								PP>4.5
10						LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, Low Plastic Fines, High Dry Strength, Non Dilatency, Medium Toughness, Fine Sand, No HCL Reaction										
	■	7 8 8	16	21			61	FS#6	0	37	63	28	15	12.2	CL	PP>4.5
12						Same As Above										
	■															PP=2.0

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-03

PROJECT	INSTALLATION	SHEET 2 OF 4 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1932408.891 E 6398473.671	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
		3 4 21	25	33		SAND, Poorly Graded (SP); Moist, 10yr7/2 Light Gray, 90% Fine to Coarse Sand, 5% Non Plastic Fines, 5% Fine Sub Angular Gravel to 0.3 inches, Weak HCL Reaction	67	FS#7 FS#8								
14		13 14 20	34	45		SAND, Silty With Gravel (SM); Moist, 10yr7/2 Light Gray, Fine to Coarse Sand, Fine to Coarse Sub Angular Gravel to 1.5 inches, Strong HCL Reaction	67	FS#9	35	50	15					
16		7 7 10	17	23		LEAN CLAY, Sandy (CL); Moist, 10yr5/6 Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 40% Fine to Medium Sand, No HCL Reaction	61	FS#10								PP=3.5
18		7 8 11	19	25		SAND, Silty (SM); Moist, 10yr5/6 Yellow Brown, Fine to Medium Sand, Low Plastic Fines, No HCL Reaction	72	FS#11	0	65	35	NV	NP	9.9	SM	
20		8 9 15	24	32		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, No HCL Reaction	78	FS#12								PP=4.5
22																
24		5 6 7	13	17		SAND, Silty (SM); Moist, 10yr5/8 Yellow Brown, 80% Fine Sand, 20% Non-plastic Fines, No HCL Reaction	39	FS#13								
26																
		11 7 9	16	21		LEAN CLAY, With Sand (CL); Moist, 10yr4/4 Dark Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 20% Fine Sand, No HCL Reaction	44	FS#14								PP>4.5
28																
30		3 4 6	10	13		LEAN CLAY, (CL); Moist, 10yr5/6 Yellow Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, No HCL Reaction	44	FS#15								PP=2.0

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-03	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 4 SHEETS
LOCATION COORDINATES N 1932408.891 E 6398473.671	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		3 7 11	18	24		Same as Above	89	FS#16								PP>4.5
34																
36		3 10 13	23	31		Silty, Clayey Sand (SM-SC); Moist, 10YR5/4 Yellow Brown, Fine Sand, Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, No HCL Reaction	83	FS#17	0	52	48	24	7	14.9	SM-SC	
38																
		11 16 27	43	57		Same as Above Except; Trace Fine Subangular Gravel to 0.3 inches, Strong HCL Reaction	89	FS#18								
40																
42		8 19 27	46	61		LEAN CLAY, with Sand (CL); Moist, 7.5yr6/6 Reddish Yellow, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine to Medium Sand, Trace Fine to Coarse Sub Rounded Gravel to 0.5 inches, Strong HCL Reaction	61	FS#19								PP>4.5
44																
		15 17 21	38	51		LEAN CLAY, Sandy (CL); Wet, 10yr5/6 Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 40% Fine Sand, Trace Fine to Coarse Sub Rounded to Sub Angular Gravel to 0.6 inches, Strong HCL Reaction	44	FS#20								Switched to Mud Rotary
46																
48		15 16 18	34	45		SAND, Poorly Graded with Silt (SP-SM); Wet, 10yr6/6 Brownish Yellow, 90% Fine Sand, 10% Non Plastic Fines, No HCL Reaction	56	FS#21								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-03
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District
	SHEET 4 OF 4 SHEETS
LOCATION COORDINATES: N 1932408.891 E 6398473.671	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
50																
		12 15 16	31	41		SAND, Silty (SM); Wet, 10yr5/2 Grayish Brown, 80% Fine Sand, 20% Non Plastic Fines, No HCL Reaction	100	FS#22								
52																
54		12 11 15	26	35		Same as Above Except; Trace Coarse Sub Angular Gravel to 0.6 inches, Weak to Strong HCL Reaction	94	FS#23								
56																
		8 12 16	28	37		Same as Above Except; 65% Fine Sand, 35% Non Plastic Fines, No HCL Reaction	100	FS#24								
58																
		9 12 20	32	43		SILT, Sandy (ML), Wet, 10yr5/2 Gray Brown, 70% Non Plastic Fines, 30% Fine Sand, Strong HCL Reaction	100	FS#25								PP>4.5
60						Bottom of Boring at 60 Feet BSG										
62																
64																
66																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-04	LOCATION COORDINATES: N 1933586.65 E 6398800.678	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 18
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: 35.0 Feet BSG		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/10/10	COMPLETED: 11/10/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, (CH); Moist, 10yr6/4 Light Yellow Brown, High Plastic Fines, 90% High Dry Strength, Medium Toughness, 10% Fine Sand, No HCL Reaction										
		13 11 9	20	27			22	FS#1								PP>4.5
2																
		6 4 4	8	11		Same as Above except; FAT CLAY, With Sand (CH); 10yr5/6 Yellow Brown	44	FS#2	0	25	75	53	30	7.5	CH	PP>4.5
4																
		6 7 10	17	23		Same as Above Except Trace Coarse Sand, Weak HCL Reaction	44	FS#3								PP>4.5
6																
		8 15 25	40	53		Same as Above Except; 100% Fines, Trace Fine Sand, Strong HCL Reaction	67	FS#4								PP>4.5
8																
		15 17 20	37	49		SAND, Silty with Gravel (SM); Moist, 10yr6/2 Light Brownish Gray, Fine to Coarse Sand, Fine to Coarse Sub Rounded Gravel to 1.1 inches, Non Plastic Fines, Weak HCL Reaction	83	FS#5	37	50	13					
10																
		5 9 10	19	25		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Sub Rounded Gravel to 0.8 inches, No HCL Reaction	56	FS#6								
12																
						Same as Above Except; Fine to Coarse Sub Rounded Gravel to 1 inch, Strong HCL Reaction										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-04
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1933586.65 E 6398800.678	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		5 8 8	16	21			61	FS#7								
16		2 1 2	3	4		SAND, Poorly Graded (SP); Moist, 10yr6/8 Brownish Yellow, 100% Fine to Medium Sand, No HCL Reaction	67	FS#8								
18		2 3 4	7	9		Same as Above	100	FS#9								
20		3 5 9	14	19		Same as Above Except; 100% Fine to Coarse Sand, Trace Fine Sub Rounded Gravel to 0.5 inches	100	FS#10								
22		7 11 16	27	36		SAND, Poorly Graded With Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Sub Rounded Gravel to 1 inches, No HCL Reaction	100	FS#11								
24		6 5 5	10	13		Same as Above Except; Fine Subrounded Gravel to 0.5 inch, Trace Coarse Sub Rounded Gravel to 1 inch	89	FS#12	23	65	12					
26																
28		5 15 14	29	39		LEAN CLAY, Sandy (CL); Moist, 10yr5/6 Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency, Low to Medium Toughness, 40% Fine Sand, No HCL Reaction	89	FS#13								PP=3.0
30		9 8 7	15	20		Same as Above Except; Trace Subrounded Fine Gravel to 0.5 inch	89	FS#14								PP=3.5

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-04
PROJECT Orestimba, Newman	INSTALLATION Sacramento District — SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1933586.65 E 6398800.678	COORDINATE SYSTEM State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	2 2 2	4	5		Same as Above Except; 10yr4/6 Dark Yellow Brown, Trace Coarse Sand	100	FS#15	1	37	62	42	23	16.1	CL	PP=3.5
34																
	■	3 4 3	7	9		Same as Above Except; Wet	78	FS#16								PP=2.5
36																
38																
	■	2 5 29	34	45		Same as Above	100	FS#17 FS#18								PP=2.5
40						SAND, Poorly Graded With Gravel (SP); Wet, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1.5 inches, Strong HCL Reaction										
						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG	DIVISION South Pacific	INSTALLATION Sacramento District	SHEET 1 OF 3 SHEETS

1. PROJECT Orestimba, Newman	9. COORDINATE SYSTEM State Plane CA Zone 2 NAD83
	10. SIZE AND TYPE OF BIT 6 5/8" HSA
2. HOLE NO. 2F-11-05 — LOCATION COORDINATES N 1934415.226 E 6399678.189	11. MANUFACTURER'S DESIGNATION OF DRILL CME 75
3. DRILLING AGENCY Moore Twining Associates, Inc.	12. TOTAL SAMPLES — DISTURBED NA — UNDISTURBED 17
4. NAME OF DRILLER A. Bushey	13. TOTAL NUMBER CORE BOXES NA
	14. DEPTH TO GROUND WATER ENCOUNTERED 37.5 Feet BSG
5. DIRECTION OF HOLE VERTICAL ☒ _____ DEG. FROM VERT INCLINED ☐	15. DATE HOLE — STARTED 11/9/10 — COMPLETED 11/9/10
	16. ELEVATION TOP OF HOLE NA
6. THICKNESS OF OVERBURDEN 40	17. TOTAL CORE RECOVERY FOR BORING NA
7. DEPTH DRILLED INTO ROCK NE	18. LOGGED BY D. Ledgerwood — CHECKED BY R. Andersen
8. TOTAL DEPTH OF HOLE 40	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr4 3 Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Weak HCL Reaction										
	■	5 6 6	12	16			22	FS#1								PP=2.0
2																
	■	3 5 4	9	12		Same as Above Except; Trace Coarse Sand	28	FS#2								PP>4.5
4																
	■	2 1 2	3	4		LEAN CLAY With Sand (CL); 10yr5/6 Yellow Brown, Moist, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Coarse Subrounded Gravel to 1.3 inches, Strong HCL Reaction	28	FS#3								PP=2.5
6																
	■	12 9 12	21	28		SAND, Poorly Graded With Silt (SP-SM); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 10% Non Plastic Fines, 10% Fine Sub Rounded Gravel to 0.5 inch, No HCL Reaction	67	FS#4								
8																
	■	13 10 13	23	31		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subrounded Gravel to 1 inches, Non Plastic Fines, No HCL Reaction	78	FS#5	37	50	13					
10																
	■	6 10 12	22	29		SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Subrounded Gravel to 1.1 inches, Weak HCL Reaction	83	FS#6								
12																
	■					Same as Above Except; Gravel to 1.3 inches, No HCL Reaction										

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-05

PROJECT	INSTALLATION	SHEET 2 OF 3 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1934415.226 E 6399678.189	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		4 13 10	23	31			83	FS#7								
16		2 3 5	8	11		FAT CLAY, Sandy (CH); Moist, 10yr4/6 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, Strong HCL Reaction	89	FS#8	0	30	70	50	31	16.8	CH	PP=1.5
18		5 10 13	23	31		Same as Above Except; Weak to Strong HCL Reaction	100	FS#9								PP=3.5
20		7 11 14	25	33		LEAN CLAY, With Sand (CL), Moist, 10yr5/6 Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Fine Subrounded Gravel to 0.4 inches, Strong HCL Reaction	100	FS#10								PP>4.5
22		4 5 10	15	20		LEAN CLAY, Sandy (CL), Moist, 10yr5/8 Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, No HCL Reaction	89	FS#11								PP=3.0
24		6 5 6	11	15		Same as Above Except; Trace Medium to Coarse Sand	56	FS#12								PP=2.5
28		4 5 8	13	17		FAT CLAY, Sandy (CH); Moist, 10yr5/6 Yellow Brown, 90% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Strong HCL Reaction	56	FS#13	0	35	65	58	37	15.0	CH	PP=3.75
30		10 14 17	31	41		LEAN CLAY, Sandy (CL); Moist, 10yr4/6 Dark Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine to Medium Sand, No HCL Reaction	100	FS#14								PP>4.5

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-05	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1934415.226 E 6399678.189	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	7 11 13	24	32		LEAN CLAY, With Sand (CL); Moist, 10yr4/6 Dark Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Strong HCL Reaction	89	FS#15								PP>4.5
34																
36	■	3 3 4	7	9		LEAN CLAY, Sandy (CL); Moist, 10yr5/6 Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 40% Fine Sand, No HCL Reaction	89	FS#16								PP=2.0
38																
	■	2 2 3	5	7		LEAN CLAY (CL); Moist, 10yr5 8 Yellow Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Low to Medium Toughness, 10% Fine Sand, Trace Medium to Coarse Sand, Weak HCL Reaction	78	FS#17								PP=2.5
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-06	LOCATION COORDINATES: N 1935104.235 E 6400764.227	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 17
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: 38.5 Feet BSG		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/9/10	COMPLETED: 11/9/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, with Sand (CH); Moist, 10yr4/3 Brown, 95% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Strong HCL Reaction										
		3 4 4	8	11			33	FS#1								PP=4.5
2						Same as Above										
		4 5 5	10	13			83	FS#2	1	26	73	60	37	11.3	CH	PP=2
4																
		2 2 2	4	5		LEAN CLAY, With Sand (CL); Moist, 10yr5/3 Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, Weak HCL Reaction	44	FS#3								PP=1.5
6																
		2 2 2	4	5		LEAN CLAY, Sandy (CL); Moist 10yr4/6 Dark Yellow Brown, 60% Low Plastic Fines, High Dry Strength, None Dilatency Low to Medium Toughness, 40% Fine Sand, Strong HCL Reaction	44	FS#4								PP=1.25
8																
		3 4 5	9	12		SAND, Clayey with Gravel (SC); Moist, 10yr4/6 Dark Yellow Brown, 80% Fine Sand, 20% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Coarse Gravels Sub Rounded to 1.5 inches, Strong HCL Reaction	39	FS#5	28	34	38					PP=4.0
10																
		10 8 6	14	19		SAND, Poorly Graded With Silt and Gravel (SP-SM); Moist 10yr6/3 Pale Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse Sub Rounded Gravel to 1 inch, 10% Non Plastic Fines, No HCL Reaction	44	FS#6								
12																
						Same as Above Except; Gravel to 1.5 inches										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-06
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1935104.235 E 6400764.227	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		5 2 3	5	7			33	FS#7								
16		10 9 10	19	25		SAND, Silty With Gravel (SM); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 15% Fine to Coarse Sub Rounded Gravel to 2 inches, 15% Non Plastic Fines, No HCL Reaction	33	FS#8								
18		13 15 12	27	36		Same as Above Except; 10yr5/3 Brown, Gravel to 1.5 inches, Weak HCL Reaction	67	FS#9	40	47	13					
20		9 7 4	11	15		SAND, Poorly Graded (SP); Moist, 10yr5/3 Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Sub Rounded Gravel to 0.8 inches, No HCL Reaction	44	FS#10								
22		5 4 5	9	12		FAT CLAY, Sandy (CH); Moist, 10yr4/6 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, No HCL Reaction	56	FS#11	0	32	68	58	36	13.9	CH	PP>4.5
24		11 14 13	27	36		SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine Gravel Sub Rounded to 0.5 inches, No HCL Reaction	89	FS#12								
26																
28		13 11 9	20	27		Same as Above Except; 10yr6/4 Light Yellow Brown, Fine to Coarse Sub Rounded Gravel to 1 inch	78	FS#13								
30		4 4 8	12	16		LEAN CLAY (CL); Moist, 10yr5 6 Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, 5% Fine Sand, No HCL Reaction	100	FS#14								PP=3.0

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-06

PROJECT	INSTALLATION	SHEET 3 OF 3 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1935104.235 E 6400764.227	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	23 46 34	77	102		SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Sub Rounded Gravel to 1 inch, No HCL Reaction	67	FS#15								
34																
36	■	13 18 18	36	48		SAND, Poorly Graded With Silt (SP-SM); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 10% Non Plastic Fines, 10% Fine Sub Rounded Gravel to 0.6 inches, No HCL Reaction	56	FS#16								
38																
	■	9 4 5	9	12		LEAN CLAY (CL); Moist, 10yr6/6 Brownish Yellow, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, No HCL Reaction	83	FS#17								PP=2.5
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 4 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 8" HSA / 4" Mud Rotary		
2. HOLE NO.: 2F-11-07	LOCATION COORDINATES: N 1936107.117 E 6401113.338	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 25
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: 52.0 Feet BSG		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 12/1/10	COMPLETED: 12/1/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 60	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 60			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY With Sand (CL); Moist, 10yr4/4 Dark Yellow Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, Weak HCL Reaction										
	■	3 4 6	10	13			44	FS#1								PP>4.5
2																
	■	6 8 9	17	23		Same as Above Except; No HCL Reaction	44	FS#2								PP>4.5
4																
	■	4 6 7	13	17		Same as Above Except; 75% Fines, 25% Fine Sand, Strong HCL Reaction	33	FS#3								PP=4.5
6																
	■	2 2 2	4	5		LEAN CLAY (CL); Moist 10yr5/6 Yellow Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Strong HCL Reaction	22	FS#4								PP=1.5
8																
	■	2 3 2	5	7		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, Strong HCL Reaction	44	FS#5								PP=1.5
10																
	■	1 2 4	6	8		LEAN CLAY with Sand (CL); Moist, 10yr5/4 Yellow Brown, Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, No HCL Reaction	44	FS#6	0	26	74	32	15	18.4	CL	PP=2.25
12																
	■					Same as Above Except; Trace Subrounded Fine Gravel to 0.5 inches										PP>4.5

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-07

PROJECT	INSTALLATION	SHEET 2 OF 4 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1936107.117 E 6401113.338	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		3 4 5	9	12			83	FS#7								
16		10 10 11	21	28		SAND, Poorly Graded With Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.3 inches, Strong HCL Reaction	67	FS#8	39	50	11					
18		7 12 19	31	41		Same as Above Except; Gravel to 1 inch, No HCL Reaction	78	FS#9								
20		18 22 15	37	49		Same as Above	100	FS#10								
22		10 8 8	16	21		SAND, Poorly Graded (SP); Moist, 10yr4/3 Brown, 95% Fine to Coarse Sand, 5% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	94	FS#11								
24		7 7 7	14	19		LEAN CLAY, With Sand (CL); Moist, 10yr5/6 Yellow Brown, 85% Low Plastic Fines, High Dry Strength, Non Dilatency, Medium Toughness, 15% Fine Sand, No HCL Reaction	100	FS#12								PP=2.75
26		4 5 5	10	13		Same as Above Except; LEAN CLAY, Sandy (CL); Weak HCL Reaction	89	FS#13	0	40	60	35	18	17.7	CL	PP=1.5
30		4 5 6	11	15		Same as Above Except; No HCL Reaction	100	FS#14								PP=2.25

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-07
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 3 OF 4 SHEETS
LOCATION COORDINATES: N 1936107.117 E 6401113.338	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		4 4 4	8	11		Same as Above Except; Weak HCL Reaction	56	FS#15								PP=2.5
34																
36		8 26 27	53	70		SAND, Clayey (SC); Moist, 10yr5/3 Brown, 75% Fine to Medium Sand, 25% Low Plastic Fines, No HCL Reaction	100	FS#17 FS#16								
						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, Weak HCL Reaction										
38																
		14 13 17	30	40		SAND, Silty with Gravel (SM); Moist, 10yr5/3 Brown, 88% Fine to Coarse Sand, 12% Non Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	100	FS#18								
40																
42		20 12 13	25	33		Same as above	78	FS#19	41	46	13					
44																
		8 6 8	14	19		LEAN CLAY, Sandy (CL); Moist, 10yr5/3 Brown, 65% Low Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, 35% Fine Sand, Trace Fine Subrounded Gravel to 0.3 inches, No HCL Reaction	100	FS#20								PP=2.5
46																
48		24 10 4	14	19		SAND, Poorly Graded with Gravel (SP); Moist, 10yr4/3 Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, No HCL Reaction	100	FS#21								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-07
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District
	SHEET 4 OF 4 SHEETS
LOCATION COORDINATES: N 1936107.117 E 6401113.338	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
50																
		8 12 17	29	39		SAND, Silty with Gravel (SM); Moist, 10yr5/3 Brown, Fine to Coarse Sand, Non Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 0.8 inches, Weak HCL Reaction	100	FS#22	43	44	13					
52																
54		16 13 14	27	36		Same as Above Except; No HCL Reaction	83	FS#23								
56																
		17 18 18	36	48		Same as Above Except; Fine Subrounded to Subangular Gravel to 0.5 inches	100	FS#24								
58																
		26 43 37	80	106		Same as Above Except; Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	100	FS#25								
60						Bottom of Boring at 60 Feet BSG										
62																
64																
66																

DRILLING LOG	DIVISION South Pacific	INSTALLATION Sacramento District	SHEET 1 OF 3 SHEETS

1. PROJECT Orestimba, Newman	9. COORDINATE SYSTEM State Plane CA Zone 2 NAD83
	10. SIZE AND TYPE OF BIT 6 5/8" HSA
2. HOLE NO. 2F-11-08 — LOCATION COORDINATES N 1937265.985 E 6401562.221	11. MANUFACTURER'S DESIGNATION OF DRILL CME 75
3. DRILLING AGENCY Moore Twining Associates, Inc.	12. TOTAL SAMPLES — DISTURBED NA — UNDISTURBED 17
4. NAME OF DRILLER A. Bushey	13. TOTAL NUMBER CORE BOXES NA
	14. DEPTH TO GROUND WATER ENCOUNTERED NE
5. DIRECTION OF HOLE — VERTICAL ☒ _____ DEG. FROM VERT — INCLINED ☐	15. DATE HOLE — STARTED 11/8/10 — COMPLETED 11/8/10
	16. ELEVATION TOP OF HOLE NA
6. THICKNESS OF OVERBURDEN 40	17. TOTAL CORE RECOVERY FOR BORING NA
7. DEPTH DRILLED INTO ROCK NE	18. LOGGED BY D. Ledgerwood — CHECKED BY R. Andersen
8. TOTAL DEPTH OF HOLE 40	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY, with Sand (CL); Moist, 10yr4/3 Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Coarse Sand, No HCL Reaction										
		6 5 5	10	13			33	FS#1								PP>4.5
2																
		2 2 2	4	5		Same as Above Except; Weak HCL Reaction	33	FS#2								PP=4.25
4																
		1 1 2	3	4		FAT CLAY, Sandy (CH); Moist, 10yr4/4 Dark Yellow Brown, High Plastic Fines, High Dry Strength, Medium Toughness, Fine Sand, Strong HCL Reaction	39	FS#3	1	36	63	51	30	12.0	CH	PP=2.5
6																
		1 3 11	14	19		Same as Above Except; Fine to Medium Sand	44	FS#4 FS#5								
8						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 0.7 inches, Weak HCL Reaction										
		8 7 8	15	20		SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine Subrounded Gravel to 0.4 inches, No HCL Reaction	56	FS#6								
10																
		5 4 5	9	12		Same as Above Except; 100% Fine to Medium Sand, Weak HCL Reaction	67	FS#7								
12																
						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-08
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1937265.985 E 6401562.221	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		6 14 17	31	41		Subrounded Gravel to 0.8 inches, Weak HCL Reaction	56	FS#8								
16		12 8 13	21	28		Same as Above Except; Gravel to 1.5 inches	6	FS#9								
18		16 14 10	24	32		Same as Above Except; No HCL Reaction	78	FS#10								
20		5 9 11	20	27		SAND, Well Graded with Silt and Gravel (SW-SM); Fine to Coarse Sand, Fine to Coarse Subrounded Gravel to 1 inches, No HCL Reaction	67	FS#11	32	58	10					
22		21 26 20	46	61		SAND, Poorly Graded with Silt and Gravel (SP-SM); 10yr6/4 Light Yellow Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1.2 inches, 10% Non Plastic Fines, Weak HCL Reactions	72	FS#12								
24		7 5 2	7	9		No Recovery	0									
28		24 20 15	35	47		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 0.8 inches, No HCL Reaction	89	FS#13								
30		18 15 18	33	44		SAND, Poorly Graded with Silt (SP); Moist, 10yr5/3 Brown, 85% Fine to Coarse Sand, 10% Non Plastic Fines, 5% Fine Subrounded Gravels to 0.3 inches, No HCL Reaction	89	FS#14								

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-08

PROJECT	INSTALLATION	SHEET 3 OF 3 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1937265.985 E 6401562.221	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	9 9 6	15	20		SAND, Poorly Graded (SP); Moist, 10yr5/4 Yellow Brown, 90% Fine to Medium Sand, Trace Coarse Sand, 5% Non Plastic Fines, 5% Fine to Coarse Subrounded Gravel to 0.7 inches, No HCL Reaction	89	FS#15								
34																
36	■	15 3 3	6	8		Same as Above Except; Gravel to 0.9 inches	56	FS#16								
38																
	■	4 3 4	7	9		SILTY CLAY, with Sand (CL-ML); Moist, 10yr5/6 Light Yellow Brown, Low Plastic Fines, Medium Dry Strength, Non Dilatency, Low to Medium Toughness, Fine Sand, Weak HCL Reaction	67	FS#17	1	22	77					PP=1.5
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-09	LOCATION COORDINATES: N 1938292.199 E 6402280.741	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 17
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/8/10	COMPLETED: 11/8/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY, with Sand (CL); Moist, 10yr4/4 Dark Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Subrounded Gravel to 0.4 inches, No HCL Reaction										
	■	3 3 2	5	7			33	FS#1								PP>4.5
2						Same as Above Except; Strong HCL Reaction, No Gravel										
	■	4 3 4	12	16			44	FS#2								PP>4.5
4																
	■	5 5 4	9	12		FAT CLAY, Sandy (CH); Moist, 10yr5/5 Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, Strong HCL Reaction	44	FS#3	0	38	62	50	29	12.3	CH	PP>4.5
6																
	■	2 3 5	8	11		Same as Above Except; Fine to Medium Sand, Trace Fine Subrounded Gravel to 0.4 inches, No HCL Reaction	44	FS#4								PP=3.5
						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 0.7 inches, No HCL Reaction		FS#5								
8																
	■	10 10 13	23	31		Same as Above Except; Gravel to 1 inch	67	FS#6								
10																
	■	10 8 12	20	27		Same as Above Except; Subrounded to Subangular Gravel to 1.5 inches, Strong HCL Reaction	67	FS#7								
12																
	■					Sand, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse			27	62	11					

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-09
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District; SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1938292.199 E 6402280.741	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		10 15 13	28	37		Subrounded to Subangular Gravel to 1.3 inches, Non Plastic Fines, No HCL Reaction	72	FS#8								
16		6 6 6	14	19		SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Subrounded Gravel to 1.2 inches, No HCL Reaction	78	FS#9								
18		4 8 7	15	20		Same as Above	100	FS#10								
20		4 8 8	16	21		No Recovery	0									
22		8 8 6	14	19		Same as Above Except; Gravel to 1.5 inches	28	FS#11								
24		8 6 12	18	24		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, No HCL Reaction	78	FS#12								
26																
28		6 12 16	20	27		SAND, Silty with Gravel (SM); Moist, 10yr5/3 Brown, Fine to Coarse Sand, Fine to Coarse Subrounded Gravel to 1.0 inch, Non to Low Plastic Fines, Strong HCL Reaction	100	FS#13	33	52	15					
30		6 8 12	28	37		SAND, Poorly Graded (SP); Moist, 10yr5/3 Brown, 90% Fine to Coarse Sand, 5% Fine to Coarse Subrounded Gravel to 0.8 inches, 5% Non Plastic Fines, No HCL Reaction	100	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-09	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1938292.199 E 6402280.741	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	3 3 8				LEAN CLAY, Sandy (CL); Moist, 10Yr4/4 Dark Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, 30% Fine Sand, No HCL Reaction	89	FS#15								PP=2.5
34																
36	■	9 24 26	50	67		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.1 inches, No HCL Reaction	100	FS#16								
38																
	■	4 3 6	9	12		SILTY CLAY, with Sand (CL-ML); Moist, 10yr5/4 Yellow Brown, 80% Low Plastic Fines, Medium Dry Strength, None Dilatency, Low to Medium Toughness, 20% Fine Sand, No HCL Reaction	89	FS#17								PP=2.0
40						Bottom of Boring At 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-10	LOCATION COORDINATES: N 1939496.529 E 6402430.284	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 20
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/4/10	COMPLETED: 11/4/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY, With Sand (CL); Moist, 10yr5/3 Brown, 80% Low Plastic Fines, High Dry Strength , None Dilatency, Medium Toughness, 20% Fine Sand, Trace Sub Rounded Fine Gravel to 0.4", No HCL Reaction										
		6 6 6	12	16			42	FS#1								PP>4.5
2						Same as Above Except; 10yr4/4 Dark Yellow Brown										
		3 2 3	5	7			19	FS#2								PP=4.0
4						FAT CLAY, Sandy (CH); Moist 10yr4/4 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine to Medium Sand, Trace Fine to Coarse Subrounded Gravel to 1.3 inches, Strong HCL Reaction			6	33	61	50	31	9.1	CH	
		4 4 5	9	12			53	FS#3								PP=3.5
6						Same as Above										
		6 6 11	17	23			72	FS#4								PP=3
						SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/4 Light Yellow Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1 inch, 10% Non Plastic Fines, Weak HCL Reaction		FS#5								
8									58	35	7					
		11 14 18	32	43		Well Graded Gravel with Silt and Sand (GW-GM); 10yr6/3 Light Yellow Brown, Fine to Coarse Subrounded Gravel to 1.6 inches, Fine to Coarse Sand, Non Plastic Fines, Weak to Strong HCL Reaction	61	FS#6								
10						AT 10.5 Feet BSG Same as Above										
		4 6 8	14	19			69	FS#7								
						At 11.5 Feet BSG: SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 95% Fine to Coarse Sand, 5% Non Plastic Fines, Subrounded to Subangular Gravel to 0.3 inches, Weak HCL Reaction		FS#8 FS#9								
12									45	44	11					
						LEAN CLAY, With Sand (CL); Moist, 10yr4/										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-10
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1939496.529 E 6402430.284	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		14 11 11	22	29		4 Dark Yellow Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, Trace Coarse Gravel to 1 inch, Weak HCL Reaction	67	FS#10								
16		16 29 31	60	80		Poorly Graded Gravel with Silt and Sand (GP-GM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Subrounded Gravel to 1.4 inches, Fine to Coarse Sand, Non Plastic Fines, No HCL Reaction, 2 inch Lens of Silty Sand	89	FS#11								
18		12 18 7	25	33		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 25% Fine to Coarse Subrounded Gravel to 1 inch, 5% Non Plastic Fines, Strong HCL Reaction Same as Above	61	FS#12								
20		2 2 6	8	11		FAT CLAY with Sand (CH); Moist, 10yr5/4, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, Trace Subrounded Coarse Gravel to 1 inch, Weak HCL Reaction	83	FS#13	4	15	81	55	32	20.7	CH	PP=1.5
22		19 19 21	40	53		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 75% Fine to Coarse Sand, 25% Fine to Coarse Subrounded Gravel, Weak HCL Reaction	67	FS#14								
24		4 8 10	18	24		LEAN CLAY (CL); Moist, 10yr4/ 4 Dark Yellow Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Trace Fine to Coarse Subrounded Gravel to 0.7 inches, 1 inch Poorly Graded Sand Lens, No HCL Reaction	67	FS#15								PP=1.0
26																
28		4 5 7	12	16		FAT CLAY with Sand (CH); Moist, 10yr4/4 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Coarse Sand, Weak HCL Reaction	67	FS#16	3	26	71	56	33		CH	PP=2.5
30		3 5 10	15	20		Same as Above Except; 90% Fines, 10% Fine to Medium Sand, Strong HCL Reaction	78	FS#17								PP=4.0

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-10
PROJECT Orestimba, Newman	INSTALLATION Sacramento District; SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1939496.529 E 6402430.284	COORDINATE SYSTEM State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	17 23 16	39	52		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/3 Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1.1 inches, Weak HCL Reaction	78	FS#18								
34																
36	■	3 3 7	10	13		SAND, Clayey (SC); Moist, 10yr5/4 Yellow Brown, 60% Fine to Medium Sand, 40% Low Plastic Fines, No HCL Reaction	78	FS#19								
38																
	■	13 18 18	36	48		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/3 Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1.5 inches, Weak HCL Reaction	75	FS#20								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 4 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 8" HSA / 4" Mud Rotary		
2. HOLE NO.: 2F-11-11	LOCATION COORDINATES: N 1940740.366 E 6402673.096	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 30
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: 47.5 Feet BSG		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/2/10	COMPLETED: 11/3/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 60	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 60			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, Sandy (CH); Moist, 10yr4/3 Brown, High Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, Fine Sand, Trace Fine Subrounded Gravel to 0.4 inches, No HCL Reaction										
		4 5 5	10	13			40	FS#1	6	33	61	50	31	9.1	CH	PP>4.5
2						Same as Above Except; Trace Subangular Gravel to 0.4 inches										
		1 2 2	4	5			28	FS#2								PP=2.75
4						SAND, Poorly Graded with Silt and Gravel, (SP-SM); Moist, 10yr6/2 Light Brown Gray, Fine to Coarse Sand, Subangular to Subrounded Gravel to 1.4 inches, Non Plastic Fines, Weak to Strong HCL Reaction										
		22 22 23	45	60			92	FS#3	42	47	11					
6						Same as Above Except; Gravel to 1.5 inches, Weak HCL Reaction										
		10 10 11	21	28			81	FS#4								
8						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/2 Light Brown Gray, 70% Fine to Coarse Sand, 25% Fine to Coarse Subangular to Subrounded Gravel to 1 inch, 5% Non Plastic Fines, Strong HCL Reaction										
		4 1 3	4	5			58	FS#5 FS#6								PP=2.75
10						LEAN CLAY, Sandy (CL); Moist, 10yr4/4 Dark Yellow Brown, 70% Low Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, Trace Fine Subangular to Subrounded Gravel to 0.5 inches, No HCL Reaction										
		6 8 7	15	20			69	FS#7	44	48	8					
12						SAND, Well Graded with Silt and Gravel (SW-SM); Moist, 10yr5/4 Yellow Brown, Fine to Coarse Sand, Fine to Coarse Subangular to Subrounded Gravel to 1.2 inches, Non Plastic Fines, No HCL Reaction										

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-11

PROJECT	INSTALLATION	SHEET 2 OF 4 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1940740.366 E 6402673.096	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		4 4 5	9	12		Same as Above Except; Fine to Coarse Subangular to Subrounded Gravel to 1.2 inches, Weak HCL Reaction	75	FS#8								
16		7 9 11	20	27		Same as Above Except; Gravel to 1.5 inches	75	FS#9								
18		9 15 16	31	41		Same as Above	78	FS#10								
20		4 1 2	3	4		FAT CLAY (CH); Moist, 10yr4/4 Dark Yellow Brown, High Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, Trace Fine Sand, No HCL Reaction	67	FS#11	0	14	86	56	33	20.5	CH	PP=2.25
22		3 8 18	26	35		LEAN CLAY, Sandy (CL); Moist, 10yr5/4 Yellow Brown, 70% Low Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, No HCL Reaction	86	FS#12								PP=1.75
						SAND, Clayey (SC); Moist, 10yr5/4 Yellow Brown, 70% Fine to Medium Sand, 30% Low Plastic Fines, No HCL Reaction		FS#13 FS#14								
						SAND, Silty, with Gravel (SM); Moist, 10yr5/4 Yellow Brown, 60% Fine to Medium Sand, 25% Fine to Coarse Subangular to Subrounded Gravel to 0.8 inches, 15% Non to Low Plastic Fines, No HCL Reaction										
24		3 9 14	23	31		LEAN CLAY, Sandy (CL); Moist, 10yr4/4 Dark Yellow Brown, 70% Low Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, Trace Fine to Coarse Subrounded Gravel to 1 inch, No HCL Reaction	61	FS#15 FS#16								PP=1.5
26						SAND, Silty with Gravel (SM); Moist, 10yr5/4 Yellow Brown, 60% Fine to Medium Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 0.8 inch, 20% Non to Low Plastic Fines, No HCL Reaction										
28		10 15 16	31	41		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/3 Brown, 65% Fine to Coarse Sand, 30% Fine to Coarse Subangular to Subrounded Gravel to 1.3 inches, 5% Non Plastic Fines, No HCL Reaction	75	FS#17								
30		17 24 17	41	55		Same as Above Except; 75% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, 5% Non Plastic Fines, No HCL Reaction	75	FS#18								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-11
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 3 OF 4 SHEETS
LOCATION COORDINATES: N 1940740.366 E 6402673.096	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		5 5 5	10	13		LEAN CLAY, Sandy (CL); Moist, 10yr4/4 Dark Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, No HCL Reaction	61	FS#19								PP=2.25
34																
36		3 4 5	9	12		LEAN CLAY (CL); Moist, 10yr4/5 Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Trace Coarse Gravel to 1.4 inches, Strong HCL Reaction	94	FS#20								PP=2.5
38																
		5 7 8	15	20		LEAN CLAY, Sandy (CL); Moist, 10yr4/5 Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine Sand, Trace Coarse Subrounded Gravel to 0.8 inches, No HCL Reaction	56	FS#21								PP=4.5
40																
42		11 22 20	42	56		Same as Above Except; Trace Fine Gravel to 0.5 inches	83	FS#22 FS#23								PP=3.5
						SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/4 Yellow Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1 inches, No HCL Reaction										
44																
		10 17 8	25	33		Same as Above	67	FS#24								
46																
48		9 3 5	8	11		Same as Above Except; Wet, Subrounded Gravel to 1.5 inches	100	FS#26 FS#25								PP=3 Switched to Mud Rotary
						LEAN CLAY (CL); Wet, 10yr4/4 Dark Yellow Brown, 100% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Trace Fine to Coarse Sand, No										

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-11

PROJECT	INSTALLATION	SHEET 4 OF 4 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1940740.366 E 6402673.096	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
						HCL Reaction										
50																
	■	4 4 5	9	12		LEAN CLAY, Sandy (CL); Wet, 10yr4/6 Dark Yellow Brown, 70% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 30% Fine to Coarse Sand, Trace Subrounded Gravel to 1 inches, No HCL Reaction	58	FS#27								PP=2.75
52																
54	■	5 17 19	36	48		SAND, Poorly Graded with Silt and Gravel (SP-SM); Wet, 10yr4/4 Dark Yellow Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1.1 inches, 10% Non Plastic Fines, No HCL Reaction	89	FS#28								
56																
	■	2 3 7	10	13		GRAVEL, Poorly Graded with Sand (GP); Wet, 10yr4/4 Dark Yellow Brown, 75% Fine Subrounded to Subangular Gravel to 0.5 inches, 25% Medium to Coarse Sand, Trace Coarse Gravel to 1 inch, No HCL Reaction	100	FS#29								
58																
	■	6 15 23	38	51		SAND, Poorly Graded with Gravel (SP); Wet, 10yr4/4 Dark Yellow Brown, 60% Fine to Coarse Sand, 40% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, No HCL Reaction	67	FS#30								
60						Bottom of Boring at 60 Feet BSG										
62																
64																
66																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-12	LOCATION COORDINATES: N 1941745.831 E 6403208.176	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 18
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: 38.5 Feet BSG		
5. DIRECTION OF HOLE: VERTICAL ☒ ____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/2/10	COMPLETED: 11/2/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, Sandy with Gravel (CH); Moist, 10yr4/4 Dark Yellow Brown, High Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, Fine Sand, Trace Coarse Subangular Gravel to 1 inches, No HCL Reaction										
		2 4 4	8	11			42	FS#1	19	21	60	55	34	10.4	CH	PP=2.75
2						Same as Above Except; 10yr5/3 Dark Brown, No Gravel, Weak HCL Reaction										
		2 1 2	3	4			28	FS#2								PP=3.5
4						SILTY CLAY (CL-ML), Moist, 10yr4/4 Dark Yellow Brown, 95% Low Plastic Fines, Medium Dry Strength, Non Dilatency, Medium Toughness, 5% Fine Sand, Strong HCL Reaction										
		1 1 1	2	3			42	FS#3								PP=2.75
6						FAT CLAY with Sand (CH); Moist, 10yr4/4 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand, Weak HCL Reaction										
		1 2 3	5	7			53	FS#4	0	24	76	53	30	15.2	CH	PP=1.5
8						SAND, Silty (SM); Moist, 10yr4/4 Dark Yellow Brown, 70% Fine to Medium Sand, 30% Non Plastic Fines, Trace Fine Subrounded Gravel to 0.5 inches, No HCL Reaction										
		2 2 5	8	11			44	FS#5								
10						Same as Above Except; Non to Low Plastic Fines, Trace Fine to Coarse Subangular Gravel to 1 inch										
		3 4 3	7	9			61	FS#6	2	53	45					
12						SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr5/3 Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-12	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 2 OF 3 SHEETS
LOCATION COORDINATES N 1941745.831 E 6403208.176	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		10 10 9	19	25		Subangular Gravel to 1.2 inches, 10% Non Plastic Fines, Weak HCL Reaction	50	FS#7								
16		4 10 16	26	35		SILTY CLAY (CL-ML); Moist, 10yr5/4 Yellow Brown, 95% Low Plastic Fines, Medium Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Strong HCL Reaction	89	FS#8								PP=0.75
						SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subangular to Subrounded Gravel to 1 inch, 10% Non Plastic Fines, Weak HCL Reaction		FS#9								
18		11 11 11	22	29		Same as Above	67	FS#10								
20		9 10 13	23	31		Same as Above Except; Gravel to 1.2 inches, Weak to Strong HCL Reaction	64	FS#11								
22		12 15 16	31	41		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subangular to Subrounded Gravel to 1.3 inches, Non Plastic Fines, Weak HCL Reaction	94	FS#12	34	54	12					
24		10 7 10	17	23		Same as Above Except; 10yr5/4 Yellow Brown Fine to Coarse Subangular to Subrounded Gravel to 1.4 inches, Non to Low Plastic Fines	89	FS#13								
26																
28		15 16 20	36	48		Same as Above Except; 75% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1.1 inches, No HCL Reaction	89	FS#14								
30		9 15 13	25	33		Same as Above Except; Weak HCL Reaction	69	FS#15								

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-12

PROJECT	INSTALLATION	SHEET 3 OF 3 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1941745.831 E 6403208.176	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	10 9 9	18	24		SAND, Silty with Gravel (SM); Moist, 10yr5/4 Yellow Brown, 60% Fine to Coarse Sand, 20% Non Plastic Fines, 20% Fine to Coarse Subangular to Subrounded Gravel to 1.3 inches, Weak HCL Reaction	61	FS#16								
34																
36	■	8 14 17	31	41		Same as Above Except; Fine to Coarse Sand, Subrounded to Subangular Coarse Gravel to 1.1 inches, No HCL Reaction	61	FS#17								
38																
	■	4 6 6	12	16		SILT, Sandy (ML); Moist, 10yr5/4 Yellow Brown, 55% Non Plastic Fines, Low Dry Strength, Slow Dilatency, Low Toughness, 45% Fine Sand, Trace Rounded Gravel to 0.25 inches, No HCL Reaction	100	FS#18								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-13	LOCATION COORDINATES: N 1942978.499 E 6403494.483	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 16
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/2/10	COMPLETED: 11/2/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						SAND, Clayey with Gravel (SC); Moist, 10yr5/4 Yellowish Brown, Fine Sand, Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine to Coarse Subrounded to Subangular Gravel to 1.3 inches, No HCL Reaction										
	■	7 7 6	13	17			67	FS#1	18	47	35	43	24		SC	
2																
	■	5 3 3	6	8		SAND, Silty with Gravel (SM); Moist, 10yr4/4 Dark Yellow Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1 inches, Non Plastic Fines, Strong HCL Reaction	64	FS#2	38	50	12					
4																
	■	3 7 7	14	19		Same As Above Except; 10yr5/4 Yellow Brown, Weak HCL Reaction	39	FS#3								
6																
	■	3 4 4	8	11		No Recovery	0									
8																
	■	2 2 4	6	8		LEAN CLAY, with Sand (CL); Moist, 10yr4/4 Dark Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Fine Subrounded Gravel to 0.5 inches, Weak HCL Reaction	47	FS#4								PP=4.0
10																
	■	4 5 5	10	13		FAT CLAY, Sandy (CH); Moist 10yr4/4 Dark Yellow Brown High Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand, Trace Fine to Coarse Subrounded Gravel to 0.8 inches, Strong HCL Reaction	64	FS#5	2	41	57	53	32	9.7	CH	PP=3.5
12																
	■					SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/2 Light Gray Brown, 50% Fine to Coarse Sand, 40% Fine										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-13
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1942978.499 E 6403494.483	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		11 13 14	27	36		to Coarse Subrounded to Subangular Gravel to 1.5 inches, 10% Non Plastic Fines, Weak HCL Reaction	39	FS#6								
16		9 8 10	18	24		SAND, Poorly Graded with Gravel; Moist, 10yr6/2 Light Gray Brown, 70% Fine to Coarse Sand, 30% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, Weak HCL Reaction	72	FS#7								
18		8 11 13	23	31		SAND, Poorly Graded with Silt and Gravel; Moist, 10yr6/2 Light Gray Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, Weak HCL Reaction	81	FS#8	37	53	10					
20		14 17 15	32	43		Same As Above Except; 10yr5/2 Grayish Brown, Fine to Coarse Subrounded to Subangular Gravel to 1.3"	86	FS#9								
22		11 13 17	30	40		Same as Above Except; Gravel to 1 inch	97	FS#10								
24		18 14 20	34	45		SAND, Silty with Gravel (SM); Moist, 10yr4/3 Brown, 65% Fine to Coarse Sand, 20% Non to Low Plastic Fines, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, Weak HCL Reaction	81	FS#11								
26																
28		13 10 13	23	31		SAND, Silty (SM); Moist, 10yr4/3 Brown, 60% Fine to Coarse Sand, 30% Low Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, Weak to Strong HCL Reaction	75	FS#12								
30		10 9 8	17	23		SAND, Poorly Graded with Gravel (SP); Moist, 10yr4/3 Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1.5 inches, No HCL Reaction	69	FS#13								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-13	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1942978.499 E 6403494.483	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	9 6 4	10	13		SAND, Silty (SM); Moist, 10yr4/3 Brown, 70% Fine to Coarse Sand, 20% Low Plastic Fines, 10% Fine to Coarse Subangular to Subrounded Gravel to 1.3 inches, Weak HCL Reaction	67	FS#14								
34																
36	■	20 23 21	44	59		SAND, Silty with Gravel (SM); Moist, 10yr4/3 Brown, 60% Fine to Coarse Sand, 20% Low Plastic Fines, 20% Fine to Coarse Subangular to Subrounded Gravel to 1.5 inches, Weak HCL Reaction	89	FS#15								
38																
	■	11 17 20	37	49		SAND, Silty (SM); Moist, 10yr5/4 Yellow Brown, 65% Fine to Medium Sand, 35% Non to Low Plastic Fines, Trace Subrounded to Subangular Gravel to 1.2 inches, No HCL Reaction, 2 inch Lense of Clay	86	FS#16								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-14	LOCATION COORDINATES: N 1943917.448 E 6402947.518	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 18
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/1/10	COMPLETED: 11/1/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						Lean CLAY, with Sand (CL); Moist, 2.5yr5/3 Light Olive Brown, 80% Low to Medium Plastic Fines, Hard Strength, None Dilatency, Low Toughness, 20% Fine Sand, Trace Coarse Subrounded Gravel to 0.75 inches, No HCL Reaction										
	■	6 7 8	15	20			62	FS#1								PP=2.0
2																
	■	5 4 5	9	12		FAT CLAY, Sandy (CH); Moist, 2.5yr5/3 Light Olive Brown, High Plastic Fines, None Dilatency, Low Toughness, High Dry Strength, Fine Sand, Trace Coarse Gravel to 0.75 inches, No HCL Reaction	48	FS#2	3	29	68	50	29	9	CH	PP=4.0
4																
	■	3 3 2	5	7		LEAN CLAY, with Sand (CL); Moist, 2.5yr5/3 Light Olive Brown, 75% Low Plastic Fines, Medium to High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, 5% Fine to Coarse Subrounded Gravel to 1 inch, No HCL Reaction	43	FS#3								PP>4.5
6																
	■	3 4 4	8	11		Same as Above Except; 2.5yr6/4 Light Yellow Brown, Weak HCL Reaction	36	FS#4								PP>4.5
8																
	■	5 9 25	34	45		SAND, Silty (SM); Moist, 10yr5/6 Yellow Brown, 65% Fine Sand, 35% Non Plastic Fines, None Dry Strength, Slow Dilatency, Low Toughness, No HCL Reaction	72	FS#5								
						GRAVEL, Poorly Graded with Sand (GP); Moist, 2.5yr7/2 Light Gray, 80% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, 20% Fine to Medium Sand, Weak HCL Reaction		FS#6								
10																
	■	15 13 14	27	36		SAND, Silty with Gravel (SM); Moist, 2.5yr7/2 Light Gray, Fine to Coarse Sand, Fine Subrounded to Subangular Gravel to 0.5 inches, No HCL Reaction	44	FS#7	27	55	18					
12																
	■					Same as Above Except; Fine Subangular to Subrounded Gravel to 0.6 inches										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-14
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1943917.448 E 6402947.518	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		4 12 14	26	35			61	FS#8								
16		4 8 6	14	19		SAND, Poorly Graded with Gravel (SP); Dry, 10yr6/2 Light Brownish Gray, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1.2 inches, No HCL Reaction	53	FS#9								
18		3 15 18	33	44		SAND, Poorly Graded with Gravel and Silt (SP-SM); Moist, 10yr5/3 Brown, 60% Fine to Coarse Sand, 30% Non Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.3 inches, No HCL Reaction	61	FS#10								
20		13 13 10	23	31		SAND, Poorly Graded with Gravel (SP); Moist, 10yr7/2 Light Gray, 70% Fine to Coarse Sand, 30% Fine to Coarse Subrounded to Subangular Gravel to 2 inches, Weak HCL Reaction	36	FS#11								
22		4 17 14	31	41		SAND, Poorly Graded with Silt and Gravel (SP-SM); 10yr6/3 Pale Brown, Fine to Coarse Sand, Coarse Subrounded to Subangular Gravel to 1.5 inches, Weak HCL Reaction	89	FS#12	32	61	7					
24		12 16 13	29	39		Same as Above	89	FS#13								
26						SILTY CLAY (CL-ML); Moist, 10yr5/4 Yellow Brown, 90% Low Plastic Fines, Medium to High Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Weak HCL Reaction										
28		17 13 10	23	31		SAND, Poorley Graded with Gravel and Silt (SP-SM); Moist, 10yr5/3 Brown, 65% Fine to Coarse Sand, 25% Fine to Coarse Subangular to Subrounded Gravel to 1.2 inches, 10% Non Plastic Fines, Weak HCL Reaction	92	FS#14								
30		6 13 13	26	35		SAND, Clayey (SC); Moist, 10yr5/3 Brown, Fine Sand, Low Plastic Fines, Medium to High Strength, Non Dilatency, Medium Toughness, Trace Fine Gravel to 0.5 inches, No HCL Reaction	81	FS#15	5	63	32					

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-14

PROJECT	INSTALLATION	SHEET 3 OF 3 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1943917.448 E 6402947.518	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	5 3 3	6	8		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/3 Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1 inch, Weak HCL Reaction	44	FS#16								
34																
36	■	16 24 18	42	56		Same as Above Except; Gravel to 1.2 inches, No HCL Reaction	92	FS#17								
38																
	■	10 6 13	19	25		SAND, Silty with Gravel (SM); Moist, 10yr5/3 Brown, 65% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1.4 inches, 15% Non Plastic Fines, Weak HCL Reaction	78	FS#18								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG	DIVISION South Pacific	INSTALLATION Sacramento District	SHEET 1 OF 4 SHEETS

1. PROJECT Orestimba, Newman	9. COORDINATE SYSTEM State Plane CA Zone 2 NAD83
	10. SIZE AND TYPE OF BIT 8" HSA / 4" Mud Rotary
2. HOLE NO. 2F-11-15 — LOCATION COORDINATES N 6403024.684 E 1945184.102	11. MANUFACTURER'S DESIGNATION OF DRILL CME 75
3. DRILLING AGENCY Moore Twining Associates, Inc.	12. TOTAL SAMPLES — DISTURBED NA — UNDISTURBED 21
4. NAME OF DRILLER A. Bushey	13. TOTAL NUMBER CORE BOXES NA
	14. DEPTH TO GROUND WATER ENCOUNTERED 36.5 Feet BSG
5. DIRECTION OF HOLE VERTICAL ☒ _____ DEG. FROM VERT INCLINED ☐	15. DATE HOLE — STARTED 11/30/10 — COMPLETED 11/30/10
	16. ELEVATION TOP OF HOLE NA
6. THICKNESS OF OVERBURDEN 53.5	17. TOTAL CORE RECOVERY FOR BORING NA
7. DEPTH DRILLED INTO ROCK NE	18. LOGGED BY D. Ledgerwood — CHECKED BY R. Andersen
8. TOTAL DEPTH OF HOLE 53.5	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr5 4 Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, No HCL Reaction										
	■	5 5 5	10	13			56	FS#1								PP>4.5
2																
	■	3 4 4	8	11		Same as Above Except; Trace Fine Subrounded Gravel to 0.25 inches	44	FS#2								PP>4.5
4																
	■	6 7 7	14	19		Same as Above Except; LEAN CLAY, with Sand (CL); No Gravel, Strong HCL Reaction	56	FS#3	0	23	77	36	21	9.5	CL	PP=4.0
6																
	■	4 5 7	12	16		Same as Above Except; Trace Fine Subangular Gravel to 0.2 inches	56	FS#4								PP=2.0
8																
	■	15 22 31	53	70		SAND, Poorly Graded with Silt (SP-SM); Moist, 10yr6/2 Light Gray Brown, 80% Fine Coarse Sand, 10% Non Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, Weak HCL Reaction	78	FS#5								
10																
	■	19 20 25	45	60		Same as Above Except; Gravel to 1.3 inches	100	FS#6								
12																
	■					SAND, Silty with Gravel (SM); Moist, Fine to Coarse Sand, Non Plastic Fines, Fine to Coarse Subrounded to Subangular			32	55	13					

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-15
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 4 SHEETS
LOCATION COORDINATES: N 6403024.684 E 1945184.102	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		9 10 15	25	33		Gravel to 1 inch, No HCL Reaction	89	FS#7								
16		8 9 16	25	33		Same as Above Except; Gravel to 1.5 inches	83	FS#8								
18		5 6 8	14	19		Same as Above Except; Gravel to 1 inch	22	FS#9								
20		17 18 25	43	57		Same as Above Except; 75% Fine to Coarse Sand, 15% Non Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inch, Weak HCL Reaction	78	FS#10								
22		14 14 16	30	40		Same as Above Except; Gravel to 1 inch, Strong HCL Reaction	83	FS#11								
24		15 13 16	29	39		Same as Above Except; Fine to Coarse Subrounded to Subangular Gravel to 0.75 inches, Weak HCL Reaction	100	FS#12								
26																
28		3 4 8	12	16		LEAN CLAY (CL); Moist, 10yr5/6 Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Trace Coarse Sand, No HCL Reaction	44	FS#13								PP=3.25
30		14 17 25	37	49		SAND, Silty (SM); Moist, 10yr5/3 Brown, 70% Fine to Coarse Sand, 20% Non Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, Trace Clay, No HCL Reaction	78	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-15	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 3 OF 4 SHEETS
LOCATION COORDINATES N 6403024.684 E 1945184.102	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	17 15 20	35	47		Same as Above Except; Weak HCL Reaction	94	FS#15								
34																
36	■	3 4 6	10	13		LEAN CLAY (CL); Wet, 10yr5/6 Yellowish Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, No HCL Reaction	100	FS#16								PP=1.5
38																
	■	3 3 4	7	9		Same as Above Except; Trace Fine Subrounded Gravel to 0.5 inches	100	FS#17								PP=1.75 Switched to Mud Rotary
40																
42	■	3 4 5	9	12		Same as Above Except; LEAN CLAY, Sandy (CL); No Gravel	100	FS#18	0	37	63	39	22	18.8	CL	PP=1.5
44																
	■	3 4 6	10	13		Same as Above	100	FS#19								PP=2.0
46																
48	■	9 17 16	33	44		SAND, Poorly Graded (SP); Wet, 10yr6/4 Light Yellow Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	83	FS#20								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-15	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 4 OF 4 SHEETS
LOCATION COORDINATES N 6403024.684 E 1945184.102	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
50																
		5 8 11	19	25		GRAVEL, Poorly Graded (GP); Wet, 10yr5/1 Gray, 90% Fine to Coarse Subrounded to Subangular Gravel, 10% Fine to Coarse Sand, No HCL Reaction	67	FS#21								
52																
						Bottom of Boring at 53.5 Feet BSG NOTE: Hole Collapsed to 50 Feet BSG after advancement to 53.5 Feet BSG. Attempted One Redrill, After Redrill Caving Occurred to 50 Feet BSG. Test Hole Terminated Per Discussion with Army Corp										
54																
56																
58																
60																
62																
64																
66																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-16	LOCATION COORDINATES: N 1946302.426 E 6402938.173	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 20
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/4/10	COMPLETED: 11/4/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr4/3 Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Trace Coarse Subrounded Sand, No HCL Reaction										
		2 2 2	4	5			28	FS#1								PP=4.0
2																
		2 2 2	4	5		FAT CLAY with Sand (CH); Moist, 10yr6/6 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand, No HCL Reaction	44	FS#2	0	29	71	57	35	11.4	CH	PP=3.5
4																
		2 2 3	5	7		Same as Above Except; Trace Subrounded Gravel to 0.4 inches, Strong HCL Reaction	8	FS#3								PP=2.5
6																
		3 10 7	17	23		FAT CLAY, SANDY (CH); Moist, 10yr6/6 Dark Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Tough, Fine Sand ,Trace Coarse Subrounded Gravel to 1.5 inches, Strong HCL Reaction	78	FS#4 FS#5	8	34	58	58	35	10.9	CH	PP=3.5
8						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1.1 inches, Weak HCL Reaction										
		6 14 16	30	40		Same as Above Except; Gravel to 1.5 inches, Strong HCL Reaction	50	FS#6								
10																
		10 13 13	26	35		SAND, Well Graded with Silt and Gravel (SW-SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1.1 inches, Non Plastic Fines,No HCL Reaction	72	FS#7	41	50	9					
12																
						Same as Above Except; 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1 inch, Weak										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-16
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1946302.426 E 6402938.173	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		13 20 13	33	44		to Strong HCL Reaction	78	FS#8								
16		9 16 20	36	48		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, 10% Non Plastic Fines, No HCL Reaction	83	FS#9								
18		21 20 22	42	56		Same as Above Except; Gravel to 0.75 inches, Weak HCL Reaction	83	FS#10								
20		20 16 9	25	33		GRAVEL, Silty with Sand (GM); Moist, 10yr4/4 Dark Yellow Brown, Fine to Coarse Subrounded Gravel to 1 inch, Non Plastic Fines, Fine to Coarse Sand, Weak HCL Reaction	67	FS#11	45	41	14					
22		13 20 17	37	49		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 85% Fine to Coarse Sand, 10% Non Plastic Fines, 5% Fine to Coarse Subrounded Gravel to 1.3 inches, Strong HCL Reaction	83	FS#12								
24		3 8 17	25	33		SAND, Clayey (SC); Moist, 10yr4/6 Dark Yellow Brown, 60% Fine Sand, 40% Low Plastic Fines, Trace Coarse Sands, No HCL Reaction	78	FS#13								
26						SAND, Poorly Graded (SP); 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Subangular to Subrounded Gravel to 0.75 inches, No HCL Reaction		FS#14								
28		15 23 20	43	57		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, Weak HCL Reaction	83	FS#15								
30		13 14 11	25	33		SAND, Clayey (SC); Moist, 10yr4/6 Dark Yellow Brown, 60% Fine Sand, 40% Low Plastic Fines, No HCL Reaction	100	FS#16								
						SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 75% Fine to Coarse Sand, 20% Fine to Coarse		FS#17								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-16
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District; SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1946302.426 E 6402938.173	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
						Subrounded Gravel to 1.3 inches, 5% Non Plastic Fines, No HCL Reaction										
32																
		10 9 13	22	29		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 75% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1.3 inches, 10% Non Plastic Fines, Weak HCL Reaction	56	FS#18									
34																
		17 16 15	31	41		Same as Above Except; Gravel to 0.8 inches, No HCL Reaction	61	FS#19								
36																
38																
		17 14 14	28	37		Same as Above Except; Weak HCL Reaction	67	FS#20								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION	South Pacific
INSTALLATION	Sacramento District
SHEET	1 OF 3 SHEETS
1. PROJECT	Orestimba, Newman
9. COORDINATE SYSTEM	State Plane CA Zone 2 NAD83
10. SIZE AND TYPE OF BIT	6 5/8" HSA
2. HOLE NO.	2F-11-17
LOCATION COORDINATES	N 1947196.028 E 6402675.93
11. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
3. DRILLING AGENCY	Moore Twining Associates, Inc.
12. TOTAL SAMPLES	DISTURBED NA; UNDISTURBED 17
4. NAME OF DRILLER	A. Bushey
13. TOTAL NUMBER CORE BOXES	NA
14. DEPTH TO GROUND WATER ENCOUNTERED	NE
5. DIRECTION OF HOLE	VERTICAL ☒ INCLINED ☐ _____ DEG. FROM VERT
15. DATE HOLE	STARTED 11/4/10; COMPLETED 11/4/10
16. ELEVATION TOP OF HOLE	NA
6. THICKNESS OF OVERBURDEN	40
17. TOTAL CORE RECOVERY FOR BORING	NA
7. DEPTH DRILLED INTO ROCK	NE
18. LOGGED BY	D. Ledgerwood
CHECKED BY	R. Andersen
8. TOTAL DEPTH OF HOLE	40

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, with Sand (CH); Moist, 10yr5/3 Brown, 85% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, Trace Fine Subangular Gravel to 0.5 inches, No HCL Reaction										
	■	9 9 8	17	23			44	FS#1								PP>4.5
2																
	■	3 3 3	6	8		Same as Above Except; FAT CLAY, Sandy (CH)	44	FS#2	2	28	70	59	36	8.1	CH	PP>4.5
4																
	■	1 1 3	4	5		Same as Above Except; FAT CLAY, With Sand (CH); Strong HCL Reaction	67	FS#3	2	24	74	61	37	8.2	CH	PP>4.5
6																
	■	3 4 5	9	12		Same as Above Except; Trace Coarse Sand	83	FS#4								PP>4.5
8																
	■	12 15 23	28	37		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 30% Fine to Coarse Subangular to Subrounded Gravel to 1.5 inches, Weak HCL Reaction	83	FS#5								
10																
	■	16 12 14	26	35		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subangular to Subrounded Gravel to 1.2 inches, Non Plastic Fines, Weak HCL Reaction	67	FS#6	41	46	13					
12																
	■					Same as Above Except; Gravel to 1.4 inches, Strong HCL Reaction										

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-17
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District; SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1947196.028 E 6402675.93	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		13 16 13	29	39			78	FS#7								
16		9 8 7	15	20		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1.1 inches, Non Plastic Fines, No HCL Reaction	67	FS#8	43	46	11					
18		15 18 11	29	39		SAND, Silty with Gravel (SP); Moist, 10yr4/3 Brown, 65% Fine to Coarse Sand, 20% Non Plastic Fines, 15% Fine to Coarse Subrounded Gravel to 1.5 inches, Weak HCL Reaction	89	FS#9								
20		9 17 17	34	45		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subrounded Gravel to 1.4 inches, 10% Non Plastic Fines, No HCL Reaction	83	FS#10								
22		9 24 21	45	60		Same as Before Except; Gravel to 1.2 inches, Strong HCL Reaction	67	FS#11								
24		14 17 18	35	47		SAND, Poorly Graded with Silt (SP-SM); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.4 inches, 10% Non Plastic Fines, Weak HCL Reaction	56	FS#12								
26																
28		15 23 20	43	57		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1.1 inches, 10% Non Plastic Fines, No HCL Reaction	83	FS#13								
30		15 13 14	27	36		Same as Above Except; Gravel to 1.5 inches, Weak HCL Reaction	83	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-17
PROJECT Orestimba, Newman	INSTALLATION Sacramento District — SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1947196.028 E 6402675.93	COORDINATE SYSTEM State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	11 13 18	31	41		Same as Above Except; Gravel to 1.1 inches, No HCL Reaction	78	FS#15								
34																
36	■	12 17 17	34	45		SAND, Silty with Gravel (SM); Moist, 10yr5/4 Brown, 60% Fine to Coarse Sand, 15% Non Plastic Fines, 25% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, No HCL Reaction	100	FS#16								
38																
	■	13 13 22	35	47		Same as Above Except; Gravel to 1 inch	78	FS#17								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 5 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 8" HSA / 4" Mud Rotary		
2. HOLE NO.: 2F-11-19	LOCATION COORDINATES: N 1949518.346 E 6402797.056	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 27
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: 47.5 Feet BSG		
5. DIRECTION OF HOLE: VERTICAL ☒ ____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 12/1/10	COMPLETED: 12/3/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 81.5	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 81.5			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr4/3 Brown, 90% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 10% Fine Sand, Weak HCL Reaction										
	■	5 6 8	14	19			22	FS#1								PP=4.0
2																
	■	3 3 2	5	7		Same as Above Except; Strong HCL Reaction	33	FS#2								PP=3.5
4																
	■	2 1 3	4	5		Same as Above	56	FS#3								PP=1.5
6																
	■	2 3 4	7	9		Same as Above Except; 10yr5/6 Yellow Brown, Weak HCL Reaction	56	FS#4								PP=1.75
8																
	■	3 4 7	11	15		Same as Above Except; LEAN CLAY, With Sand (CL)	89	FS#5	0	20	80	35	19	16.1	CL	PP=2.75
10																
	■	3 3 5	8	11		Same as Above Except; Strong HCL Reaction	56	FS#6								PP=2.5
12																
	■					Same as Above Except; Trace Subangular Gravel to 0.3 inches			0	15	85	36	16	21.1	CL	PP=1.5

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-19	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 2 OF 5 SHEETS
LOCATION COORDINATES N 1949518.346 E 6402797.056	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		2 2 2	4	5			44	FS#7								
16		3 5 7	12	16		Same as Above Except; No Gravel, No HCL Reaction	89	FS#8								PP=2.0
18		3 12 10	30	40		Same as Above Except; Weak HCL Reaction SAND, Poorly Graded (SP); Moist, 10yr6/3 Pale Brown, 95% Fine to Coarse Sand, 5% Fine Subrounded to Subangular Gravel to 0.4 inches, No HCL Reaction	100	FS#10 FS#9								PP=1.5
20		11 11 16	27	36		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/2 Grayish Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1.2 inches, No HCL Reaction	89	FS#11								
22		7 15 18	33	44		Same as Above	89	FS#12								
24		11 16 18	34	45		Same as Above Except; Fine to Course Subrounded to Subangular Gravel to 1 inch, Trace Non Plastic Fines	100	FS#13								
26																
28		21 27 30	57	76		Same as Above Except; 80% Fine to Coarse Sand, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.2 inches, 5% Non Plastic Fines	100	FS#14								
30		11 10 17	27	36		Same as Above Except; Gravel to 1.5 inches, Weak HCL Reaction	100	FS#15								

DRILLING LOG (Cont Sheet)

Hole No. 2F-11-19

PROJECT	INSTALLATION	SHEET 3 OF 5 SHEETS
Orestimba, Newman	Sacramento District	

LOCATION COORDINATES	COORDINATE SYSTEM
N 1949518.346 E 6402797.056	State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
		10 14 16	30	40		SAND, Silty with Gravel (SM); Moist, 10yr5/2 Grayish Brown, Fine to Coarse Sand, Non Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 1.2inches, Strong HCL Reaction	78	FS#16	20	67	13					
34																
36		20 27 25	52	69		Same as Above Except; 85% Fine to Coarse Sand, 10% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, 5% Non Plastic Fines, Weak HCL Reaction	100	FS#17								
38																
		9 4 8	12	16		Same as Above LEAN CLAY (CL); Moist, 10yr5 4 Yellow Brown, 80% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Coarse Sand, No HCL Reaction	100	FS#19 FS#18								PP=2.5
40																
42		26 18 10	28	37		SAND, Poorly Graded with Clay (SP-SC); Moist, 10yr5/3 Brown, 80% Fine to Coarse Sand, 10% Low Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 0.9 inches, Weak HCL Reaction	100	FS#20								
44																
		12 18 14	32	43		SAND, Silty with Gravel (SM); Moist, 10yr5/3 Brown, Fine to Coarse Sand, Non Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 1 inch, Trace Clay, No HCL Reaction	89	FS#21	18	68	14	NV	NP		SM	
46																
48		19 25 20	45	60		SAND, Clayey (SC); Wet, 10yr5/4 Yellow Brown, 55% Fine to Coarse Sand, 35% Low Plastic Fines, 10% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, No HCL Reaction	44	FS#22								Switched to Mud Rotary

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-19	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 4 OF 5 SHEETS
LOCATION COORDINATES N 1949518.346 E 6402797.056	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
50																
		4 4 3	7	9		No Recovery	0									
52																
54																
		4 5 5	10	13		SAND, Poorly Graded with Gravel (SP); Wet, 10yr6/2 Gray Brown, 85% Fine to Coarse Sand, 15% Fine to Coarse Subangular to Subrounded Gravel to 1.5 inches, No HCL Reaction	22	FS#22A								
56																
58																
60		10 13 18	31	41		SAND, Clayey with Gravel (SC); Moist, 10yr5/8 Yellow Brown, Fine to Coarse Sand, Low Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	56	FS#23	36	48	16					
62																
64																
		4 8 10	18	24		SAND, Silty with Gravel (SM); Moist, 10yr4/5 Brown, Fine to Coarse Sand, Non Plastic Fines, Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, Trace Clay, No HCL Reaction	28	FS#24	35	50	15					
66																

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-19
PROJECT Orestimba, Newman	INSTALLATION Sacramento District — SHEET 5 OF 5 SHEETS
LOCATION COORDINATES N 1949518.346 E 6402797.056	COORDINATE SYSTEM State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
68																
70	■	8 9 23	32	43		SAND, Clayey (SC); Wet, 10yr5/3 Brown, 70% Fine to Coarse Sand, 20% Low Plastic Fines, 10% Fine to Coarse Subrounded Gravel to 1 inch, No HCL Reaction	17	FS#25								
72																
74																
76	■	10 18 40	58	77		SAND, Poorly Graded with Clay (SP-SC); Moist, 10yr5/3 Brown, 80% Fine to Coarse Sand, 10% Low Plastic Fines, 10% Fine to Coarse Gravel to 1.5 inches, No HCL Reaction	17	FS#26								
78																
80	■	13 23 36	59	78		Same as Above	17	FS#27								
82						Bottom of Boring at 81.5 Feet BSG										
84																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-20	LOCATION COORDINATES: N 1949498.733 E 6403038.214	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 18
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: NE		
5. DIRECTION OF HOLE: VERTICAL ☒ _____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/5/10	COMPLETED: 11/5/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						LEAN CLAY (CL); Moist, 10yr3/4 Dark Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Weak HCL Reaction										
	■	3 5 5	10	13			39	FS#1								PP>4.5
2						LEAN CLAY, with Sand (CL); Moist, 10yr5/4 Yellow Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, No HCL Reaction										
	■	5 3 3	6	8			33	FS#2								PP>4.5
4						FAT CLAY, with Sand (CH); Moist, 10yr5/3 Brown, High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, Fine Sand, No HCL Reaction			0	25	75	58	37	12.7	CH	PP=2.5
	■	4 4 5	9	12			50	FS#3								
6						Same as Above										
	■	4 4 6	10	13			61	FS#4								PP=4.5
8						Same as Above Except; Trace Coarse Sand, Weak HCL Reaction										
	■	3 3 4	7	9			28	FS#5								PP=4.0
10						Same as Above Except; 10yr5/6 Yellow Brown, 80% Fines, 20% Fine Sand, Strong HCL Reaction										
	■	1 3 3	6	8			56	FS#6								PP=1.5
12						Same as Above Except; FAT CLAY (CH); 10yr5/6 Yellow Brown, Trace Fine Sand			0	4	96	58	36	22.9	CH	PP=1.25

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-20
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 2 OF 3 SHEETS
LOCATION COORDINATES: N 1949498.733 E 6403038.214	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		1 2 2	4	5			44	FS#7								
16		3 3 5	8	11		Same as Above Except; Trace Subrounded Gravel to 0.8 inches, No HCL Reaction	67	FS#8								PP=2.0
18		3 22 21	43	57		Same as Above	78	FS#10 FS#9								
						SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/3 Pale Brown, 65% Fine to Coarse Sand, 25% Fine to Coarse Subrounded Gravel to 1.3 inches, 10% Non Plastic Fines, No HCL Reaction										
20		5 10 15	25	33		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 0.75 inches, 2 inch Poorly Graded Sand Lense with Fine to Medium no Gravel, Non Plastic Fines, No HCL Reaction	50	FS#11	27	57	16					
22		10 17 17	34	45		Same as Above Except; Weak HCL Reaction	61	FS#12								
24		11 9 12	21	28		Same as Above Except; Fine to Coarse Subrounded to Subangular Gravel to 1 inch, No HCL Reaction	100	FS#13								
26																
28		9 14 14	28	37		Same as Above Except; Gravel to 1.5 inches	78	FS#14								
30		20 18 17	35	47		Same as Above Except; Weak to Strong HCL Reaction	89	FS#15								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-20
PROJECT Orestimba, Newman	INSTALLATION Sacramento District — SHEET 3 OF 3 SHEETS
LOCATION COORDINATES N 1949498.733 E 6403038.214	COORDINATE SYSTEM State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	7 12 19	31	41		Same as Above Except: 10yr4/4 Dark Yellow Brown, Fine Subrounded Gravel to 0.5 inches, No HCL Reaction	83	FS#16	16	61	23					
34																
36	■	20 30 18	48	64		SAND, Poorly Graded with Gravel (SP); Moist, 10yr5/3 Brown, 80% Fine to Coarse Sand, 15% Fine to Coarse Subrounded Gravel to 1.5 inches, 5% Non Plastic Fines, Weak HCL Reaction	100	FS#17								
38																
	■	3 3 4	7	9		LEAN CLAY (CL); Moist, 10yr4/6 Dark Yellow Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, Trace Fine Subrounded Gravel to 0.4 inches, Strong HCL Reaction	44	FS#18								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG	DIVISION South Pacific	INSTALLATION Sacramento District	SHEET 1 OF 3 SHEETS

1. PROJECT Orestimba, Newman	9. COORDINATE SYSTEM State Plane CA Zone 2 NAD83
	10. SIZE AND TYPE OF BIT 6 5/8" HSA
2. HOLE NO. 2F-11-21 — LOCATION COORDINATES N 1949463.769 E 6404671.685	11. MANUFACTURER'S DESIGNATION OF DRILL CME 75
3. DRILLING AGENCY Moore Twining Associates, Inc.	12. TOTAL SAMPLES — DISTURBED NA — UNDISTURBED 17
4. NAME OF DRILLER A. Bushey	13. TOTAL NUMBER CORE BOXES NA
	14. DEPTH TO GROUND WATER ENCOUNTERED NE
5. DIRECTION OF HOLE VERTICAL ☒ _____ DEG. FROM VERT INCLINED ☐	15. DATE HOLE — STARTED 11/5/10 — COMPLETED 11/5/10
	16. ELEVATION TOP OF HOLE NA
6. THICKNESS OF OVERBURDEN 40	17. TOTAL CORE RECOVERY FOR BORING NA
7. DEPTH DRILLED INTO ROCK NE	18. LOGGED BY D. Ledgerwood — CHECKED BY R. Andersen
8. TOTAL DEPTH OF HOLE 40	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY with Sand (CH); Moist, 10yr4/3 Brown, 95% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 5% Fine Sand, No HCL Reaction										
	■	2 2 2	4	5			28	FS#1								PP>4.5
2																
	■	1 1 2	3	4		Same as Above Except; Strong HCL Reaction	39	FS#2								PP=2.5
4																
	■	2 2 2	4	5		Same as Before Except; Weak HCL Reaction	39	FS#3	0	23	77	58	37	13	CH	PP=4.0
6																
	■	1 1 1	2	3		Same As Above Except; 10yr4/4 Dark Yellow Brown	39	FS#4								PP=2.25
8																
	■	2 2 5	4	5		Same as Above Except; Strong HCL Reaction	39	FS#5								PP=1.5
10																
	■	4 4 4	8	11		FAT CLAY, Sandy (CH); Moist, 10yr5/4 Yellow Brown, High Plastic Fines, High Dry Strength, None Dilatency, Low to Medium Toughness, Fine Sand, Strong HCL Reaction	50	FS#6	0	37	63	58	39	13.9	CH	PP=2.0
12																
	■					LEAN CLAY (CL); Moist, 10yr4/3 Brown, 95% Low Plastic Fines, High Dry Strength, None Dilatency, Medium										PP=1.75

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-21	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 2 OF 3 SHEETS
LOCATION COORDINATES N 1949463.769 E 6404671.685	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		3 7 12	19	25		Toughness, 5% Fine Sand, Strong HCL Reaction	56	FS#7								
16		10 12 9	21	28		SAND, Poorly Graded with Gravel (SP); Moist, 10yr6/3 Pale Brown, 90% Fine to Coarse Sand, 10% Fine to Coarse Subrounded Gravel to 1 inch, Trace Non Plastic Fines, No HCL Reaction	100	FS#8								
18		8 10 12	22	29		Same as Above Except; Gravel to 0.75 inches	83	FS#9								
20		4 4 9	13	17		Same as Above Except; 2 inch Lense of Silty Sand	83	FS#10								
22		4 8 7	15	20		Same as Above Except; Gravel to 1.2 inches	67	FS#11								
24		20 21 19	40	53		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, 80% Fine to Coarse Sand, 10% Fine to Coarse Subrounded Gravel to 1.2 inches, 10% Non Plastic Fines, No HCL Reaction	83	FS#12								
26		17 20 22	42	56		Same as Above Except; Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches	100	FS#13	40	47	13					
28																
30		15 15 12	27	36		Same as Above Except; 10yr4/3 Brown	89	FS#14	35	52	13					

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-21
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District; SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1949463.769 E 6404671.685	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY: GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	9 11 14	25	33		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr6/5 Pale Brown, 70% Fine to Coarse Sand, 20% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, 10% Non Plastic Fines, Weak HCL Reaction	78	FS#15								
34																
36	■	12 18 14	32	43		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, 65% Fine to Coarse Sand, 20% Non Plastic Fines, 15% Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, Weak HCL Reaction	100	FS#16								
38																
	■	11 15 18	33	44		Same as Above Except; No HCL Reaction	89	FS#17								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

DRILLING LOG

DIVISION: South Pacific	INSTALLATION: Sacramento District	SHEET 1 OF 3 SHEETS	
1. PROJECT: Orestimba, Newman	9. COORDINATE SYSTEM: State Plane CA Zone 2 NAD83		
	10. SIZE AND TYPE OF BIT: 6 5/8" HSA		
2. HOLE NO.: 2F-11-22	LOCATION COORDINATES: N 1949448.404 E 6406078.534	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: Moore Twining Associates, Inc.	12. TOTAL SAMPLES	DISTURBED: NA	UNDISTURBED: 17
4. NAME OF DRILLER: A. Bushey	13. TOTAL NUMBER CORE BOXES: NA		
	14. DEPTH TO GROUND WATER ENCOUNTERED: 38.5 Feet BSG		
5. DIRECTION OF HOLE: VERTICAL ☒ ____ DEG. FROM VERT; INCLINED ☐	15. DATE HOLE	STARTED: 11/5/10	COMPLETED: 11/5/10
	16. ELEVATION TOP OF HOLE: NA		
6. THICKNESS OF OVERBURDEN: 40	17. TOTAL CORE RECOVERY FOR BORING: NA		
7. DEPTH DRILLED INTO ROCK: NE	18. LOGGED BY: D. Ledgerwood	CHECKED BY: R. Andersen	
8. TOTAL DEPTH OF HOLE: 40			

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
0						FAT CLAY, Sandy (CH); Moist, 10yr3/5 Dark Brown, 80% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 20% Fine Sand, Trace Fine Subrounded Gravel to 0.4 inches										
		2 2 3	5	7			36	FS#1								PP>4.5
2																
		1 1 2	3	4		Same as Above Except; No Gravel	39	FS#2	0	30	70	59	39	13.2	CH	PP>4.5
4																
		2 1 2	3	4		Same as Above Except; Weak HCL Reaction	39	FS#3								PP=3.5
6																
		2 2 3	5	7		Same as Above Except; 10yr5/6 Yellow Brown, Strong HCL Reaction	39	FS#4								PP=2.75
8																
		2 1 1	2	3		LEAN CLAY, Sandy (CL); Moist, 10yr4/4 Dark Yellow Brown, 65% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 35% Fine Sand, No HCL Reaction	33	FS#5								PP=3
10																
		2 6 7	13	17		LEAN CLAY, with Sand (CL); Moist, 10yr5/3 Brown, 85% Low Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 15% Fine Sand, Weak HCL Reaction	78	FS#6								PP=3.5
12																
						Same as Above Except; 75% Fines, 25% Fine Sand										PP=2.0

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-22	
PROJECT Orestimba, Newman	INSTALLATION Sacramento District	SHEET 2 OF 3 SHEETS
LOCATION COORDINATES N 1949448.404 E 6406078.534	COORDINATE SYSTEM State Plane CA Zone 3 NAD83	

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
14		4 6 6	12	16			61	FS#7								
16		5 6 6	12	16		Same as Above Except; Strong HCL Reaction	67	FS#8								PP=2.5
18		5 5 7	12	16		FAT CLAY, Sandy (CH); Moist, 10yr5/4 Yellow Brown, 65% High Plastic Fines, High Dry Strength, None Dilatency, Medium Toughness, 35% Fine Sand, No HCL Reaction	78	FS#9								PP=2.5
20		2 3 8	11	15		Same as Above	78	FS#10	1	40	59	62	40	16.9	CH	PP=2.5
22		2 2 9	11	15		Same as Above Except; Trace Coarse Sand, Trace Coarse Subrounded Gravel to 0.3 inches, Weak HCL Reaction	67	FS#11								PP=1.0
24		15 14 10	24	32		SAND, Silty with Gravel (SM); Moist, 10yr6/3 Pale Brown, Fine to Coarse Sand, Fine to Coarse Subrounded to Subangular Gravel to 1.5 inches, No HCL Reaction	78	FS#12	36	52	12					
26																
28		16 19 20	39	52		Same as Above	100	FS#13								
30		13 15 15	30	40		Same as Above Except; Gravel to 1.1 inches	100	FS#14								

DRILLING LOG (Cont Sheet)	Hole No. 2F-11-22
PROJECT: Orestimba, Newman	INSTALLATION: Sacramento District — SHEET 3 OF 3 SHEETS
LOCATION COORDINATES: N 1949448.404 E 6406078.534	COORDINATE SYSTEM: State Plane CA Zone 3 NAD83

DEPTH	Sample	Blows/ 0.5ft	Nr	N60	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	SAMPLE NO.	LABORATORY GRAVEL	SAND	FINES	LL	PI	MC %	ASTM CLASS	REMARKS
32																
	■	3 6 15	21	28		SAND, Clayey with Gravel (SC); Moist, 10yr5/3 Brown, Fine to Coarse Sand, Low Plastic Fines, Fine to Coarse Subrounded Gravel to 1.3 inches, No HCL Reaction	100	FS#15	34	49	17					
34																
36	■	6 9 9	18	24		SAND, Poorly Graded with Silt and Gravel (SP-SM); Moist, 10yr5/2 Grayish Brown, 80% Fine to Coarse Sand, 10% Fine to Coarse Subrounded to Subangular Gravel to 1 inch, 10% Non Plastic Fines, No HCL Reaction	89	FS#16								
38																
	■	13 16 18	34	45		SAND, Silty with Gravel (SM); Wet, 10yr4/3 Brown, 65% Fine to Coarse Sand, 20% Non Plastic Fines, 15% Fine to Coarse Subrounded Gravel to 1.3 inches, No HCL Reaction	89	FS#17								
40						Bottom of Boring at 40 Feet BSG										
42																
44																
46																
48																

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	LEAN Clay
	Poorly graded sand with silt
	FAT Clay
	Clayey sand
	Silty sand
	Silt
	Silty Clay
	Poorly graded sand
	Silty Sand to Clayey Sand
	Well graded sand with silt
	Well graded gravel with silt
	Poorly graded gravel
	Silty gravel
	Poorly graded sand with clay

Notes:

1. Test borings were conducted between November 1, 2010 and December 3, 2010, using a CME 75 drill rig equipped with 6 5/8 inch O.D. Hollow Stem Augers and Mud Rotary Drill Methods using a 4 inch diameter bit.

2. Groundwater was encountered at the depths ranging from 35 and 47.5 feet BSG during drilling of the test borings.

3. Test Boring locations were located based on existing staking provided by U.S. Army Corp. The test boring locations were recorded by hand held GPS.

4. These logs and laboratory data are subject to the interpretation and analysis by others. Moore Twining shall not be held responsible for incorrect useage of the data.

5. Results of tests conducted on samples recovered are reported on the logs. Abbreviations used are:

PP	=	Pocket Penetrometer (TSF)
N60	=	Corrected N-Value (does not include correction for rod length or borehole diameter.)
Nr	=	Uncorrected; Field Blow Count
LL	=	Liquid limit
PI	=	Plasticity index
MC	=	Moisture Content (%)
GRAVEL	=	Percent Retained on #4 Sieve
SAND	=	Percent Passing #4 Sieve and Retained on #200 Sieve
FINES	=	Percent Passing #200 Sieve

KEY TO SYMBOLS

Symbol	Description
Misc. Symbols	
	Boring continues
	Water table during drilling
Soil Samplers	
	Standard penetration test

APPENDIX C

DETERMINISTIC ANALYSIS

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
BORING 2F-11-03, 2F-11-04, 2F-11-05 LABORATORY TESTING SUMMARY

Boring Number	Layer ID	Soil Classification	Estimated Permeability for Seepage Analysis					Estimated Strength Parameters		
			Horizontal kh (kx) cm/sec	Anisotropy Ratio kh/kv	Vertical kv (ky) cm/sec	Horizontal kh (kx) ft/day	Vertical kv (ky) ft/day	Φ'	C' (psf)	γ (pcf)
2F-11-03, 2F-11-04, 2F-11-05	1	Lean Clay/Fat Clay Foundation	1.00E-05	1.00	1.00E-05	0.028	0.028	28	50	120
	2	Silty Sand w/Gravel	1.00E-02	10.00	1.00E-03	28.350	2.835	33	0	130
	3	Lean Clay Deep Foundation	1.00E-05	4.00	2.50E-06	0.028	0.007	28	50	120
	4	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0
	5	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0
	6	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0
	7	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0
	8	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0
	9	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
Permeability and Strength Selection for Analysis

Boring Number	Top of Boring Elevation (ft, msl)	Layer ID	Soil Description	USCS Soil Classification	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Elevation of Top of Layer (ft, NAVD 88)	Elevation of Bottom of Layer (ft, NAVD 88)	Layer Thickness (ft)	Average Depth to Groundwater During Drilling	Laboratory and Field Data						Recommended Hydraulic Conductivity					Recommended Strength Parameters		
											Average % Fines	Average Field N (blows/ft)	Average N_{60} (blows/ft)[1]	Average Normalized Blow Count, $N_{1,60}$ (blows/ft)[2]	PI	LL	Horizontal kh (kx) cm/sec	Anisotropy Ratio kh/kv	Vertical kv (ky) cm/sec	Horizontal kh (kx) ft/day	Vertical kv (ky) ft/day	Φ'	C' (psf)	γ (pcf)
2F-11-03, 2F-11-04, 2F-11-05	109.00	1	Lean Clay/Fat Clay Foundation	CL/CH	0.00	9.50	109.00	99.50	9.50	25.70	0	17	24	47	22	39	1.00E-05	1.00	1.00E-05	0.028	0.028	28	50	120
		2	Silty Sand w/Gravel	SP-SM	9.50	22.50	99.50	86.50	13.00		0	19	32	37			1.00E-02	10.00	1.00E-03	28.350	2.835	33	0	130
		3	Lean Clay Deep Foundation	CL	22.50	40.00	86.50	69.00	17.50		0	16	29	20	25	44	1.00E-05	4.00	2.50E-06	0.028	0.007	28	50	120
		4							0.00															
		5							0.00															
		6							0.00															
		7							0.00															
		8							0.00															
		9							0.00															
					Total Depth (ft.)	40.00																		

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
BORING 2F-11-03 LABORATORY TESTING SUMMARY

Ground Elev. (ft, NAVD 88) = 108.80 ft
Groundwater Depth Below GS (ft, NAVD 88) = 44.50 ft

Sample Depth (ft)	Sample Elevation (ft)	Material Description	USCS Soil Type	N	Grain Size Distribtion				Plasticity Index		Dry Unit Weight	Other Testing
					Lab Test?	% Gravel	% Sand	% Fines	LL	PI		
0.5	108.3	Sandy Lean Clay	CL	18			30	70	37	20		
2.5	106.3	Sandy Lean Clay	CL	10								
4.5	104.3	Sandy Lean Clay	CL	19			20	80				
6.5	102.3	Sandy Lean Clay	CL	21			10	90				
8.5	100.3	Sandy Lean Clay	CL	22								
10.5	98.3	Sandy Lean Clay	CL	16			37	63	28	15		
12.5	96.3	Sandy Lean Clay	CL	25								
14.5	94.3	Silty Sand w/Gravel	SM	34		35	50	15				
16.5	92.3	Sandy Lean Clay	CL	17			40	60				
18.5	90.3	Silty Sand	SM	19			65	35				
20.5	88.3	Sandy Lean Clay	CL	24								
23.5	85.3	Silty Sand	SM	13			80	20				
26.5	82.3	Lean Clay w/Sand	CL	16			20	80				
29.5	79.3	Lean Clay w/Sand	CL	10			10	90				
32.5	76.3	Lean Clay w/Sand	CL	18								
35.5	73.3	Silty Clayey Sand	SC-SM	23			52	48	24	7		
38.5	70.3	Silty Clayey Sand	SC-SM	43								
41.5	67.3	Lean Clay w/Sand	CL	46			20	80				
44.5	64.3	Sandy Lean Clay	CL	38			40	60				
47.5	61.3	Sand w/Silt	SP-SM	34			90	10				
50.5	58.3	Silty Sand	SM	31			80	20				
53.5	55.3	Silty Sand	SM	27								
56.5	52.3	Silty Sand	SM	28								
58.5	50.3	Sandy Silt	ML	32			30	70				

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
BORING 2F-11-04 LABORATORY TESTING SUMMARY

Ground Elev. (ft, NAVD 88) = 109.00 ft
Groundwater Depth Below GS (ft, NAVD 88) = 35.00 ft

Sample Depth (ft)	Sample Elevation (ft)	Material Description	USCS Soil Type	N	Grain Size Distribtion				Plasticity Index		Dry Unit Weight	Other Testing
					Lab Test?	% Gravel	% Sand	% Fines	LL	PI		
0.5	108.5	Fat Clay	CH	20			10	90				
2.5	106.5	Fat Clay	CH	8					53	30		
4.5	104.5	Fat Clay	CH	17								
6.5	102.5	Fat Clay	CH	40								
8.5	100.5	Silty Sand w/Gravel	SM	37		37	50	13				
10.5	98.5	Sand w/Gravel	SP	19		15	85					
12.5	96.5	Sand w/Gravel	SP	16								
14.5	94.5	Sand w/Gravel	SP	3			100					
16.5	92.5	Sand w/Gravel	SP	7								
18.5	90.5	Sand w/Gravel	SP	14								
20.5	88.5	Sand w/Silt and Gravel	SP-SM	27		20	80					
23.5	85.5	Sand w/Silt and Gravel	SP-SM	10								
26.5	82.5	Lean Clay	CL	29			40	60				
29.5	79.5	Lean Clay	CL	15								
32.5	76.5	Lean Clay	CL	4					42	23		
35.5	73.5	Lean Clay	CL	7								
38.5	70.5	Lean Clay	CL	34								

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
BORING 2F-11-05 LABORATORY TESTING SUMMARY

Ground Elev. (ft, NAVD 88) = 110.00 ft
Groundwater Depth Below GS (ft, NAVD 88) = 37.60 ft

Sample Depth (ft)	Sample Elevation (ft)	Material Description	USCS Soil Type	N	Grain Size Distribtion				Plasticity Index		Dry Unit Weight	Other Testing
					Lab Test?	% Gravel	% Sand	% Fines	LL	PI		
0.5	109.5	Lean Clay	CL	12			10	90				
2.5	107.5	Lean Clay	CL	9								
4.5	105.5	Lean Clay	CL	3			20	80				
6.5	103.5	Sand w/Silt	SP-SM	21		10	80	10				
8.5	101.5	Silty Sand w/Gravel	SM	23		37	50	13				
10.5	99.5	Sand	SP	22		10	90					
12.5	97.5	Sand	SP	23								
14.5	95.5	Fat Clay	CH	8			30	70	50	31		
16.5	93.5	Fat Clay	CH	23								
18.5	91.5	Lean Clay w/Sand	CL	25			20	80				
20.5	89.5	Sandy Lean Clay	CL	15			30	70				
23.5	86.5	Sandy Lean Clay	CL	11								
26.5	83.5	Sandy Fat Clay	CH	13			10	90	58	37		
29.5	80.5	Sandy Lean Clay	CL	31			30	70				
32.5	77.5	Lean Clay	CL	24			20	80				
35.5	74.5	Lean Clay	CL	7			40	60				
38.5	71.5	Lean Clay	CL	5			10	90				

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
2F-11-03: BORING SPT FIELD N TO (N1)60 CONVERSTION

Ground Elev. (ft, NAVD 88) = 108.8
Groundwater Elev. During Drilling (ft, NAVD 88) = 64.3
Groundwater Depth Below GS During Drilling (ft) = 44.5

Hammer Type = Automatic
Energy Ratio = 80 Moore Twin

													Borehole Dia. Correction Factor			Sampler Correction Factor		Rod Length Correction Factor			Overburden Correction Factor			Corrected SPT Blow Counts		
Boring Number	Depth to Sample (ft)	Elevation of Sample (ft)	USCS Soil Type	Unit Weight (pcf)	Nfield (blows/ft)	Sampler Outside Diameter (O.D., inch)	Hammer Mass (lb)	Fall Distance (inch)	SPT-Equivalent Conversion	Corrected Nfield (blows/ft	60% Hammer Energy Efficiency, C_E	Drilling Method	Borehole Diameter (inch)	Correction for Borehole Diameter, C_B	Sampling Method	Sampler Correction, C_s	Rod Length Above Ground (feet)	Rod Length (m)	Rod Length Correction Factor, C_R	Overburden Pressure, σ_v (psf)	Effective Overburden Pressure During Drilling, σ_v' (psf)	Overburden Correction Factor, C_N	N_{60}	N_1	$N_{1,60}$
2F-11-03	0.5	108.3	CL	115	18	2	140	30	1	18	1.3	H	8.0	1.15	N	1.20	7	2.0	0.75	58	58	2.0	25	36	50
	2.5	106.3	CL	115	10	2	140	30	1	10	1.3	H	8.0	1.15	N	1.20	7	2.6	0.75	288	288	2.0	14	20	28
	4.5	104.3	CL	115	19	2	140	30	1	19	1.3	H	8.0	1.15	N	1.20	7	3.2	0.75	518	518	2.0	26	38	52
	6.5	102.3	CL	115	21	2	140	30	1	21	1.3	H	8.0	1.15	N	1.20	7	3.8	0.75	748	748	2.0	29	42	58
	8.5	100.3	CL	115	22	2	140	30	1	22	1.3	H	8.0	1.15	N	1.20	7	4.4	0.85	978	978	2.0	34	44	69
	10.5	98.3	CL	115	16	2	140	30	1	16	1.3	H	8.0	1.15	N	1.20	7	5.0	0.85	1208	1208	1.8	25	28	44
	12.5	96.3	CL	115	25	2	140	30	1	25	1.3	H	8.0	1.15	N	1.20	7	5.6	0.85	1438	1438	1.5	39	37	58
	14.5	94.3	SM	125	34	2	140	30	1	34	1.3	H	8.0	1.15	N	1.20	7	6.2	0.95	1688	1688	1.1	59	38	67
	16.5	92.3	CL	115	17	2	140	30	1	17	1.3	H	8.0	1.15	N	1.20	7	6.9	0.95	1918	1918	1.1	30	19	33
	18.5	90.3	SM	125	19	2	140	30	1	19	1.3	H	8.0	1.15	N	1.20	7	7.5	0.95	2168	2168	1.0	33	19	33
	20.5	88.3	CL	115	24	2	140	30	1	24	1.3	H	8.0	1.15	N	1.20	7	8.1	0.95	2398	2398	0.9	42	21	37
	23.5	85.3	SM	125	13	2	140	30	1	13	1.3	H	8.0	1.15	N	1.20	7	9.0	0.95	2773	2773	0.9	23	11	20
	26.5	82.3	CL	115	16	2	140	30	1	16	1.3	H	8.0	1.15	N	1.20	7	9.9	0.95	3118	3118	0.7	28	11	19
	29.5	79.3	CL	115	10	2	140	30	1	10	1.3	H	8.0	1.15	N	1.20	7	10.8	1.00	3463	3463	0.6	18	6	11
	32.5	76.3	CL	115	18	2	140	30	1	18	1.3	H	8.0	1.15	N	1.20	7	11.7	1.00	3808	3808	0.6	33	10	18
	35.5	73.3	SC-SM	125	23	2	140	30	1	23	1.3	H	8.0	1.15	N	1.20	7	12.6	1.00	4183	4183	0.7	42	16	30
	38.5	70.3	SC-SM	125	43	2	140	30	1	43	1.3	H	8.0	1.15	N	1.20	7	13.6	1.00	4558	4558	0.7	79	29	54
	41.5	67.3	CL	115	46	2	140	30	1	46	1.3	H	8.0	1.15	N	1.20	7	14.5	1.00	4903	4903	0.4	85	20	37
	44.5	64.3	CL	115	38	2	140	30	1	38	1.3	H	8.0	1.15	N	1.20	7	15.4	1.00	5248	5248	0.4	70	15	28
	47.5	61.3	SP-SM	130	34	2	140	30	1	34	1.3	H	8.0	1.15	N	1.20	7	16.3	1.00	5638	5450	0.6	63	21	39
	50.5	58.3	SM	125	31	2	140	30	1	31	1.3	H	8.0	1.15	N	1.20	7	17.2	1.00	6013	5638	0.6	57	19	35
	53.5	55.3	SM	125	27	2	140	30	1	27	1.3	H	8.0	1.15	N	1.20	7	18.1	1.00	6388	5826	0.6	50	16	30
	56.5	52.3	SM	125	28	2	140	30	1	28	1.3	H	8.0	1.15	N	1.20	7	19.1	1.00	6763	6014	0.6	52	17	31
	58.5	50.3	ML	120	32	2	140	30	1	32	1.3	H	8.0	1.15	N	1.20	7	19.7	1.00	7003	6129	0.6	59	19	35

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
2F-11-04: BORING SPT FIELD N TO (N1)60 CONVERSTION

Ground Elev. (ft, NAVD 88) = 109.0
Groundwater Elev. During Drilling (ft, NAVD 88) = 74.0
Groundwater Depth Below GS During Drilling (ft) = 35.0

Hammer Type = Automatic
Energy Ratio = 80 Moore Twin

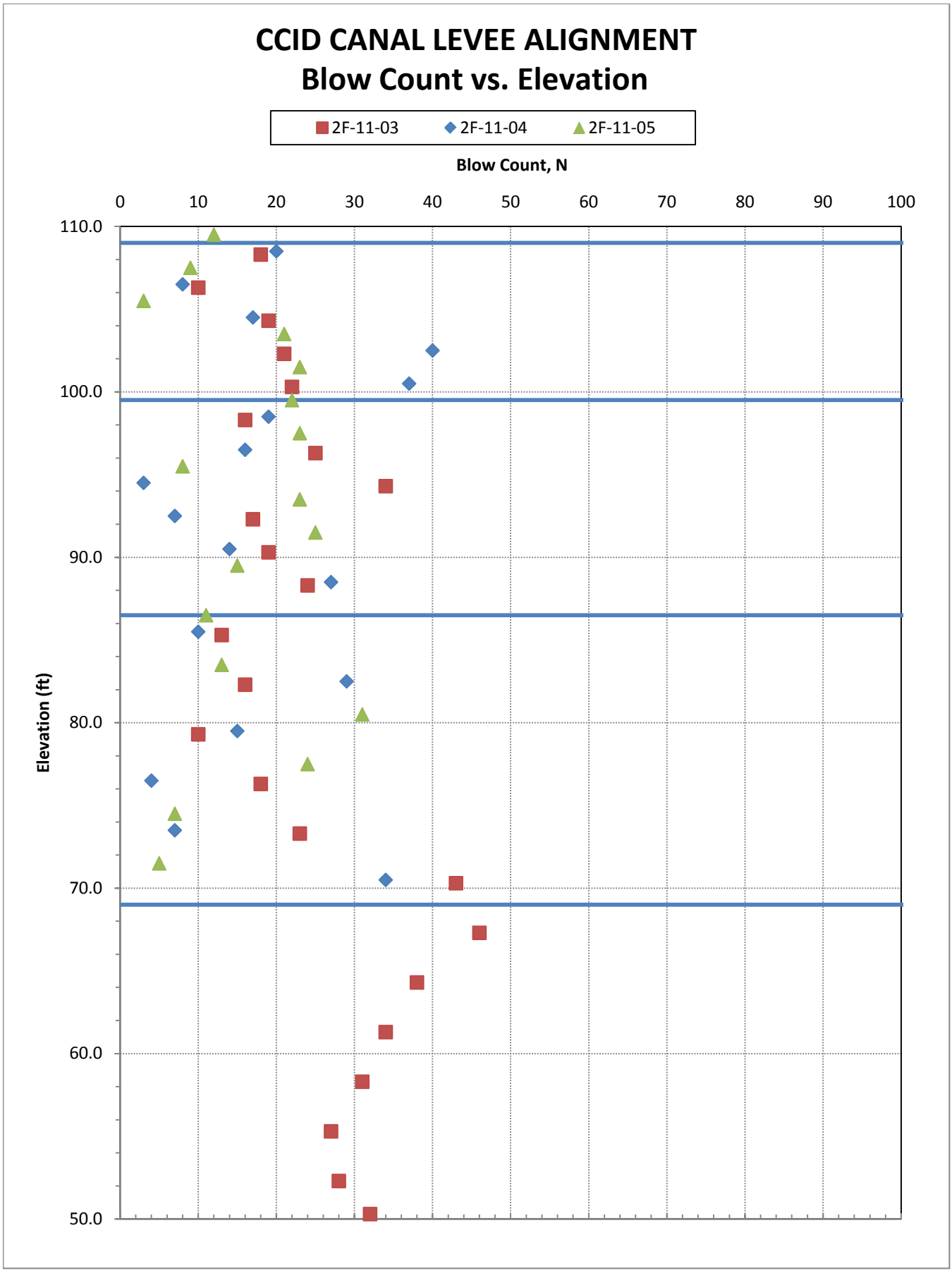
													Borehole Dia. Correction Factor			Sampler Correction Factor		Rod Length Correction Factor			Overburden Correction Factor			Corrected SPT Blow Counts		
Boring Number	Depth to Sample (ft)	Elevation of Sample (ft)	USCS Soil Type	Unit Weight (pcf)	Nfield (blows/ft)	Sampler Outside Diameter (O.D., inch)	Hammer Mass (lb)	Fall Distance (inch)	SPT-Equivalent Conversion	Corrected Nfield (blows/ft	60% Hammer Energy Efficiency, C_E	Drilling Method	Borehole Diameter (inch)	Correction for Borehole Diameter, C_B	Sampling Method	Sampler Correction, C_s	Rod Length Above Ground (feet)	Rod Length (m)	Rod Length Correction Factor, C_R	Overburden Pressure, σ_v (psf)	Effective Overburden Pressure During Drilling, σ_v' (psf)	Overburden Correction Factor, C_N	N_{60}	N_1	$N_{1,60}$
2F-11-04	0.5	108.5	CH	115	20	2	140	30	1	20	1.3	H	8.0	1.15	N	1.20	7	2.0	0.75	58	58	2.0	28	40	55
	2.5	106.5	CH	115	8	2	140	30	1	8	1.3	H	8.0	1.15	N	1.20	7	2.6	0.75	288	288	2.0	11	16	22
	4.5	104.5	CH	115	17	2	140	30	1	17	1.3	H	8.0	1.15	N	1.20	7	3.2	0.75	518	518	2.0	23	34	47
	6.5	102.5	CH	115	40	2	140	30	1	40	1.3	H	8.0	1.15	N	1.20	7	3.8	0.75	748	748	2.0	55	80	110
	8.5	100.5	SM	125	37	2	140	30	1	37	1.3	H	8.0	1.15	N	1.20	7	4.4	0.85	998	998	1.5	58	54	84
	10.5	98.5	SP	130	19	2	140	30	1	19	1.3	H	8.0	1.15	N	1.20	7	5.0	0.85	1258	1258	1.3	30	25	39
	12.5	96.5	SP	130	16	2	140	30	1	16	1.3	H	8.0	1.15	N	1.20	7	5.6	0.85	1518	1518	1.2	25	19	30
	14.5	94.5	SP	130	3	2	140	30	1	3	1.3	H	8.0	1.15	N	1.20	7	6.2	0.95	1778	1778	1.1	5	3	6
	16.5	92.5	SP	130	7	2	140	30	1	7	1.3	H	8.0	1.15	N	1.20	7	6.9	0.95	2038	2038	1.0	12	7	12
	18.5	90.5	SP	130	14	2	140	30	1	14	1.3	H	8.0	1.15	N	1.20	7	7.5	0.95	2298	2298	1.0	24	13	23
	20.5	88.5	SP-SM	130	27	2	140	30	1	27	1.3	H	8.0	1.15	N	1.20	7	8.1	0.95	2558	2558	0.9	47	25	43
	23.5	85.5	SP-SM	130	10	2	140	30	1	10	1.3	H	8.0	1.15	N	1.20	7	9.0	0.95	2948	2948	0.8	17	8	15
	26.5	82.5	CL	115	29	2	140	30	1	29	1.3	H	8.0	1.15	N	1.20	7	9.9	0.95	3293	3293	0.6	51	19	33
	29.5	79.5	CL	115	15	2	140	30	1	15	1.3	H	8.0	1.15	N	1.20	7	10.8	1.00	3638	3638	0.6	28	9	16
	32.5	76.5	CL	115	4	2	140	30	1	4	1.3	H	8.0	1.15	N	1.20	7	11.7	1.00	3983	3983	0.5	7	2	4
	35.5	73.5	CL	115	7	2	140	30	1	7	1.3	H	8.0	1.15	N	1.20	7	12.6	1.00	4328	4296	0.5	13	3	6
	38.5	70.5	CL	115	34	2	140	30	1	34	1.3	H	8.0	1.15	N	1.20	7	13.6	1.00	4673	4454	0.5	63	16	30

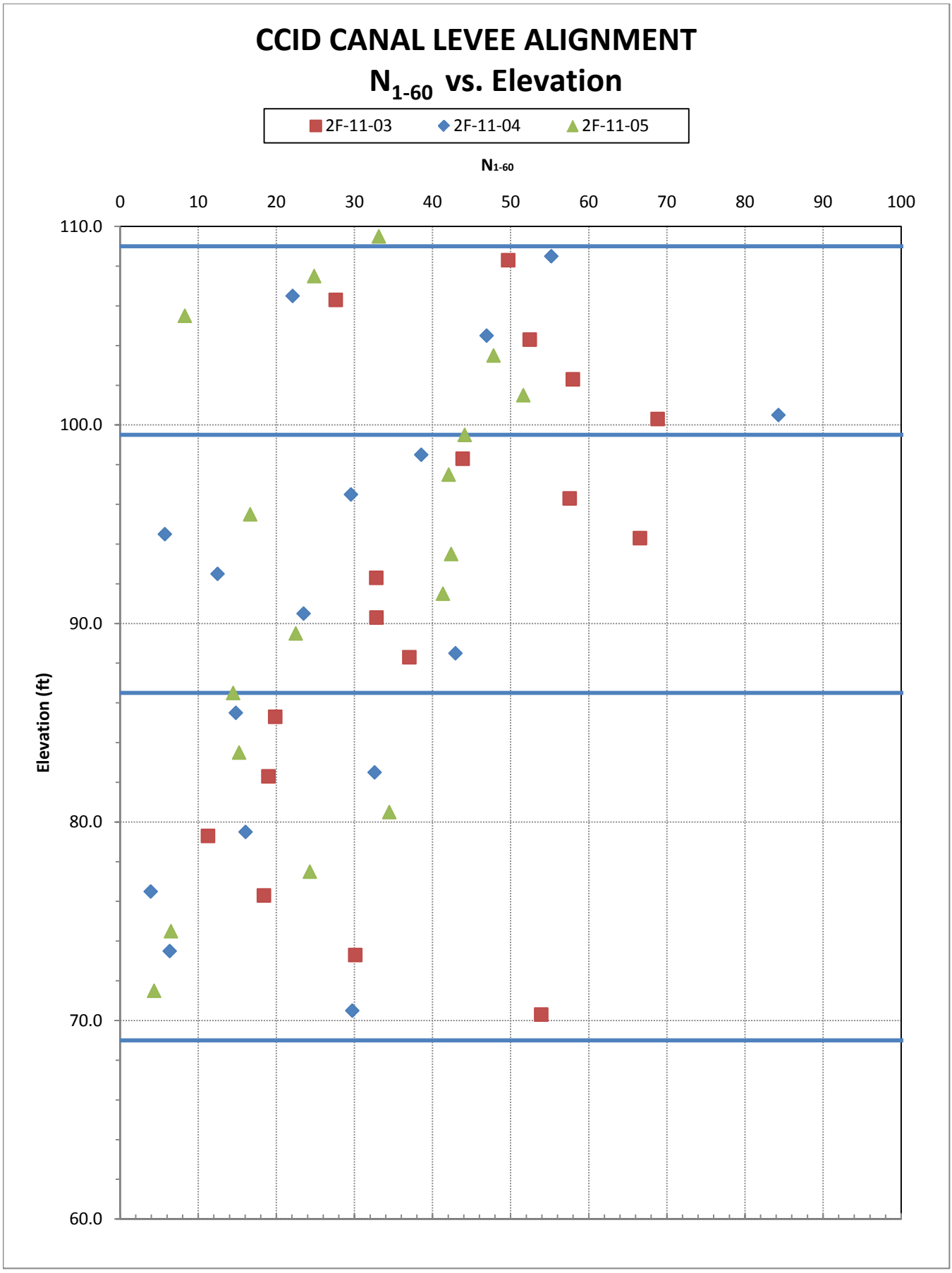
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
2F-11-05: BORING SPT FIELD N TO (N1)60 CONVERSTION

Ground Elev. (ft, NAVD 88) = 110.0
Groundwater Elev. During Drilling (ft, NAVD 88) = 6.1
Groundwater Depth Below GS During Drilling (ft) = 37.6

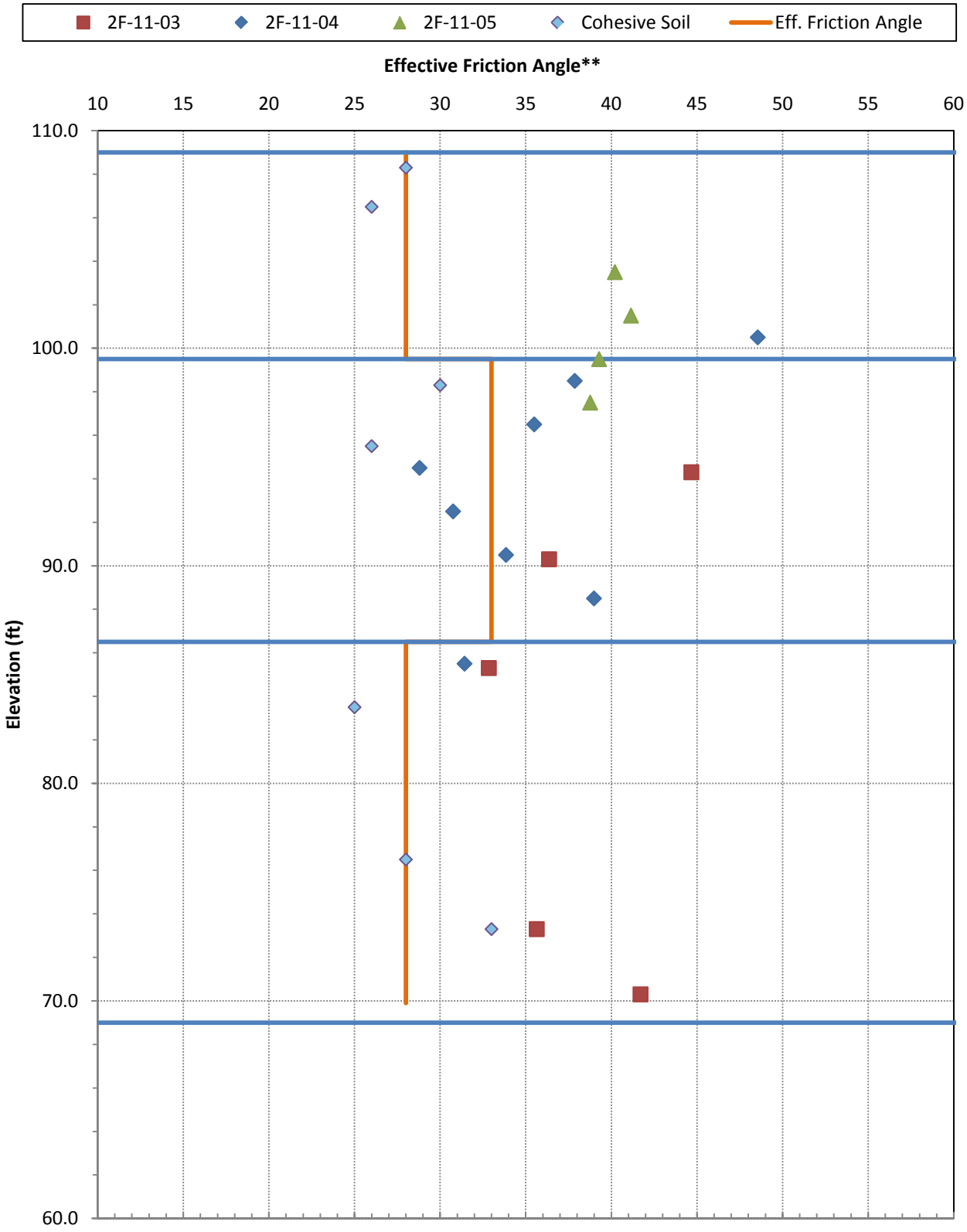
Hammer Type = Automatic
Energy Ratio = 80 Moore Twin

													Borehole Dia. Correction Factor			Sampler Correction Factor		Rod Length Correction Factor			Overburden Correction Factor			Corrected SPT Blow Counts		
Boring Number	Depth to Sample (ft)	Elevation of Sample (ft)	USCS Soil Type	Unit Weight (pcf)	Nfield (blows/ft)	Sampler Outside Diameter (O.D., inch)	Hammer Mass (lb)	Fall Distance (inch)	SPT-Equivalent Conversion	Corrected Nfield (blows/ft	60% Hammer Energy Efficiency, C_E	Drilling Method	Borehole Diameter (inch)	Correction for Borehole Diameter, C_B	Sampling Method	Sampler Correction, C_s	Rod Length Above Ground (feet)	Rod Length (m)	Rod Length Correction Factor, C_R	Overburden Pressure, σ_v (psf)	Effective Overburden Pressure During Drilling, σ_v' (psf)	Overburden Correction Factor, C_N	N_{60}	N_1	$N_{1,60}$
2F-11-05	0.5	109.5	CL	115	12	2	140	30	1	12	1.3	H	8.0	1.15	N	1.20	7	2.0	0.75	58	58	2.0	17	24	33
	2.5	107.5	CL	115	9	2	140	30	1	9	1.3	H	8.0	1.15	N	1.20	7	2.6	0.75	288	288	2.0	12	18	25
	4.5	105.5	CL	115	3	2	140	30	1	3	1.3	H	8.0	1.15	N	1.20	7	3.2	0.75	518	518	2.0	4	6	8
	6.5	103.5	SP-SM	130	21	2	140	30	1	21	1.3	H	8.0	1.15	N	1.20	7	3.8	0.75	778	778	1.6	29	35	48
	8.5	101.5	SM	125	23	2	140	30	1	23	1.3	H	8.0	1.15	N	1.20	7	4.4	0.85	1028	1028	1.4	36	33	52
	10.5	99.5	SP	130	22	2	140	30	1	22	1.3	H	8.0	1.15	N	1.20	7	5.0	0.85	1288	1288	1.3	34	28	44
	12.5	97.5	SP	130	23	2	140	30	1	23	1.3	H	8.0	1.15	N	1.20	7	5.6	0.85	1548	1548	1.2	36	27	42
	14.5	95.5	CH	115	8	2	140	30	1	8	1.3	H	8.0	1.15	N	1.20	7	6.2	0.95	1778	1778	1.2	14	10	17
	16.5	93.5	CH	115	23	2	140	30	1	23	1.3	H	8.0	1.15	N	1.20	7	6.9	0.95	2008	2008	1.1	40	24	42
	18.5	91.5	CL	115	25	2	140	30	1	25	1.3	H	8.0	1.15	N	1.20	7	7.5	0.95	2238	2238	0.9	44	24	41
	20.5	89.5	CL	115	15	2	140	30	1	15	1.3	H	8.0	1.15	N	1.20	7	8.1	0.95	2468	2468	0.9	26	13	22
	23.5	86.5	CL	115	11	2	140	30	1	11	1.3	H	8.0	1.15	N	1.20	7	9.0	0.95	2813	2813	0.8	19	8	14
	26.5	83.5	CH	115	13	2	140	30	1	13	1.3	H	8.0	1.15	N	1.20	7	9.9	0.95	3158	3158	0.7	23	9	15
	29.5	80.5	CL	115	31	2	140	30	1	31	1.3	H	8.0	1.15	N	1.20	7	10.8	1.00	3503	3503	0.6	57	19	34
	32.5	77.5	CL	115	24	2	140	30	1	24	1.3	H	8.0	1.15	N	1.20	7	11.7	1.00	3848	3848	0.5	44	13	24
	35.5	74.5	CL	115	7	2	140	30	1	7	1.3	H	8.0	1.15	N	1.20	7	12.6	1.00	4193	4193	0.5	13	4	7
	38.5	71.5	CL	115	5	2	140	30	1	5	1.3	H	8.0	1.15	N	1.20	7	13.6	1.00	4538	4481	0.5	9	2	4


CCID CANAL LEVEE ALIGNMENT
Blow Count vs. Elevation
2F-11-03
2F-11-04
2F-11-05
Blow Count, N
0
10
20
30
40
50
60
70
80
90
100
Elevation (ft)
110.0
100.0
90.0
80.0
70.0
60.0
50.0

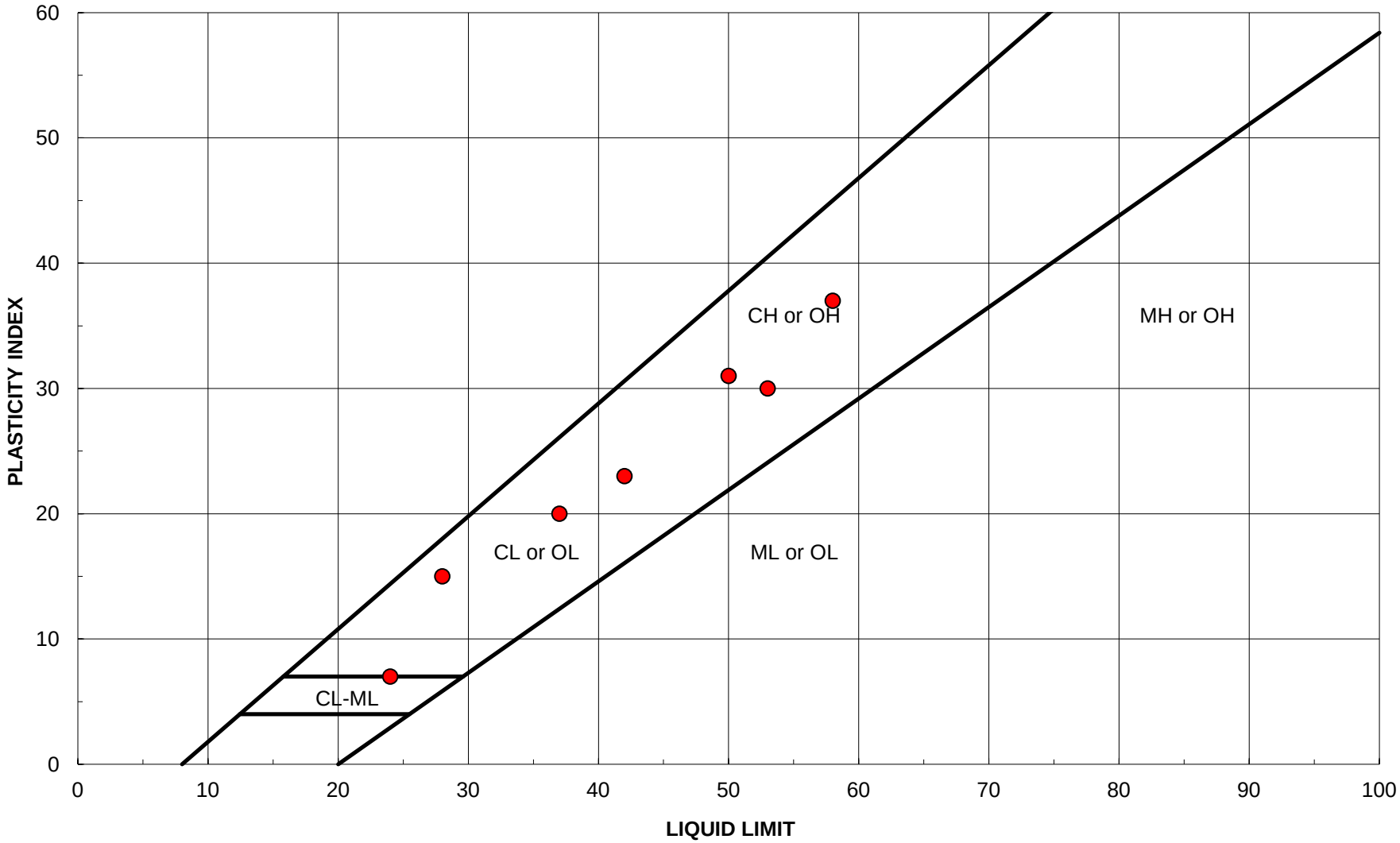

CCID CANAL LEVEE ALIGNMENT
N1-60 vs. Elevation
2F-11-03
2F-11-04
2F-11-05
N1-60
0
10
20
30
40
50
60
70
80
90
100
110.0
100.0
90.0
80.0
70.0
60.0
Elevation (ft)

CCID CANAL LEVEE ALIGNMENT
Effective Friction Angle vs. Elevation



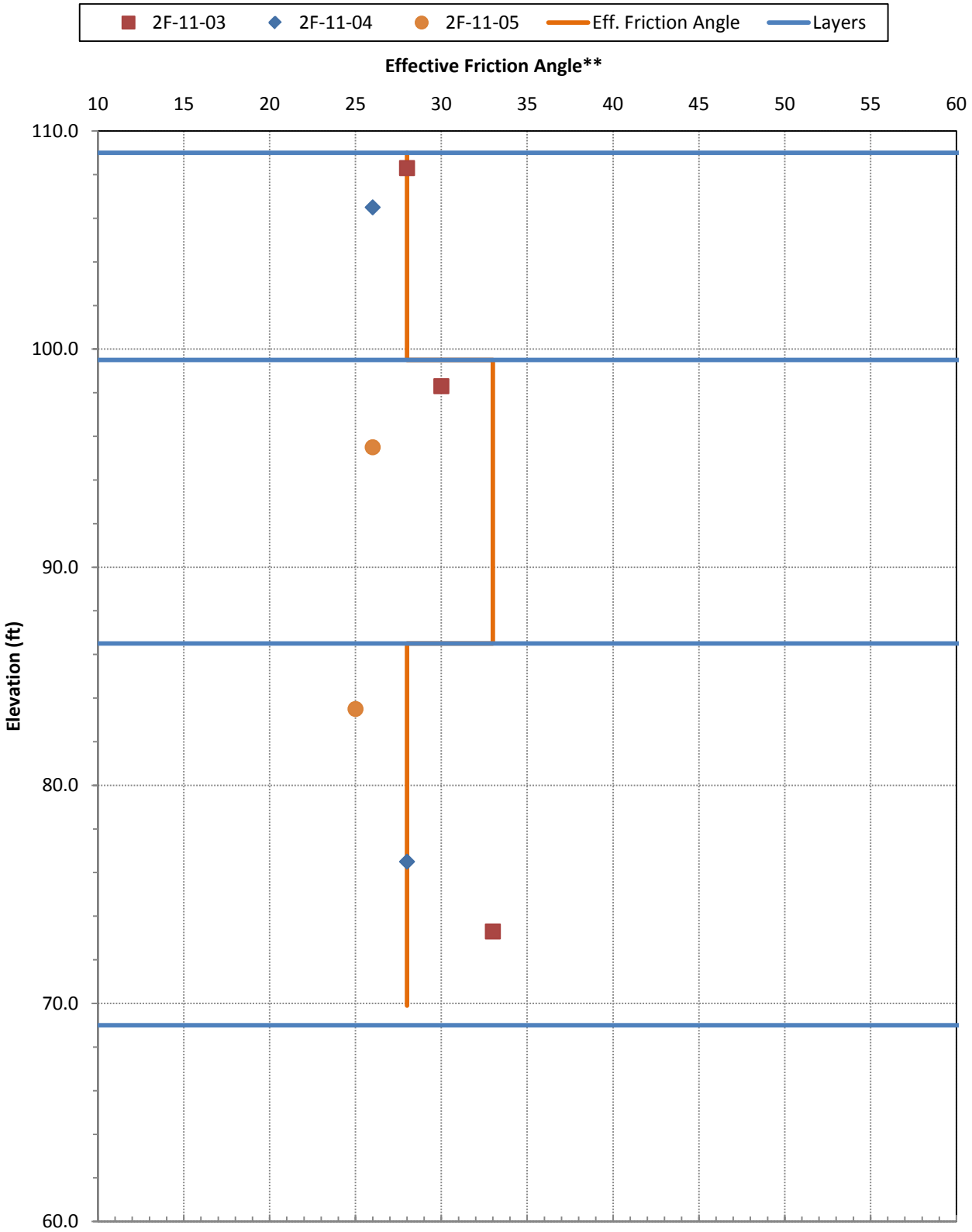
**Peck, Hanson, and Thornburn (1974). Approximated by Wolff, 1989. As presented in Das, 7th Edition.

ATTERBURG LIMITS



CCID CANAL LEVEE ALIGNMENT

Effective Friction Angle OF Cohesive Soil vs. Elevation



**Mitchell, 1976.

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
BORING 2F-11-12, 2F-11-14, 2F-11-16, 2F-11-17 LABORATORY TESTING SUMMARY

Boring Number	Layer ID	Soil Classification	Estimated Permeability for Seepage Analysis					Estimated Strength Parameters		
			Horizontal kh (kx) cm/sec	Anisotropy Ratio kh/kv	Vertical kv (ky) cm/sec	Horizontal kh (kx) ft/day	Vertical kv (ky) ft/day	Φ'	C' (psf)	γ (pcf)
2F-11-12, 2F-11-14, 2F-11-16, 2F-11-17	1	Lean Clay/Fat Clay Foundation	1.00E-05	1.00	1.00E-05	0.028	0.028	28	50	120
	2	Silty Sand w/Gravel	1.00E-02	10.00	1.00E-03	28.350	2.835	33	0	130
	3	Silty Sand/Sandy Silt	1.00E-03	4.00	2.50E-04	2.835	0.709	30	0	125
	4	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0
	5	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0
	6	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0
	7	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0
	8	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0
	9	0	0.00E+00	0.00	0.00E+00	0.000	0.000	0	0	0

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
Permeability and Strength Selection for Analysis

Boring Number	Top of Boring Elevation (ft, msl)	Layer ID	Soil Description	USCS Soil Classification	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Elevation of Top of Layer (ft, NAVD 88)	Elevation of Bottom of Layer (ft, NAVD 88)	Layer Thickness (ft)	Average Depth to Groundwater During Drilling	Laboratory and Field Data						Recommended Hydraulic Conductivity					Recommended Strength Parameters		
											Average % Fines	Average Field N (blows/ft)	Average N_{60} (blows/ft)[1]	Average Normalized Blow Count, $N_{1,60}$ (blows/ft)[2]	PI	LL	Horizontal kh (kx) cm/sec	Anisotropy Ratio kh/kv	Vertical kv (ky) cm/sec	Horizontal kh (kx) ft/day	Vertical kv (ky) ft/day	Φ'	C' (psf)	γ (pcf)
2F-11-12, 2F-11-14, 2F-11-16, 2F-11-17	107.50	1	Lean Clay/Fat Clay Foundation	CL/CH	0.00	8.50	107.50	99.00	8.50	25.70	0	7	10	21	34	56	1.00E-05	1.00	0.00001	0.028	0.028	28	50	120
		2	Silty Sand w/Gravel	SP-SM	8.50	37.00	99.00	70.50	28.50		0	28	17	29			1.00E-02	10.00	0.001	28.350	2.835	33	0	130
		3	Silty Sand/Sandy Silt	SM/ML	37.00	40.00	70.50	67.50	3.00		0	16	24	36			1.00E-03	4.00	0.00025	2.835	0.709	30	0	125
		4							0.00															
		5							0.00															
		6							0.00															
		7							0.00															
		8							0.00															
		9							0.00															

Total Depth (ft.) **40.00**

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
BORING 2F-11-12 LABORATORY TESTING SUMMARY

Ground Elev. (ft, NAVD 88) = 107.10 ft
Groundwater Depth Below GS (ft, NAVD 88) = 38.50 ft

Sample Depth (ft)	Sample Elevation (ft)	Material Description	USCS Soil Type	N	Grain Size Distribtion				Plasticity Index		Dry Unit Weight	Other Testing
					Lab Test?	% Gravel	% Sand	% Fines	LL	PI		
0.5	106.6	Fat Clay	CH	6		19	21	60	55	34		
2.5	104.6	Fat Clay	CH	3								
4.5	102.6	Silty Clay	CL-ML	2			5	95				
6.5	100.6	Fat Clay	CH	5			24	76	53	30		
8.5	98.6	Silty Sand	SM	7			70	30				
10.5	96.6	Silty Sand	SM	7								
12.5	94.6	Sand w/Silt and Gravel	SP-SM	19		15	75	10				
14.5	92.6	Sand w/Silt and Gravel	SP-SM	26								
16.5	90.6	Sand w/Silt and Gravel	SP-SM	22		20	70	10				
18.5	88.6	Sand w/Silt and Gravel	SP-SM	23								
20.5	86.6	Sand w/Silt and Gravel	SP-SM	31								
23.5	83.6	Sand w/Silt and Gravel	SP-SM	17								
26.5	80.6	Sand w/Silt and Gravel	SP-SM	36								
29.5	77.6	Sand w/Silt and Gravel	SP-SM	28								
32.5	74.6	Silty Sand w/Gravel	SM	18		20	60	20				
35.5	71.6	Silty Sand w/Gravel	SM	31								
38.5	68.6	Sandy Silt	ML	12			45	55				

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
BORING 2F-11-14 LABORATORY TESTING SUMMARY

Ground Elev. (ft, NAVD 88) = 107.70 ft
Groundwater Depth Below GS (ft, NAVD 88) = 50.00 ft

Sample Depth (ft)	Sample Elevation (ft)	Material Description	USCS Soil Type	N	Grain Size Distribtion				Plasticity Index		Dry Unit Weight	Other Testing
					Lab Test?	% Gravel	% Sand	% Fines	LL	PI		
0.5	107.2	Lean Clay	CL	15			20	80				
2.5	105.2	Fat Clay	CH	9		3	29	68	50	29		
4.5	103.2	Lean Clay	CL	5		5	20	75				
6.5	101.2	Lean Clay	CL	8								
8.5	99.2	Silty Sand	SM	34			65	35				
10.5	97.2	Silty Sand w/Gravel	SM	27		27	55	18				
12.5	95.2	Silty Sand w/Gravel	SM	26								
14.5	93.2	Poorly Graded Sand w/gravel	SP	14		20	80					
16.5	91.2	Sand w/Silt and Gravel	SP-SM	33		10	60	30				
18.5	89.2	Poorly Graded Sand w/gravel	SP	23		30	70					
20.5	87.2	Poorly Graded Sand w/gravel	SP-SM	31		32	61	7				
23.5	84.2	Poorly Graded Sand w/gravel	SP-SM	29								
26.5	81.2	Poorly Graded Sand w/gravel	SP-SM	23		25	65	10				
29.5	78.2	Clayey Sand	SC	26		5	63	32				
32.5	75.2	Poorly Graded Sand w/gravel	SP	6		20	80					
35.5	72.2	Poorly Graded Sand w/gravel	SP	42								
38.5	69.2	Silty Sand w/Gravel	SM	19		20	65	15				

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
BORING 2F-11-16 LABORATORY TESTING SUMMARY

Ground Elev. (ft, NAVD 88) = 107.40 ft
Groundwater Depth Below GS (ft, NAVD 88) = 50.00 ft

Sample Depth (ft)	Sample Elevation (ft)	Material Description	USCS Soil Type	N	Grain Size Distribtion				Plasticity Index		Dry Unit Weight	Other Testing
					Lab Test?	% Gravel	% Sand	% Fines	LL	PI		
0.5	106.9	Lean Clay	CL	4			10	90				
2.5	104.9	Fat Clay	CH	4			29	71	57	35		
4.5	102.9	Fat Clay	CH	5								
6.5	100.9	Fat Clay	CH	17					58	35		
8.5	98.9	Poorly Graded Sand w/Gravel	SP	30		20	80					
10.5	96.9	Sand w/Silt and Gravel	SW-SM	26		41	50	9				
12.5	94.9	Sand w/Silt and Gravel	SW-SM	33								
14.5	92.9	Sand w/Silt and Gravel	SP-SM	36		15	75	10				
16.5	90.9	Sand w/Silt and Gravel	SP-SM	42								
18.5	88.9	Silty Gravel w/Sand	GM	25		45	41	14				
20.5	86.9	Sand w/Silty and Gravel	SP-SM	37		5	85	10				
23.5	83.9	Clayey Sand	SC	5			60	40				
26.5	80.9	Sand	SP	43		20	80					
29.5	77.9	Sand	SP	25			60	40				
32.5	74.9	Sand w/Silt and Gravel	SP-SM	22		15	75	10				
35.5	71.9	Sand w/Silt and Gravel	SP-SM	31								
38.5	68.9	Sand w/Silt and Gravel	SP-SM	28								

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
BORING 2F-11-17 LABORATORY TESTING SUMMARY

Ground Elev. (ft, NAVD 88) = 108.00 ft
Groundwater Depth Below GS (ft, NAVD 88) = 50.00 ft

Sample Depth (ft)	Sample Elevation (ft)	Material Description	USCS Soil Type	N	Grain Size Distribtion				Plasticity Index		Dry Unit Weight	Other Testing
					Lab Test?	% Gravel	% Sand	% Fines	LL	PI		
0.5	107.5	Fat Clay	CH	17			15	85				
2.5	105.5	Fat Clay	CH	6					59	36		
4.5	103.5	Fat Clay	CH	4					61	37		
6.5	101.5	Fat Clay	CH	9								
8.5	99.5	Poorly Graded Sand w/Gravel	SP	38		30	70					
10.5	97.5	Silty Sand w/Gravel	SM	26		41	46	13				
12.5	95.5	Silty Sand w/Gravel	SM	29								
14.5	93.5	Sand w/Silt and Gravel	SP-SM	15		43	46	11				
16.5	91.5	Silty Sand w/Gravel	SP	29		15	65	20				
18.5	89.5	Sand w/Silt and Gravel	SP-SM	34		20	70	10				
20.5	87.5	Sand w/Silt and Gravel	SP-SM	45								
23.5	84.5	Sand w/Silt	SP-SM	35		10	80	10				
26.5	81.5	Sand w/Silty and Gravel	SP-SM	43		20	70	10				
29.5	78.5	Sand w/Silty and Gravel	SP-SM	27								
32.5	75.5	Sand w/Silty and Gravel	SP-SM	31								
35.5	72.5	Silty Sand w/Gravel	SM	34		25	60	15				
38.5	69.5	Silty Sand w/Gravel	SM	35								

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
2F-11-12: BORING SPT FIELD N TO (N1)60 CONVERSION

Ground Elev. (ft, NAVD 88) = 107.1
Groundwater Elev. During Drilling (ft, NAVD 88) = 68.6
Groundwater Depth Below GS During Drilling (ft) = 38.5

Hammer Type = Automatic
Energy Ratio = 80 Moore Twin

												Borehole Dia. Correction Factor			Sampler Correction Factor		Rod Length Correction Factor			Overburden Correction Factor			Corrected SPT Blow Counts		
Boring Number	Depth to Sample (ft)	Elevation of Sample (ft)	USCS Soil Type	Unit Weight (pcf)	Nfield (blows/ft)	Sampler Outside Diameter (O.D., inch)	Hammer Mass (lb)	Fall Distance (inch)	SPT-Equivalent Conversion	Corrected Nfield (blows/ft	60% Hammer Energy Efficiency, C_E	Drilling Method	Borehole Diameter (inch)	Correction for Borehole Diameter, C_B	Sampling Method	Sampler Correction, C_s	Rod Length Above Ground (feet)	Rod Length (m)	Rod Length Correction Factor, C_R	Overburden Pressure, σ_v (psf)	Effective Overburden Pressure During Drilling, σ_v' (psf)	Overburden Correction Factor, C_N	N_{60}	N_1	$N_{1,60}$
2F-11-12	0.5	106.6	CH	115	6	2	140	30	1	6	1.3	H	8.0	1.15	N	1.20	7	2.0	0.75	58	58	2.0	8	12	17
	2.5	104.6	CH	115	3	2	140	30	1	3	1.3	H	8.0	1.15	N	1.20	7	2.6	0.75	288	288	2.0	4	6	8
	4.5	102.6	CL-ML	120	2	2	140	30	1	2	1.3	H	8.0	1.15	N	1.20	7	3.2	0.75	528	528	2.0	3	4	6
	6.5	100.6	CH	115	5	2	140	30	1	5	1.3	H	8.0	1.15	N	1.20	7	3.8	0.75	758	758	2.0	7	10	14
	8.5	98.6	SM	125	7	2	140	30	1	7	1.3	H	8.0	1.15	N	1.20	7	4.4	0.85	1008	1008	1.4	11	10	16
	10.5	96.6	SM	125	7	2	140	30	1	7	1.3	H	8.0	1.15	N	1.20	7	5.0	0.85	1258	1258	1.3	11	9	14
	12.5	94.6	SP-SM	130	19	2	140	30	1	19	1.3	H	8.0	1.15	N	1.20	7	5.6	0.85	1518	1518	1.2	30	22	35
	14.5	92.6	SP-SM	130	26	2	140	30	1	26	1.3	H	8.0	1.15	N	1.20	7	6.2	0.95	1778	1778	1.1	45	28	50
	16.5	90.6	SP-SM	130	22	2	140	30	1	22	1.3	H	8.0	1.15	N	1.20	7	6.9	0.95	2038	2038	1.0	38	22	39
	18.5	88.6	SP-SM	130	23	2	140	30	1	23	1.3	H	8.0	1.15	N	1.20	7	7.5	0.95	2298	2298	1.0	40	22	39
	20.5	86.6	SP-SM	130	31	2	140	30	1	31	1.3	H	8.0	1.15	N	1.20	7	8.1	0.95	2558	2558	0.9	54	28	49
	23.5	83.6	SP-SM	130	17	2	140	30	1	17	1.3	H	8.0	1.15	N	1.20	7	9.0	0.95	2948	2948	0.8	30	14	25
	26.5	80.6	SP-SM	130	36	2	140	30	1	36	1.3	H	8.0	1.15	N	1.20	7	9.9	0.95	3338	3338	0.8	63	29	50
	29.5	77.6	SP-SM	130	28	2	140	30	1	28	1.3	H	8.0	1.15	N	1.20	7	10.8	1.00	3728	3728	0.8	52	21	39
	32.5	74.6	SM	125	18	2	140	30	1	18	1.3	H	8.0	1.15	N	1.20	7	11.7	1.00	4103	4103	0.7	33	13	24
	35.5	71.6	SM	125	31	2	140	30	1	31	1.3	H	8.0	1.15	N	1.20	7	12.6	1.00	4478	4478	0.7	57	21	39
	38.5	68.6	ML	120	12	2	140	30	1	12	1.3	H	8.0	1.15	N	1.20	7	13.6	1.00	4838	4838	0.7	22	8	15

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
2F-11-14: BORING SPT FIELD N TO (N1)60 CONVERSION

Ground Elev. (ft, NAVD 88) = 107.7
Groundwater Elev. During Drilling (ft, NAVD 88) = 57.7
Groundwater Depth Below GS During Drilling (ft) = 50.0

Hammer Type = Automatic
Energy Ratio = 80 Moore Twin

												Borehole Dia. Correction Factor			Sampler Correction Factor		Rod Length Correction Factor			Overburden Correction Factor			Corrected SPT Blow Counts		
Boring Number	Depth to Sample (ft)	Elevation of Sample (ft)	USCS Soil Type	Unit Weight (pcf)	Nfield (blows/ft)	Sampler Outside Diameter (O.D., inch)	Hammer Mass (lb)	Fall Distance (inch)	SPT-Equivalent Conversion	Corrected Nfield (blows/ft	60% Hammer Energy Efficiency, C_E	Drilling Method	Borehole Diameter (inch)	Correction for Borehole Diameter, C_B	Sampling Method	Sampler Correction, C_s	Rod Length Above Ground (feet)	Rod Length (m)	Rod Length Correction Factor, C_R	Overburden Pressure, σ_v (psf)	Effective Overburden Pressure During Drilling, σ_v' (psf)	Overburden Correction Factor, C_N	N_{60}	N_1	$N_{1,60}$
2F-11-14	0.5	107.2	CL	115	15	2	140	30	1	15	1.3	H	8.0	1.15	N	1.20	7	2.0	0.75	58	58	2.0	21	30	41
	2.5	105.2	CH	115	9	2	140	30	1	9	1.3	H	8.0	1.15	N	1.20	7	2.6	0.75	288	288	2.0	12	18	25
	4.5	103.2	CL	115	5	2	140	30	1	5	1.3	H	8.0	1.15	N	1.20	7	3.2	0.75	518	518	2.0	7	10	14
	6.5	101.2	CL	115	8	2	140	30	1	8	1.3	H	8.0	1.15	N	1.20	7	3.8	0.75	748	748	2.0	11	16	22
	8.5	99.2	SM	125	34	2	140	30	1	34	1.3	H	8.0	1.15	N	1.20	7	4.4	0.85	998	998	1.5	53	50	77
	10.5	97.2	SM	125	27	2	140	30	1	27	1.3	H	8.0	1.15	N	1.20	7	5.0	0.85	1248	1248	1.3	42	35	55
	12.5	95.2	SM	125	26	2	140	30	1	26	1.3	H	8.0	1.15	N	1.20	7	5.6	0.85	1498	1498	1.2	41	31	48
	14.5	93.2	SP	130	14	2	140	30	1	14	1.3	H	8.0	1.15	N	1.20	7	6.2	0.95	1758	1758	1.1	24	15	27
	16.5	91.2	SP-SM	130	33	2	140	30	1	33	1.3	H	8.0	1.15	N	1.20	7	6.9	0.95	2018	2018	1.0	58	34	59
	18.5	89.2	SP	130	23	2	140	30	1	23	1.3	H	8.0	1.15	N	1.20	7	7.5	0.95	2278	2278	1.0	40	22	39
	20.5	87.2	SP-SM	130	31	2	140	30	1	31	1.3	H	8.0	1.15	N	1.20	7	8.1	0.95	2538	2538	0.9	54	28	49
	23.5	84.2	SP-SM	130	29	2	140	30	1	29	1.3	H	8.0	1.15	N	1.20	7	9.0	0.95	2928	2928	0.9	51	25	43
	26.5	81.2	SP-SM	130	23	2	140	30	1	23	1.3	H	8.0	1.15	N	1.20	7	9.9	0.95	3318	3318	0.8	40	18	32
	29.5	78.2	SC	125	26	2	140	30	1	26	1.3	H	8.0	1.15	N	1.20	7	10.8	1.00	3693	3693	0.8	48	20	36
	32.5	75.2	SP	130	6	2	140	30	1	6	1.3	H	8.0	1.15	N	1.20	7	11.7	1.00	4083	4083	0.7	11	4	8
	35.5	72.2	SP	130	42	2	140	30	1	42	1.3	H	8.0	1.15	N	1.20	7	12.6	1.00	4473	4473	0.7	77	29	53
	38.5	69.2	SM	125	19	2	140	30	1	19	1.3	H	8.0	1.15	N	1.20	7	13.6	1.00	4848	4848	0.7	35	13	23

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
2F-11-16: BORING SPT FIELD N TO (N1)60 CONVERSION

Ground Elev. (ft, NAVD 88) = 107.4
Groundwater Elev. During Drilling (ft, NAVD 88) = 6.1
Groundwater Depth Below GS During Drilling (ft) = 50.0

Hammer Type = Automatic
Energy Ratio = 80 Moore Twin

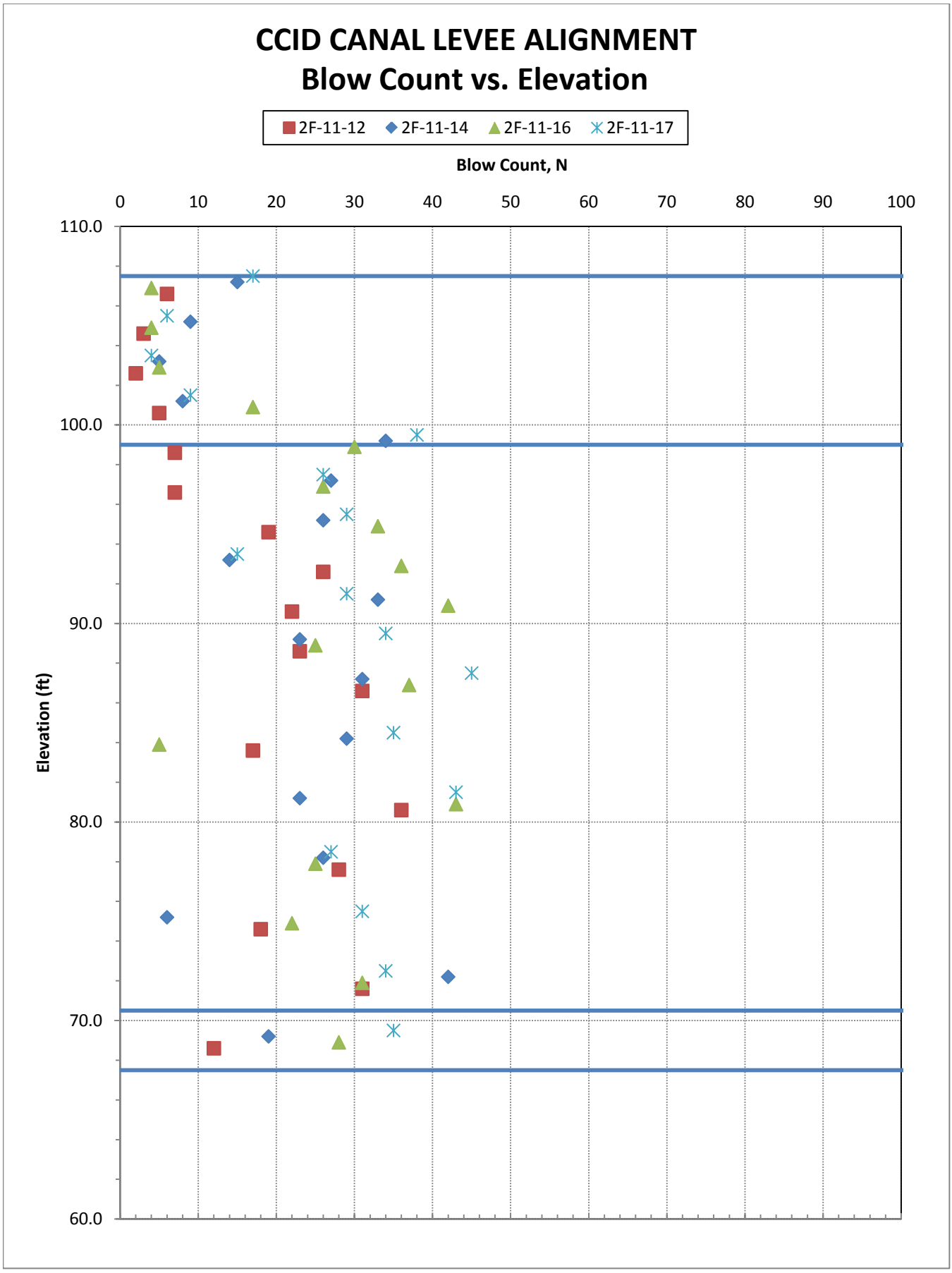
												Borehole Dia. Correction Factor			Sampler Correction Factor		Rod Length Correction Factor			Overburden Correction Factor			Corrected SPT Blow Counts		
Boring Number	Depth to Sample (ft)	Elevation of Sample (ft)	USCS Soil Type	Unit Weight (pcf)	Nfield (blows/ft)	Sampler Outside Diameter (O.D., inch)	Hammer Mass (lb)	Fall Distance (inch)	SPT-Equivalent Conversion	Corrected Nfield (blows/ft	60% Hammer Energy Efficiency, C_E	Drilling Method	Borehole Diameter (inch)	Correction for Borehole Diameter, C_B	Sampling Method	Sampler Correction, C_s	Rod Length Above Ground (feet)	Rod Length (m)	Rod Length Correction Factor, C_R	Overburden Pressure, σ_v (psf)	Effective Overburden Pressure During Drilling, σ_v' (psf)	Overburden Correction Factor, C_N	N_{60}	N_1	$N_{1,60}$
2F-11-16	0.5	106.9	CL	115	4	2	140	30	1	4	1.3	H	8.0	1.15	N	1.20	7	2.0	0.75	58	58	2.0	6	8	11
	2.5	104.9	CH	115	4	2	140	30	1	4	1.3	H	8.0	1.15	N	1.20	7	2.6	0.75	288	288	2.0	6	8	11
	4.5	102.9	CH	115	5	2	140	30	1	5	1.3	H	8.0	1.15	N	1.20	7	3.2	0.75	518	518	2.0	7	10	14
	6.5	100.9	CH	115	17	2	140	30	1	17	1.3	H	8.0	1.15	N	1.20	7	3.8	0.75	748	748	2.0	23	34	47
	8.5	98.9	SP	130	30	2	140	30	1	30	1.3	H	8.0	1.15	N	1.20	7	4.4	0.85	1008	1008	1.4	47	43	68
	10.5	96.9	SW-SM	130	26	2	140	30	1	26	1.3	H	8.0	1.15	N	1.20	7	5.0	0.85	1268	1268	1.3	41	34	53
	12.5	94.9	SW-SM	130	33	2	140	30	1	33	1.3	H	8.0	1.15	N	1.20	7	5.6	0.85	1528	1528	1.2	52	39	61
	14.5	92.9	SP-SM	130	36	2	140	30	1	36	1.3	H	8.0	1.15	N	1.20	7	6.2	0.95	1788	1788	1.1	63	39	68
	16.5	90.9	SP-SM	130	42	2	140	30	1	42	1.3	H	8.0	1.15	N	1.20	7	6.9	0.95	2048	2048	1.0	73	43	75
	18.5	88.9	GM	135	25	2	140	30	1	25	1.3	H	8.0	1.15	N	1.20	7	7.5	0.95	2318	2318	1.0	44	24	42
	20.5	86.9	SP-SM	130	37	2	140	30	1	37	1.3	H	8.0	1.15	N	1.20	7	8.1	0.95	2578	2578	0.9	65	34	59
	23.5	83.9	SC	125	5	2	140	30	1	5	1.3	H	8.0	1.15	N	1.20	7	9.0	0.95	2953	2953	0.8	9	4	7
	26.5	80.9	SP	130	43	2	140	30	1	43	1.3	H	8.0	1.15	N	1.20	7	9.9	0.95	3343	3343	0.8	75	34	60
	29.5	77.9	SP	130	25	2	140	30	1	25	1.3	H	8.0	1.15	N	1.20	7	10.8	1.00	3733	3733	0.8	46	19	35
	32.5	74.9	SP-SM	130	22	2	140	30	1	22	1.3	H	8.0	1.15	N	1.20	7	11.7	1.00	4123	4123	0.7	40	16	29
	35.5	71.9	SP-SM	130	31	2	140	30	1	31	1.3	H	8.0	1.15	N	1.20	7	12.6	1.00	4513	4513	0.7	57	21	39
	38.5	68.9	SP-SM	130	28	2	140	30	1	28	1.3	H	8.0	1.15	N	1.20	7	13.6	1.00	4903	4903	0.7	52	18	34

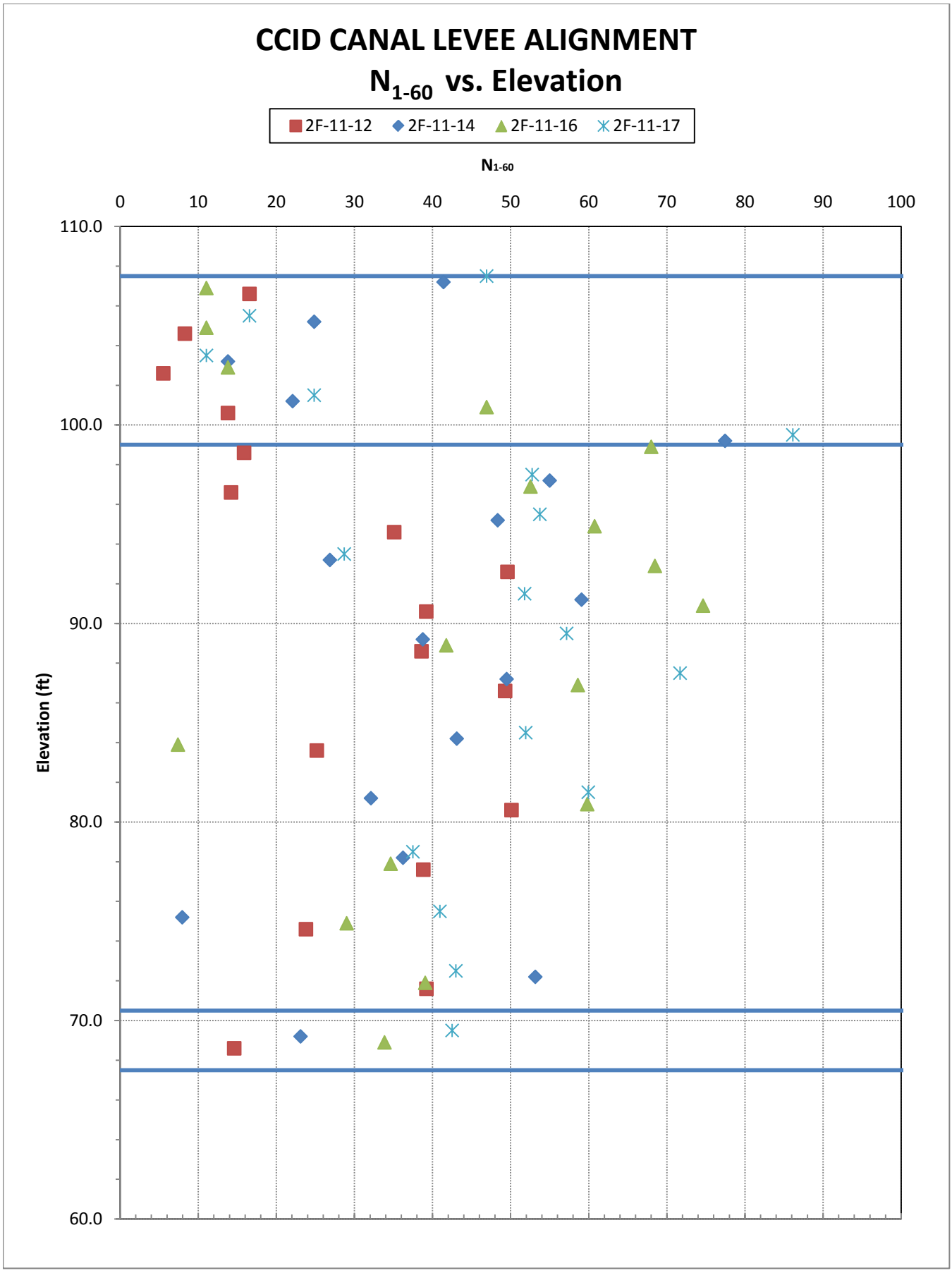
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBIITY REPORT - GEOTECHNICAL ANALYSIS
CCID CANAL LEVEE ALIGNMENT
2F-11-17: BORING SPT FIELD N TO (N1)60 CONVERSION

Ground Elev. (ft, NAVD 88) = 108.0
Groundwater Elev. During Drilling (ft, NAVD 88) = 6.1
Groundwater Depth Below GS During Drilling (ft) = 50.0

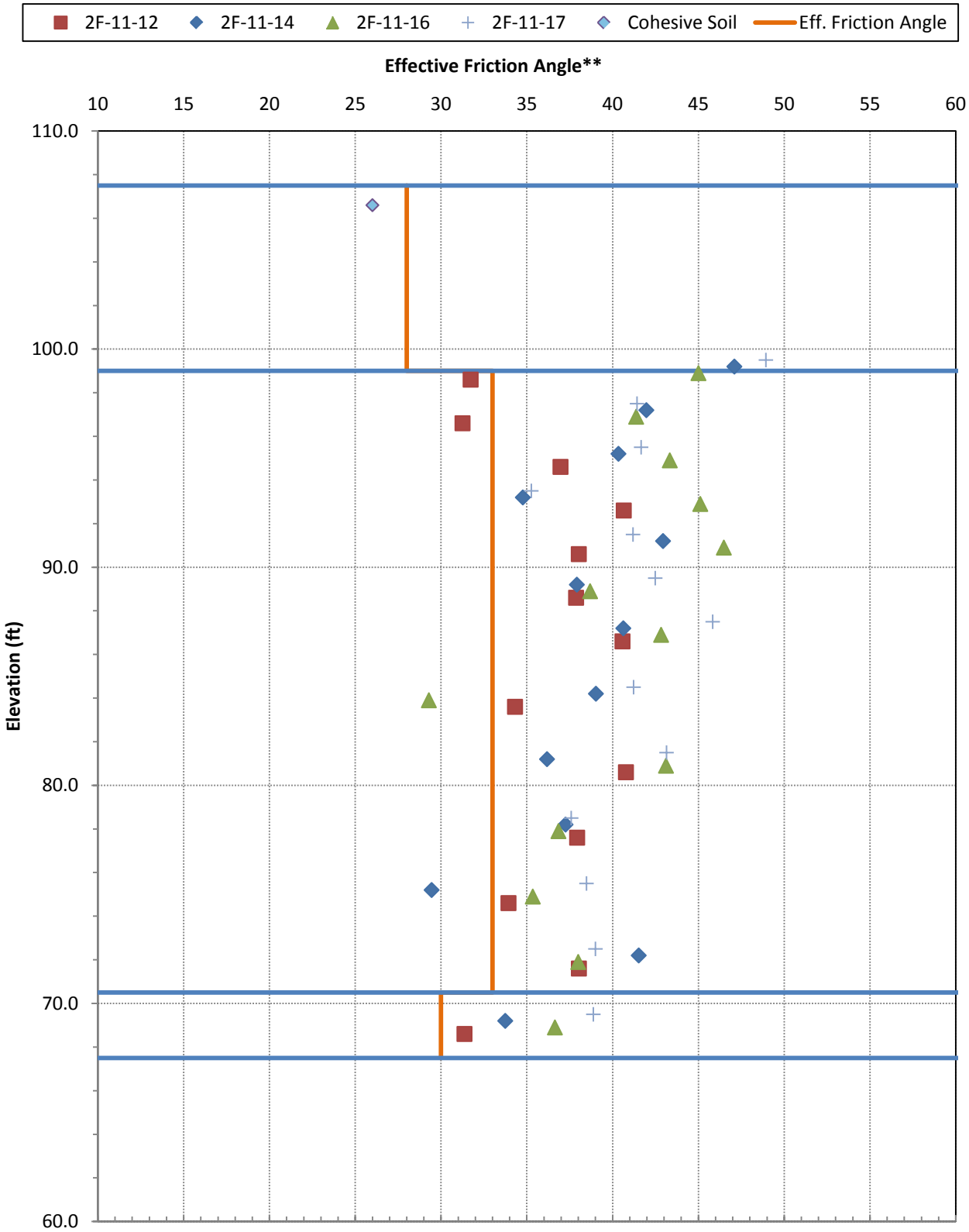
Hammer Type = Automatic
Energy Ratio = 80 Moore Twin

												Borehole Dia. Correction Factor			Sampler Correction Factor		Rod Length Correction Factor			Overburden Correction Factor			Corrected SPT Blow Counts		
Boring Number	Depth to Sample (ft)	Elevation of Sample (ft)	USCS Soil Type	Unit Weight (pcf)	Nfield (blows/ft)	Sampler Outside Diameter (O.D., inch)	Hammer Mass (lb)	Fall Distance (inch)	SPT-Equivalent Conversion	Corrected Nfield (blows/ft	60% Hammer Energy Efficiency, C_E	Drilling Method	Borehole Diameter (inch)	Correction for Borehole Diameter, C_B	Sampling Method	Sampler Correction, C_s	Rod Length Above Ground (feet)	Rod Length (m)	Rod Length Correction Factor, C_R	Overburden Pressure, σ_v (psf)	Effective Overburden Pressure During Drilling, σ_v' (psf)	Overburden Correction Factor, C_N	N_{60}	N_1	$N_{1,60}$
2F-11-17	0.5	107.5	CH	115	17	2	140	30	1	17	1.3	H	8.0	1.15	N	1.20	7	2.0	0.75	58	58	2.0	23	34	47
	2.5	105.5	CH	115	6	2	140	30	1	6	1.3	H	8.0	1.15	N	1.20	7	2.6	0.75	288	288	2.0	8	12	17
	4.5	103.5	CH	115	4	2	140	30	1	4	1.3	H	8.0	1.15	N	1.20	7	3.2	0.75	518	518	2.0	6	8	11
	6.5	101.5	CH	115	9	2	140	30	1	9	1.3	H	8.0	1.15	N	1.20	7	3.8	0.75	748	748	2.0	12	18	25
	8.5	99.5	SP	130	38	2	140	30	1	38	1.3	H	8.0	1.15	N	1.20	7	4.4	0.85	1008	1008	1.4	59	55	86
	10.5	97.5	SM	125	26	2	140	30	1	26	1.3	H	8.0	1.15	N	1.20	7	5.0	0.85	1258	1258	1.3	41	34	53
	12.5	95.5	SM	125	29	2	140	30	1	29	1.3	H	8.0	1.15	N	1.20	7	5.6	0.85	1508	1508	1.2	45	34	54
	14.5	93.5	SP-SM	130	15	2	140	30	1	15	1.3	H	8.0	1.15	N	1.20	7	6.2	0.95	1768	1768	1.1	26	16	29
	16.5	91.5	SP	130	29	2	140	30	1	29	1.3	H	8.0	1.15	N	1.20	7	6.9	0.95	2028	2028	1.0	51	30	52
	18.5	89.5	SP-SM	130	34	2	140	30	1	34	1.3	H	8.0	1.15	N	1.20	7	7.5	0.95	2288	2288	1.0	59	33	57
	20.5	87.5	SP-SM	130	45	2	140	30	1	45	1.3	H	8.0	1.15	N	1.20	7	8.1	0.95	2548	2548	0.9	79	41	72
	23.5	84.5	SP-SM	130	35	2	140	30	1	35	1.3	H	8.0	1.15	N	1.20	7	9.0	0.95	2938	2938	0.8	61	30	52
	26.5	81.5	SP-SM	130	43	2	140	30	1	43	1.3	H	8.0	1.15	N	1.20	7	9.9	0.95	3328	3328	0.8	75	34	60
	29.5	78.5	SP-SM	130	27	2	140	30	1	27	1.3	H	8.0	1.15	N	1.20	7	10.8	1.00	3718	3718	0.8	50	20	37
	32.5	75.5	SP-SM	130	31	2	140	30	1	31	1.3	H	8.0	1.15	N	1.20	7	11.7	1.00	4108	4108	0.7	57	22	41
	35.5	72.5	SM	125	34	2	140	30	1	34	1.3	H	8.0	1.15	N	1.20	7	12.6	1.00	4483	4483	0.7	63	23	43
	38.5	69.5	SM	125	35	2	140	30	1	35	1.3	H	8.0	1.15	N	1.20	7	13.6	1.00	4858	4858	0.7	64	23	43


CCID CANAL LEVEE ALIGNMENT
Blow Count vs. Elevation
2F-11-12
2F-11-14
2F-11-16
2F-11-17
Blow Count, N
0
10
20
30
40
50
60
70
80
90
100
110.0
100.0
90.0
80.0
70.0
60.0
Elevation (ft)

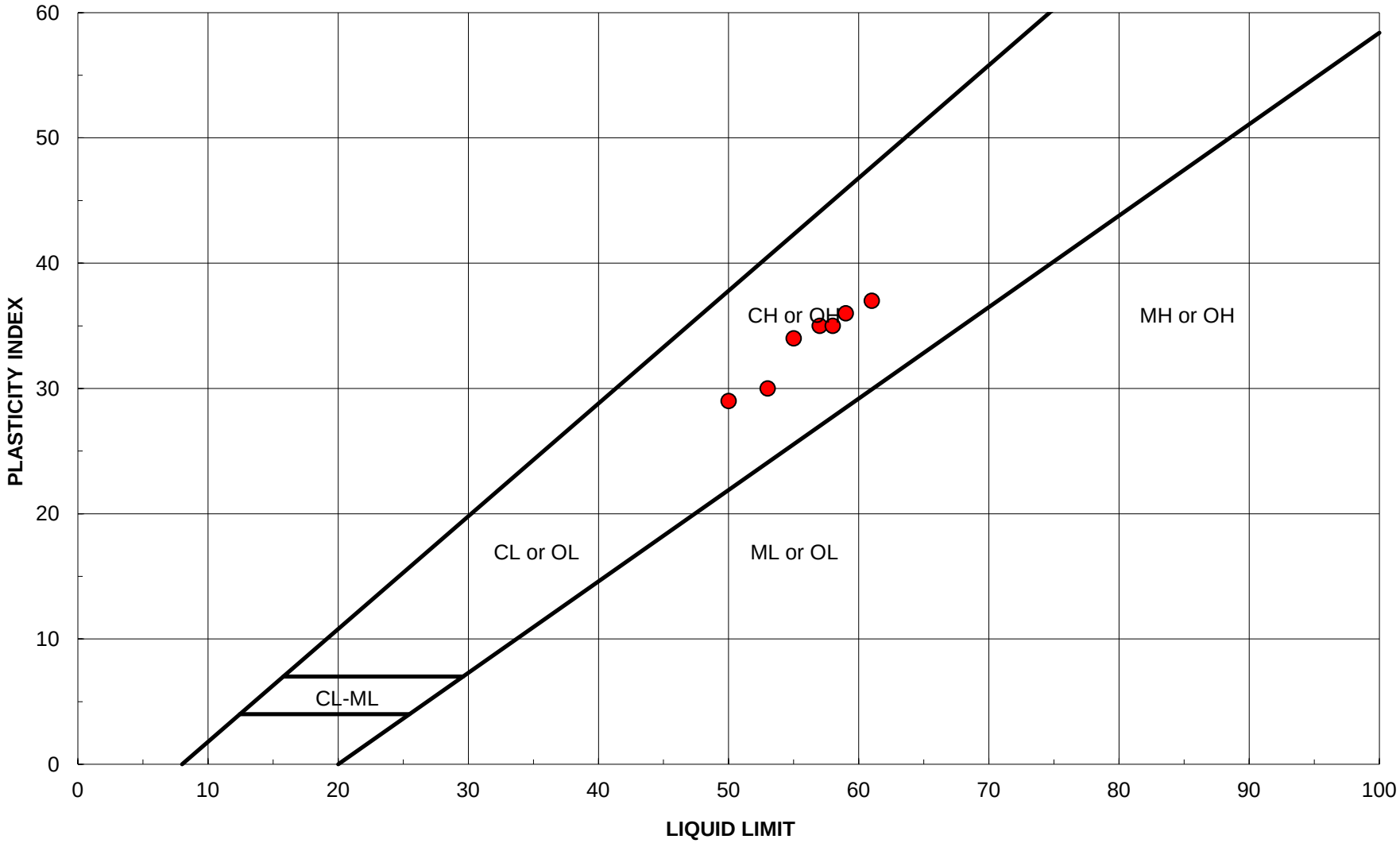

CCID CANAL LEVEE ALIGNMENT
N1-60 vs. Elevation
2F-11-12
2F-11-14
2F-11-16
2F-11-17
N1-60
0
10
20
30
40
50
60
70
80
90
100
110.0
100.0
90.0
80.0
70.0
60.0
Elevation (ft)

CCID CANAL LEVEE ALIGNMENT
Effective Friction Angle vs. Elevation



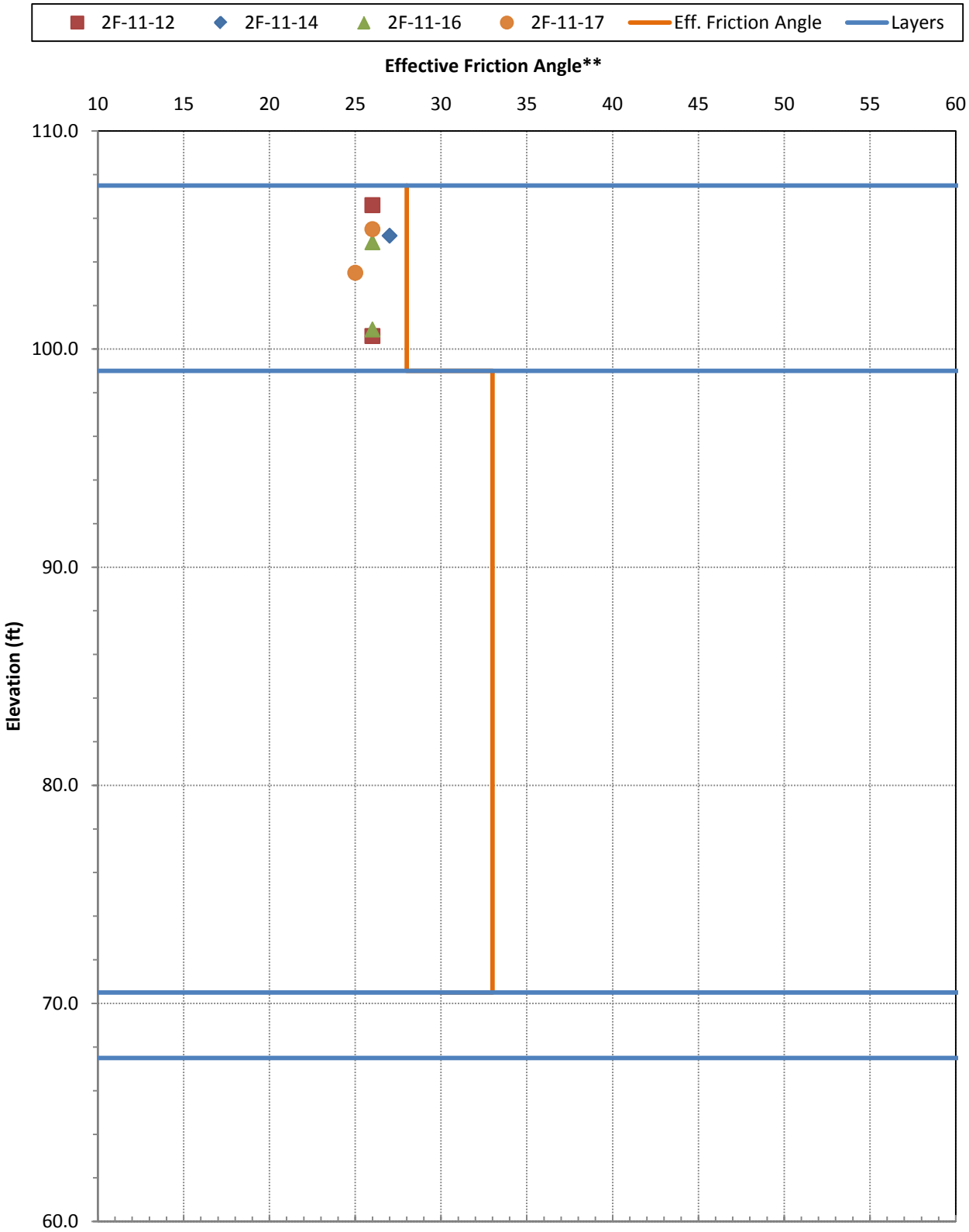
**Peck, Hanson, and Thornburn (1974). Approximated by Wolff, 1989. As presented in Das, 7th Edition.

ATTERBURG LIMITS



CCID CANAL LEVEE ALIGNMENT

Effective Friction Angle OF Cohesive Soil vs. Elevation

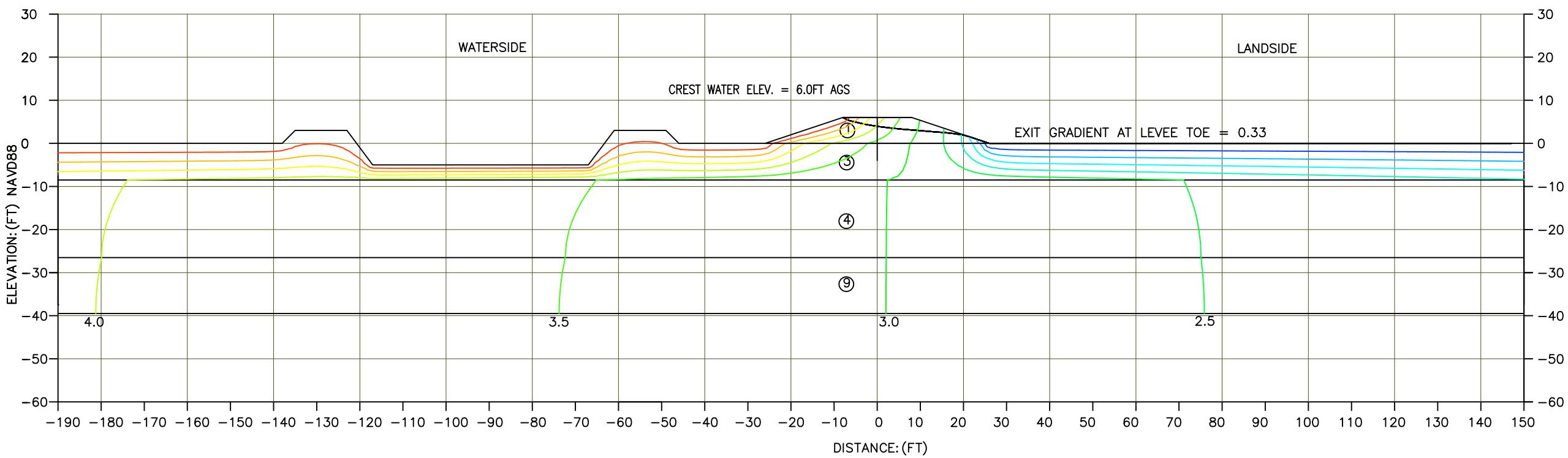


**Mitchell, 1976.

APPENDIX D

SEEPAGE ANALYSIS

EAST LEVEE ALIGNMENT
STA 38 + 00
REACH A
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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SACRAMENTO, CALIFORNIA

SACRAMENTO CALIFORNIA

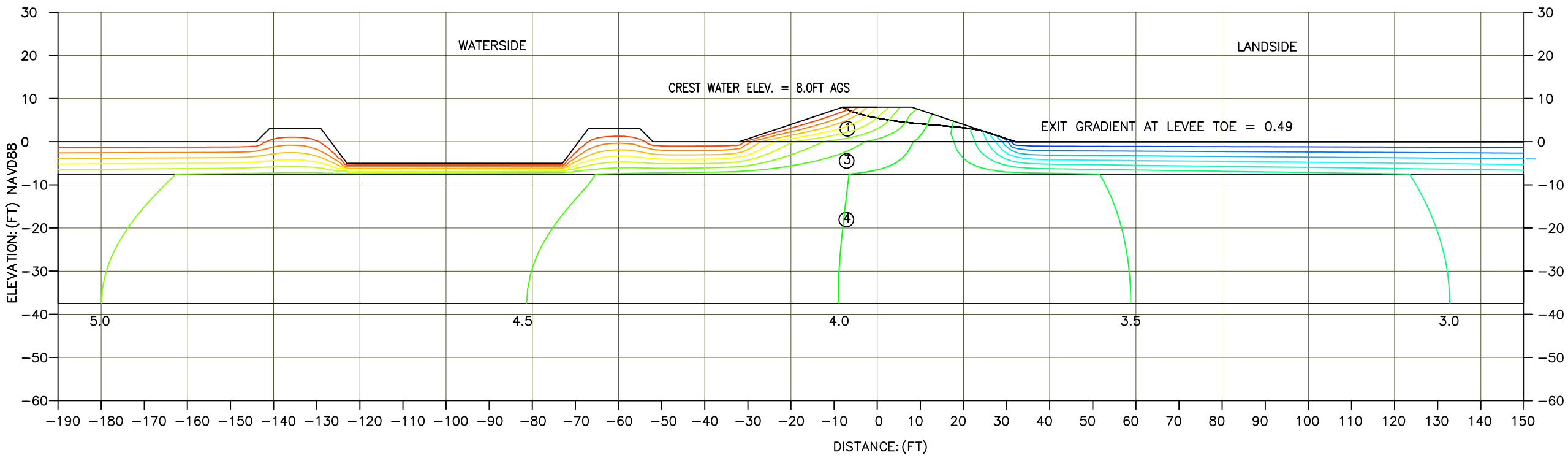
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

NED WITH PROJECT CONDITIONS
STA 38+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	1 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 3:45:14pm
DRAWING: F:\Orestimba\Drawings\Reach A\Reach A 38+00 NED DWSE.dwg

EAST LEVEE ALIGNMENT
STA 86 + 00
REACH B
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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SACRAMENTO CALIFORNIA

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

NED WITH PROJECT CONDITIONS
STA 86+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	2 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 4:34:38pm
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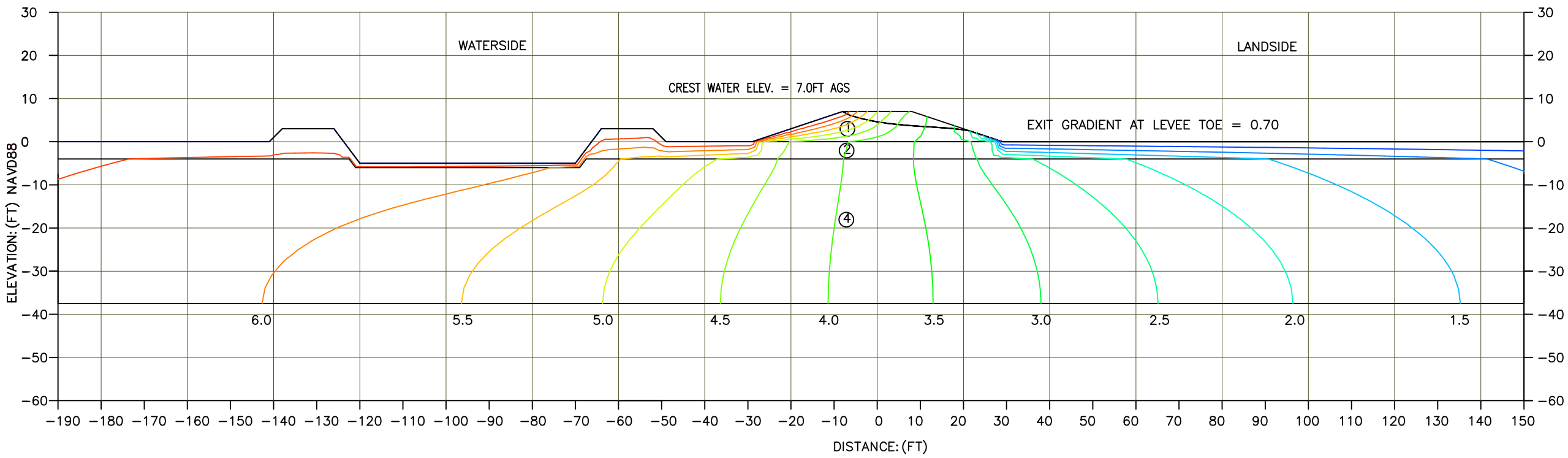
EAST LEVEE ALIGNMENT
STA 125 + 00
REACH C
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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SACRAMENTO CALIFORNIA

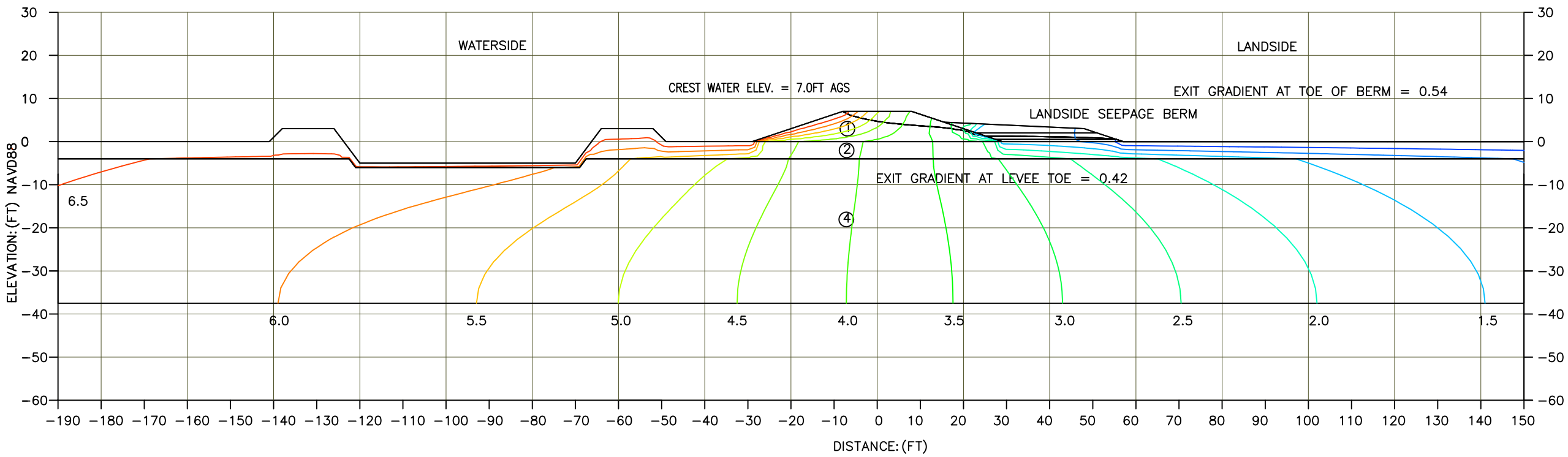
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

NED WITH PROJECT CONDITIONS
STA 125+00 DWSE WITHOUT BERM

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	3 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 4:56:46pm
DRAWING: F:\Orestimba\Drawings\Reach C\125+00\Reach C 125+00 NED DWSE without berm.dwg

EAST LEVEE ALIGNMENT
STA 125 + 00
REACH C
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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SACRAMENTO CALIFORNIA

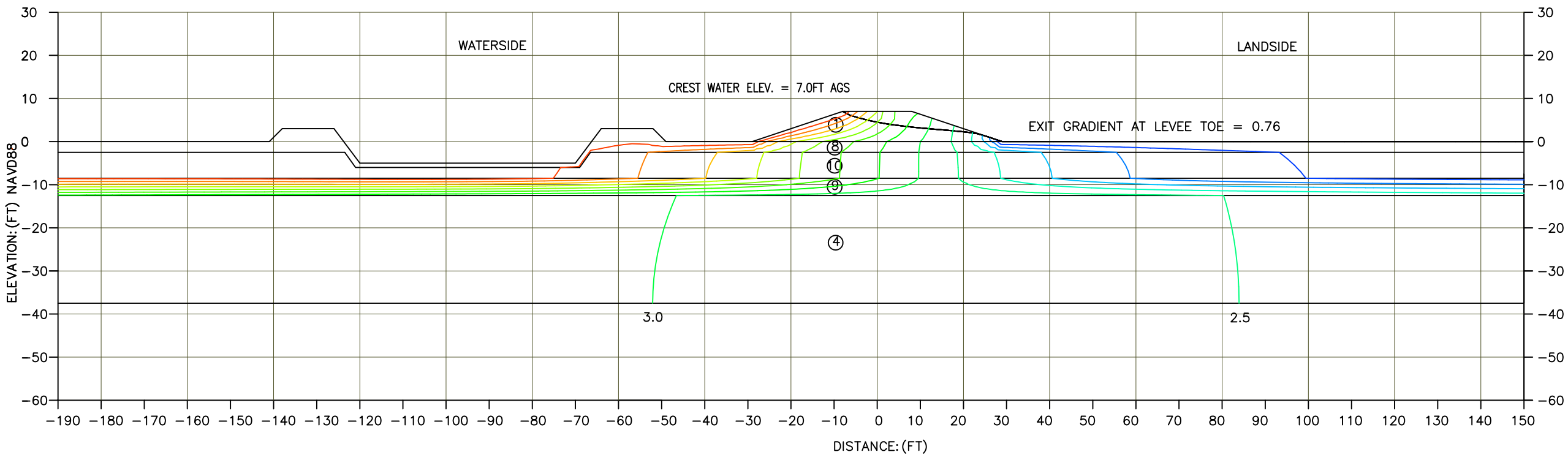
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

NED WITH PROJECT CONDITIONS
STA 125+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	4 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 5:52:37pm
DRAWING: F:\Orestimba\Drawings\Reach C\125+00\Reach C 125+00 NED DWSE with berm.dwg

EAST LEVEE ALIGNMENT
STA 151 + 00
REACH C
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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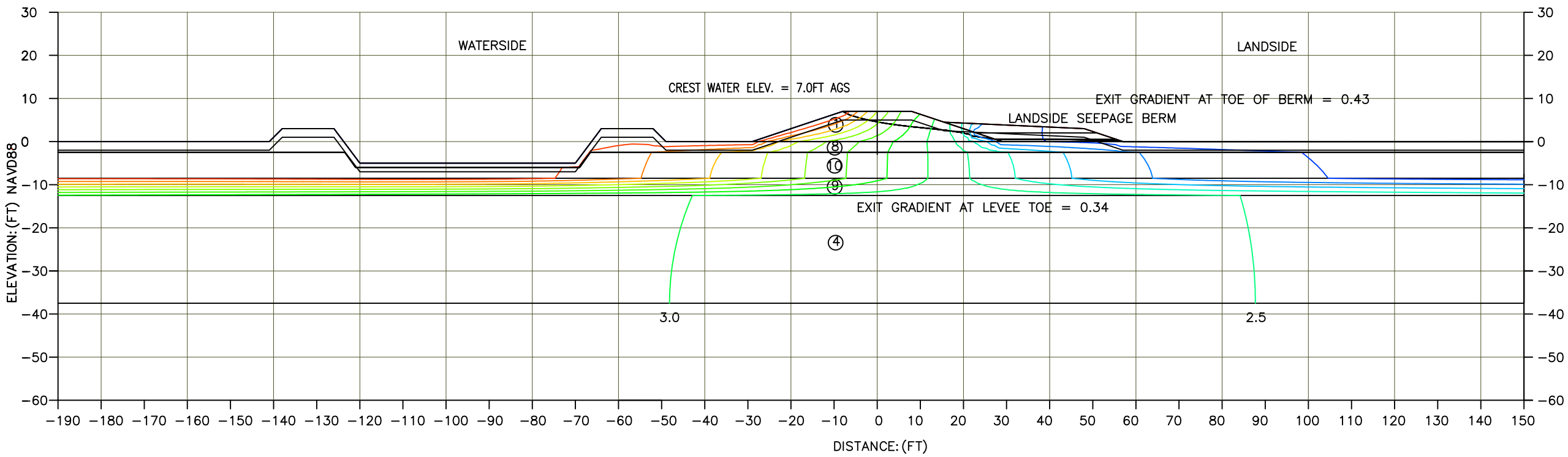
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

NED WITH PROJECT CONDITIONS
STA 151+00 DWSE WITHOUT BERM

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	5 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 6:17:15pm
DRAWING: F:\Orestimba\Drawings\Reach C\151+00\Reach C 151+00 NED DWSE without berm.dwg

EAST LEVEE ALIGNMENT
STA 151 + 00
REACH C
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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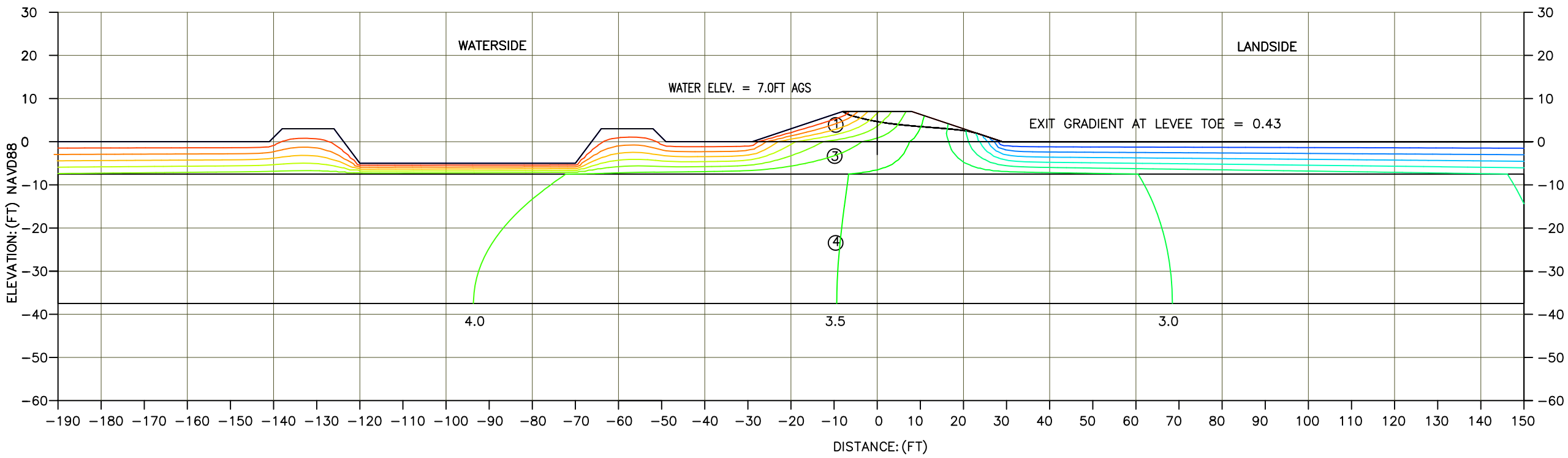
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

NED WITH PROJECT CONDITIONS
STA 151+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	6 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 6:52:54pm
DRAWING: F:\Orestimba\Drawings\Reach C\151+00\Reach C 151+00 NED DWSE with berm.dwg

EAST LEVEE ALIGNMENT
STA 195 + 00
REACH D
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP-SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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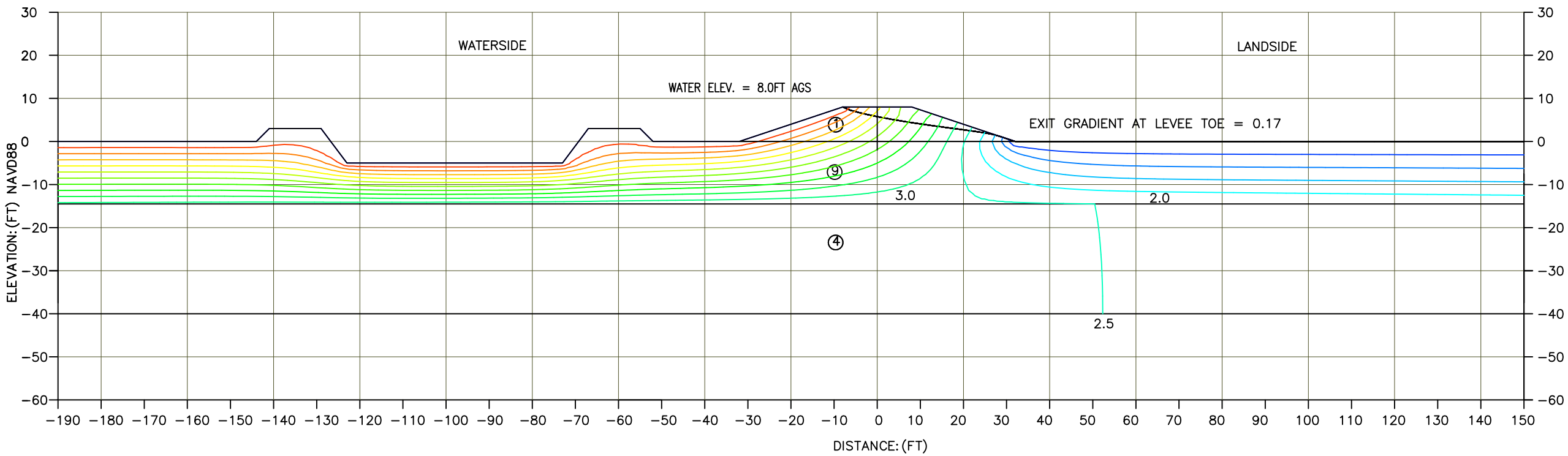
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

NED WITH PROJECT CONDITIONS
STA 195+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	7 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 7:20:45pm
DRAWING: F:\Orestimba\Drawings\Reach D\Reach D 195+00 NED DWSE.dwg

EAST LEVEE ALIGNMENT
STA 232 + 00
REACH E
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP-SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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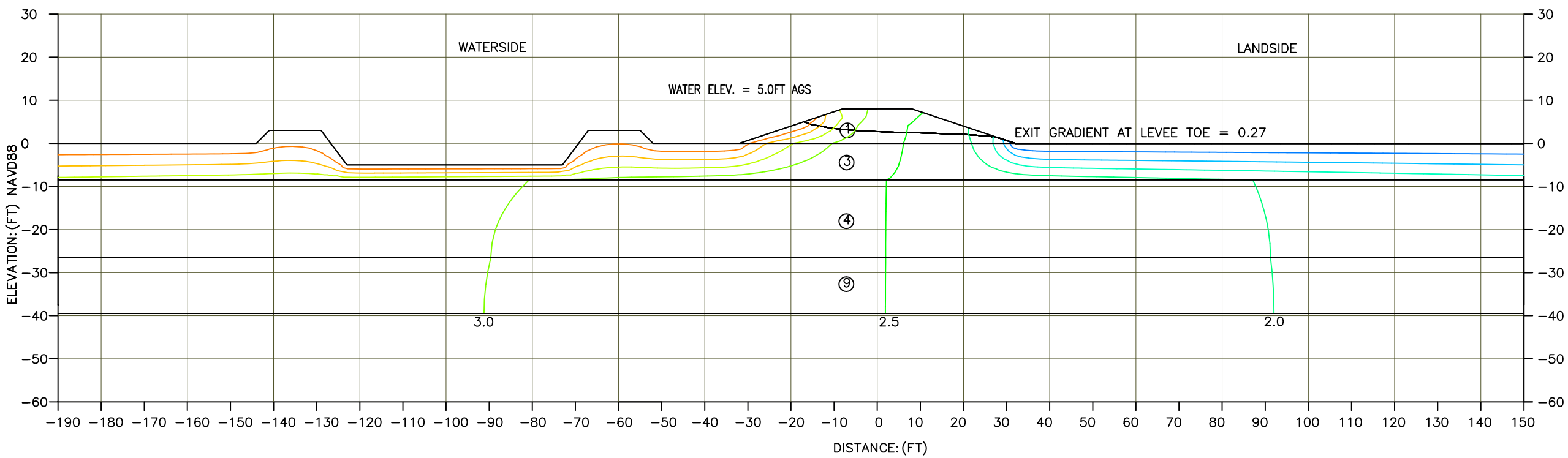
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

NED WITH PROJECT CONDITIONS
STA 232+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	8 of 22

PLOT BY: LZEDGGAJ - Nov 16, 2011 - 7:49:10pm
DRAWING: F:\Orestimba\Drawings\Reach E\Reach E 232+00 NED DWSE.dwg

EAST LEVEE ALIGNMENT
STA 38 + 00
REACH A
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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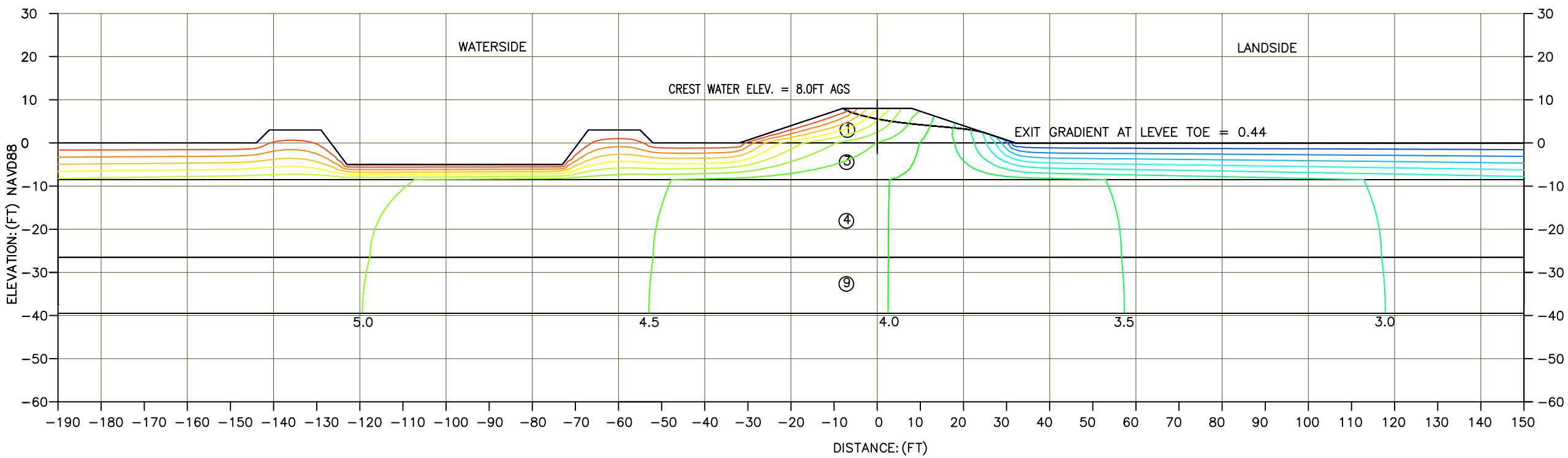
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 38+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	9 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 3:20:31pm
DRAWING: F:\Orestimba\Drawings\Reach A\Reach A 38+00 LPP DWSE.dwg

EAST LEVEE ALIGNMENT
STA 38 + 00
REACH A
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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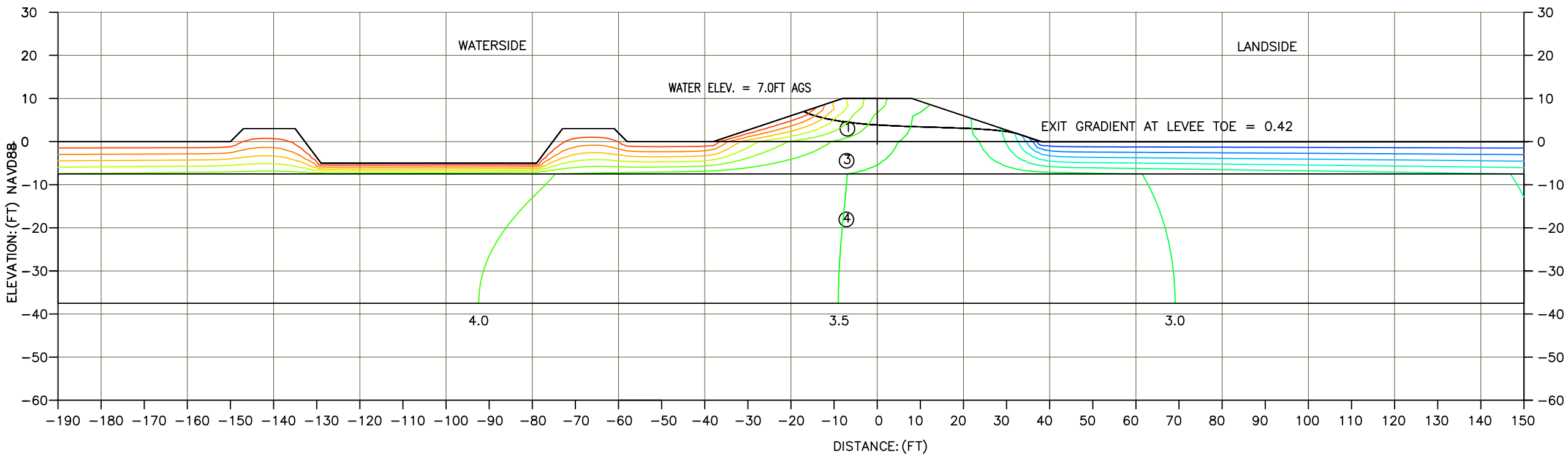
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 38+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	10 of 22

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:03:29am
DRAWING: F:\Orestimba\Drawings\Reach A\Reach A 38+00 LPP Top of Levee.dwg

EAST LEVEE ALIGNMENT
STA 86 + 00
REACH B
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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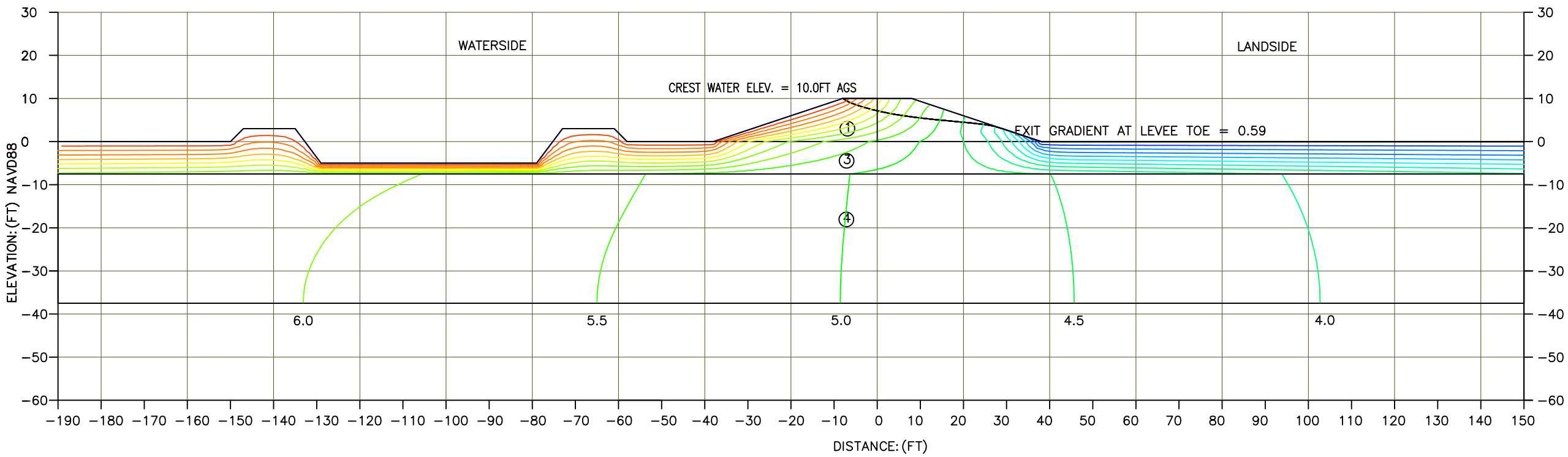
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 86+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	11 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 2:52:45pm
DRAWING: F:\Orestimba\Drawings\Reach B\Reach B 86+00 LPP DWSE.dwg

EAST LEVEE ALIGNMENT
STA 86 + 00
REACH B
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP-SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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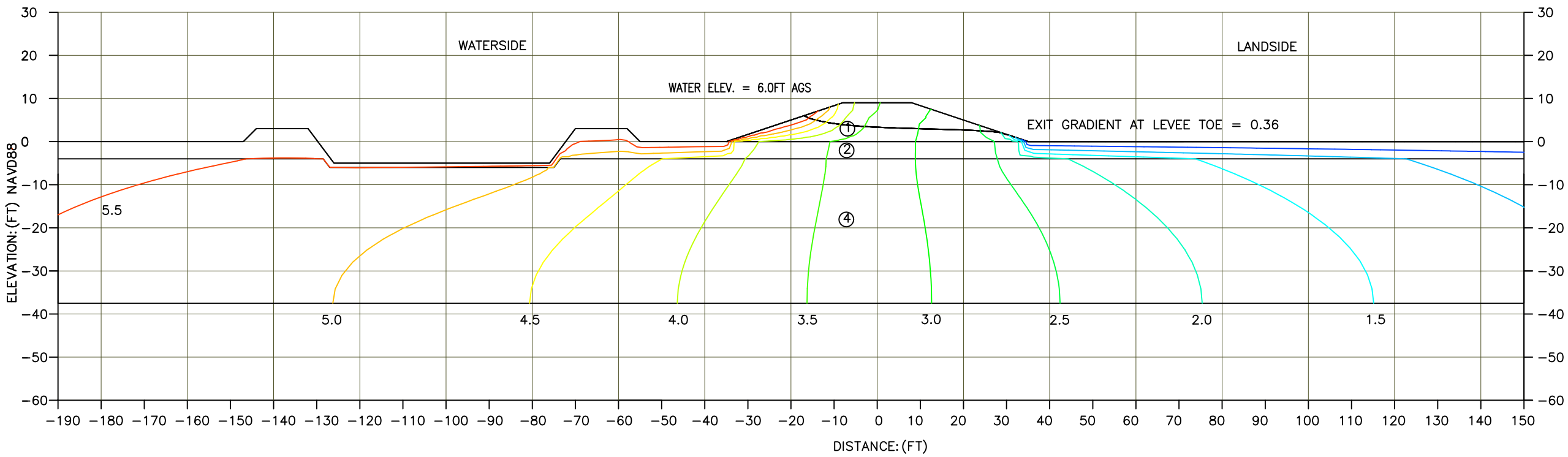
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 86+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	12 of 22

PLOT BY: L2EDGGAJ - Nov 15, 2011 - 11:27:08am
DRAWING: F:\Orestimba\Drawings\Reach B\GMSUTEXAS Reach B 86+00.dwg

EAST LEVEE ALIGNMENT
STA 125 + 00
REACH C
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP-SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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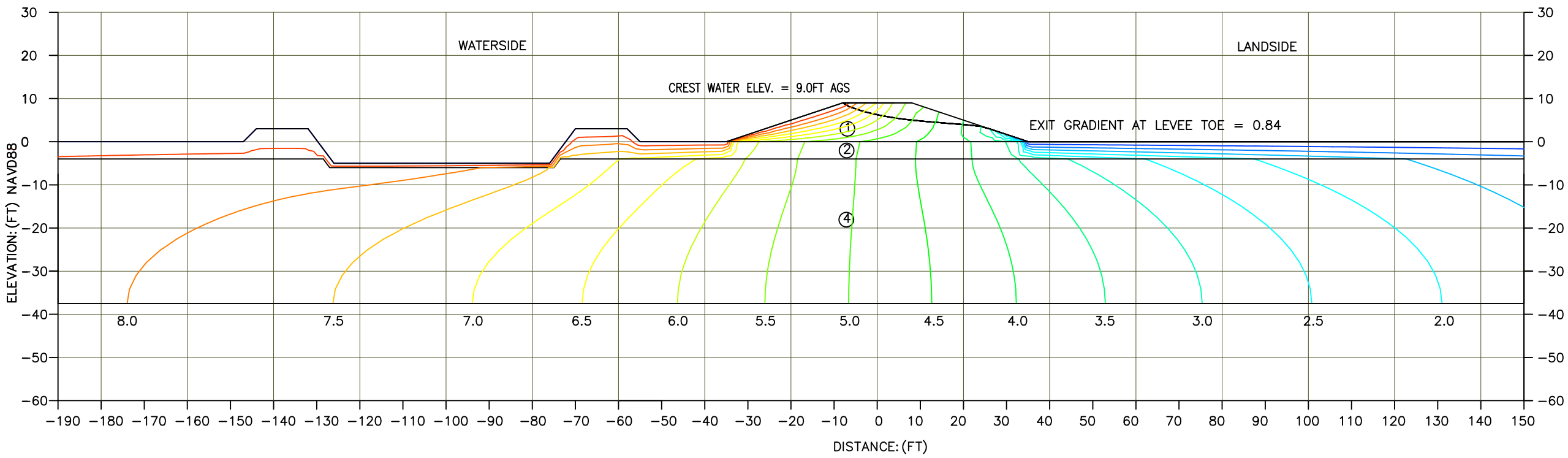
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 125+00 DWSE WITHOUT BERM

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	13 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 12:44:50pm
DRAWING: F:\Orestimba\Drawings\Reach C\125+00\Reach C 125+00 LPP DWSE without berm.dwg

EAST LEVEE ALIGNMENT
STA 125 + 00
REACH C
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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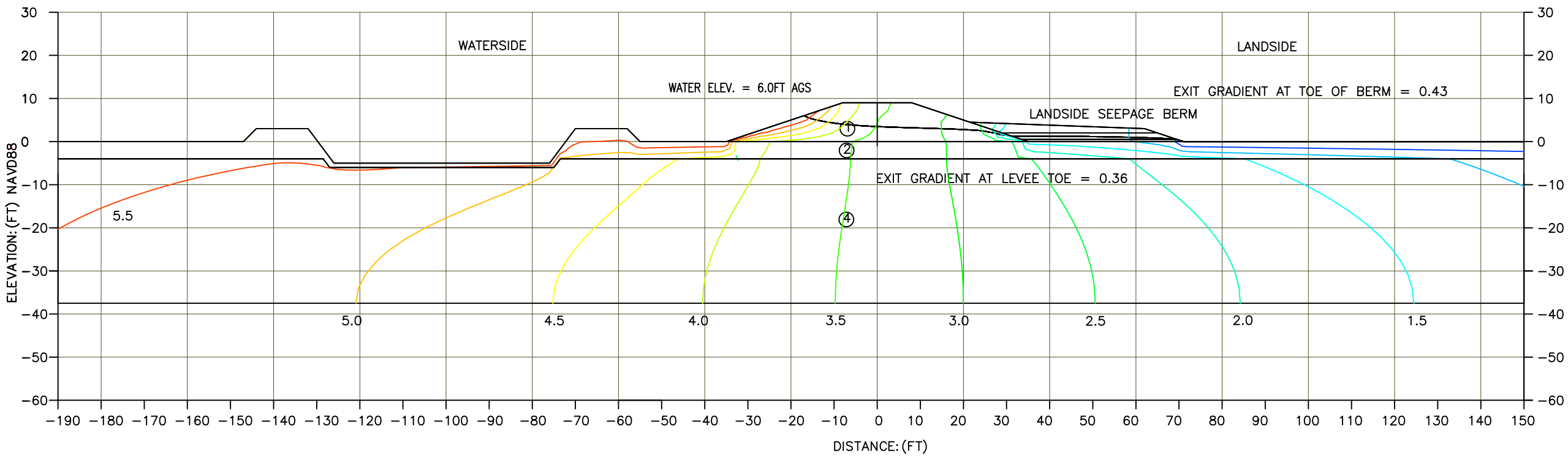
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 125+00 TOP OF LEVEE WITHOUT BERM

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	14 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 2:20:34pm
DRAWING: F:\Orestimba\Drawings\Reach C\125+00\Reach C 125+00 LPP Top of Levee without berm.dwg

EAST LEVEE ALIGNMENT
STA 125 + 00
REACH C
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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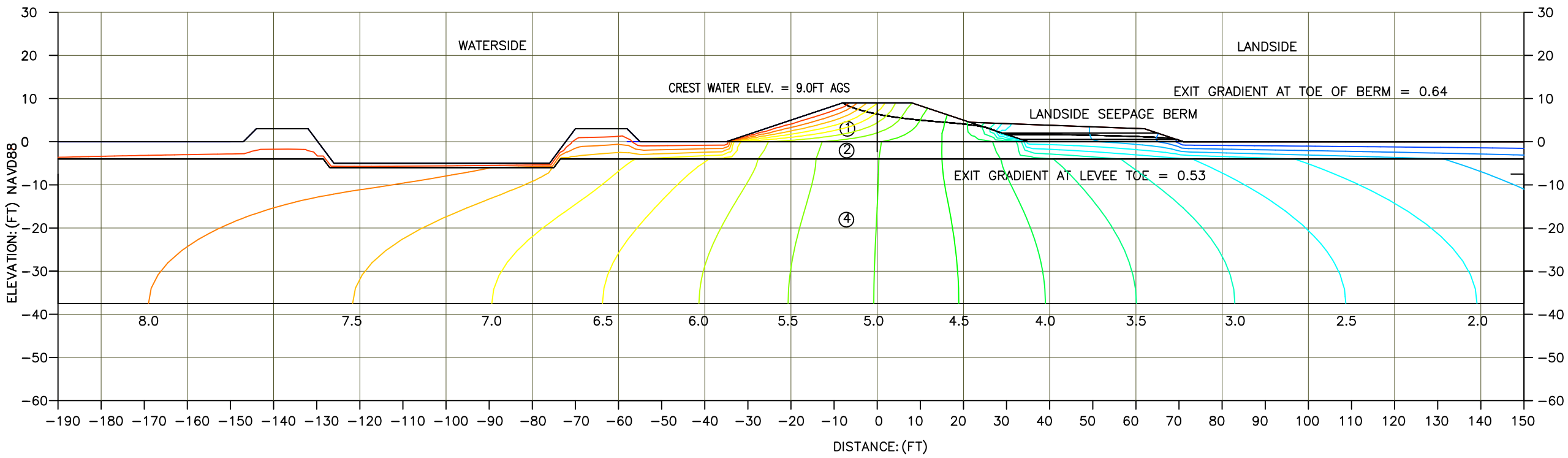
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 125+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	15 of 22

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:16:37am
DRAWING: F:\Orestimba\Drawings\Reach C\125+00\Reach C 125+00 LPP DWSE.dwg

EAST LEVEE ALIGNMENT
STA 125 + 00
REACH C
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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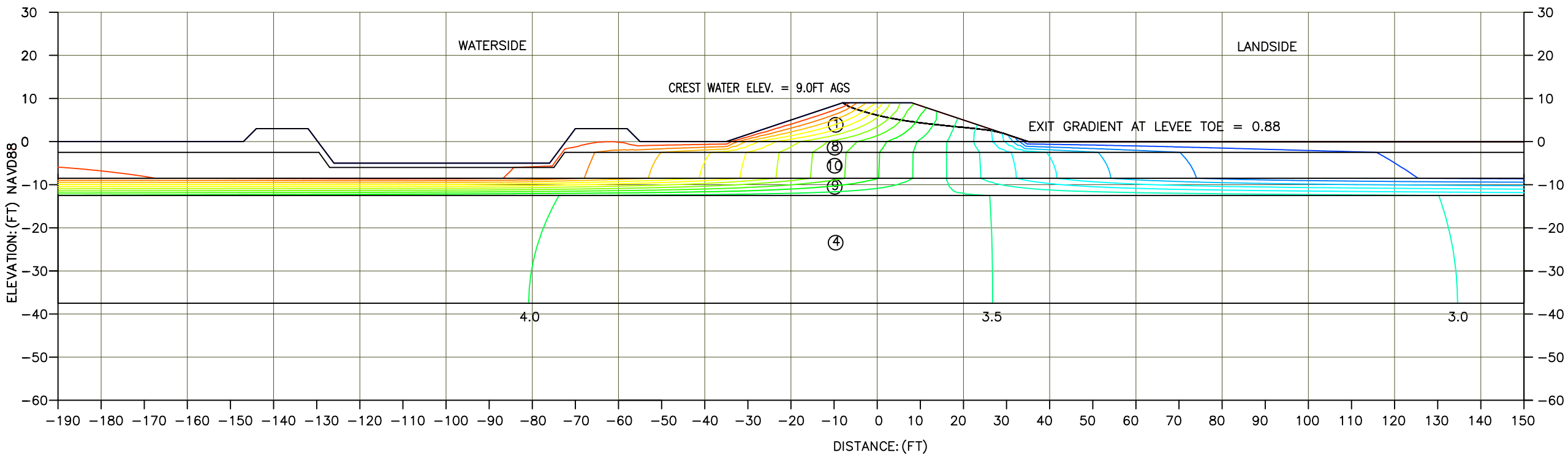
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 125+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	16 of 22

PLOT BY: L2EDGGAJ - Nov 15, 2011 - 11:55:21am
DRAWING: F:\Orestimba\Drawings\Reach C\125+00\GMSUTEXAS Reach C 125+00.dwg

EAST LEVEE ALIGNMENT
STA 151 + 00
REACH C
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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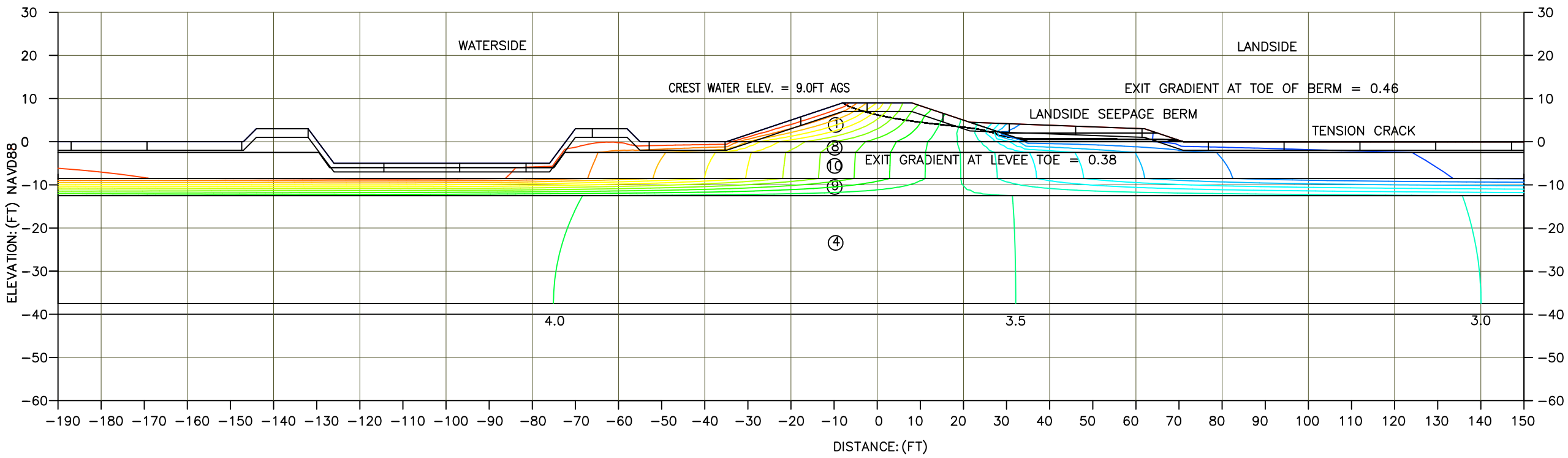
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 151+00 TOP OF LEVEE WITHOUT BERM

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	17 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 7:59:42am
DRAWING: F:\Orestimba\Drawings\Reach C\151+00\Reach C 151+00 LPP Top of Levee without berm.dwg

EAST LEVEE ALIGNMENT
STA 151 + 00
REACH C
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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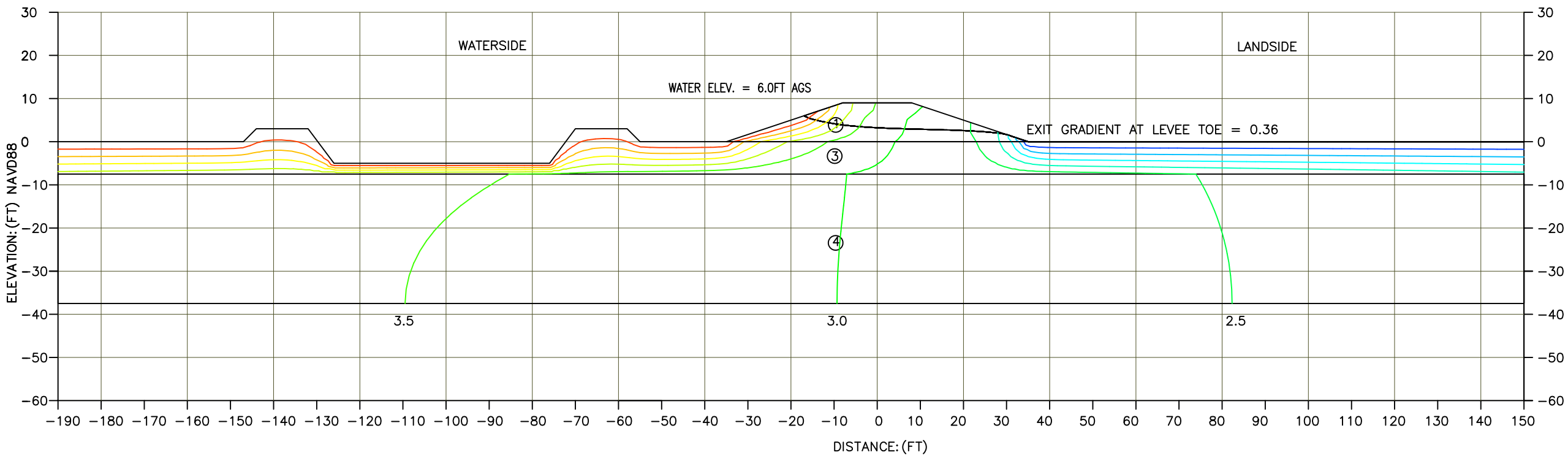
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 151+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	18 of 22

PLOT BY: L2EDGGAJ - Nov 15, 2011 - 1:27:15pm
DRAWING: F:\Orestimba\Drawings\Reach C\151+00\GMSUTEXAS Reach C 151+00.dwg

EAST LEVEE ALIGNMENT
STA 195 + 00
REACH D
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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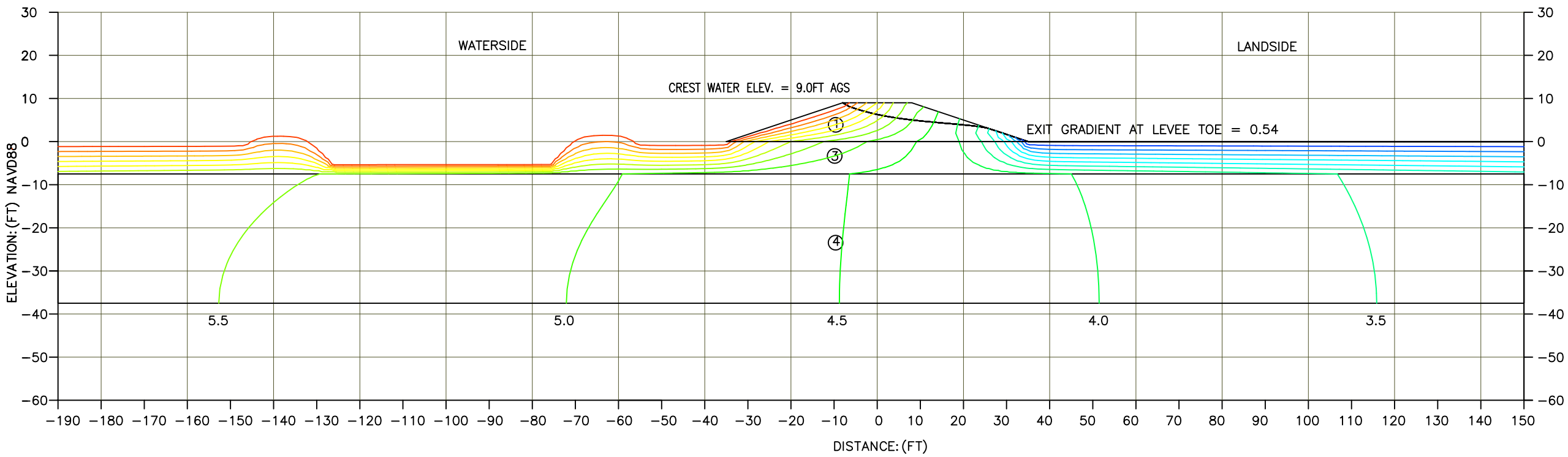
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 195+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	19 of 22

PLOT BY: L2EDGGAJ - Nov 15, 2011 - 5:15:18pm
DRAWING: F:\Orestimba\Drawings\Reach D\Reach D 195+00 LPP DWSE.dwg

EAST LEVEE ALIGNMENT
STA 195 + 00
REACH D
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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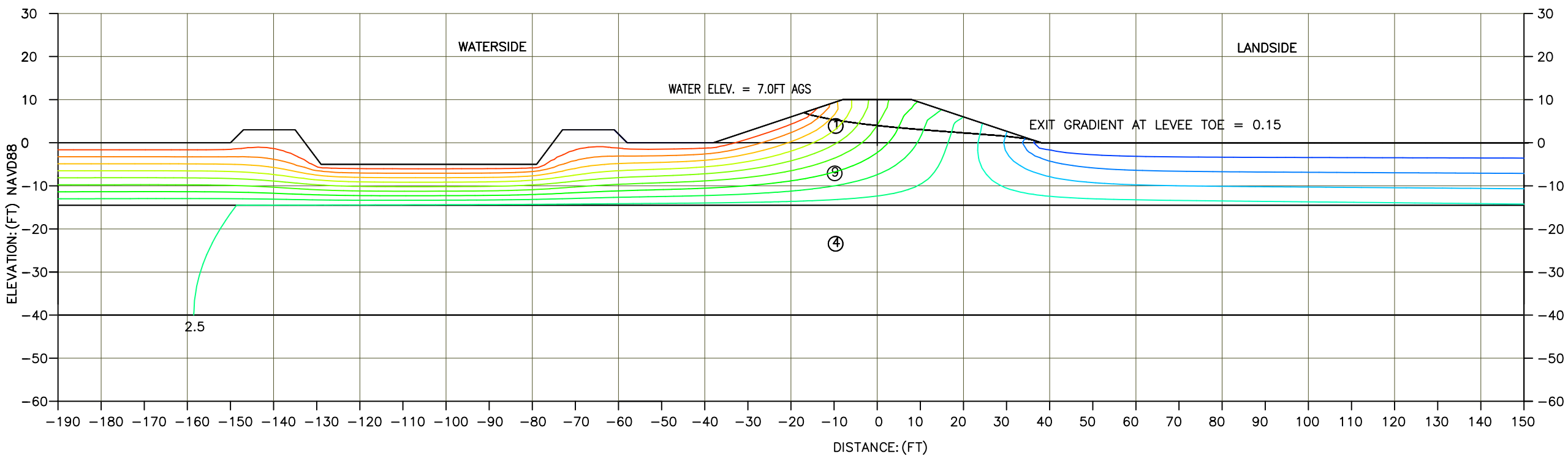
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 195+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	20 of 22

PLOT BY: L2EDGGAJ - Nov 15, 2011 - 2:02:27pm
DRAWING: F:\Orestimba\Drawings\Reach D\GMSUTEXAS Reach D 195+00.dwg

EAST LEVEE ALIGNMENT
STA 232 + 00
REACH E
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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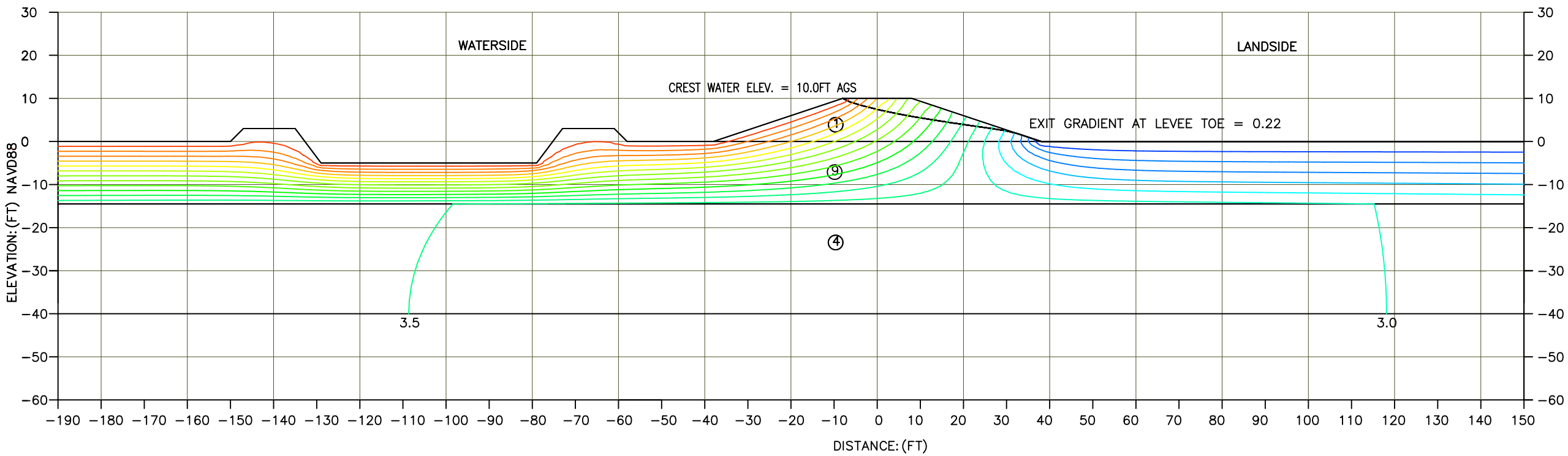
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 232+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	21 of 22

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 7:16:12am
DRAWING: F:\Orestimba\Drawings\Reach E\Reach E 232+00 LPP DWSE.dwg

EAST LEVEE ALIGNMENT
STA 232 + 00
REACH E
SEEPAGE ANALYSIS TOTAL HEAD CONTOURS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT

LPP WITH PROJECT CONDITIONS
STA 232+00 TOP OF LEVEE

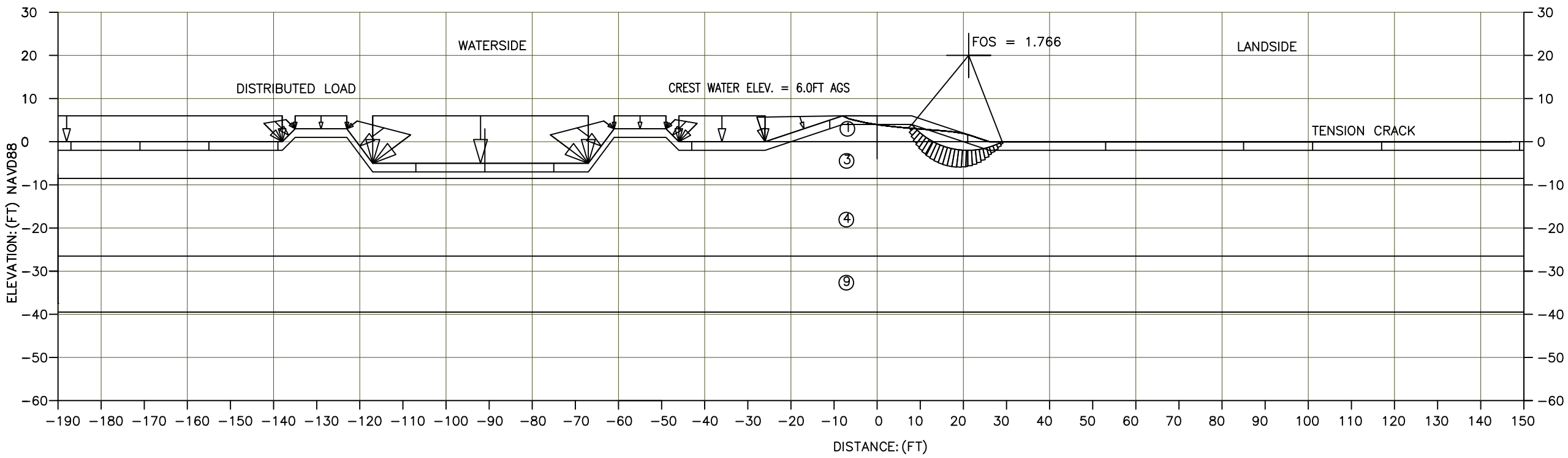
DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	22 of 22

PLOT BY: L2EDGGAJ - Nov 15, 2011 - 3:00:11pm
DRAWING: F:\Orestimba\Drawings\Reach E\GMSUTEXAS Reach E 232+00.dwg

APPENDIX E

STABILITY ANALYSIS

EAST LEVEE ALIGNMENT
STA 38 + 00
REACH A
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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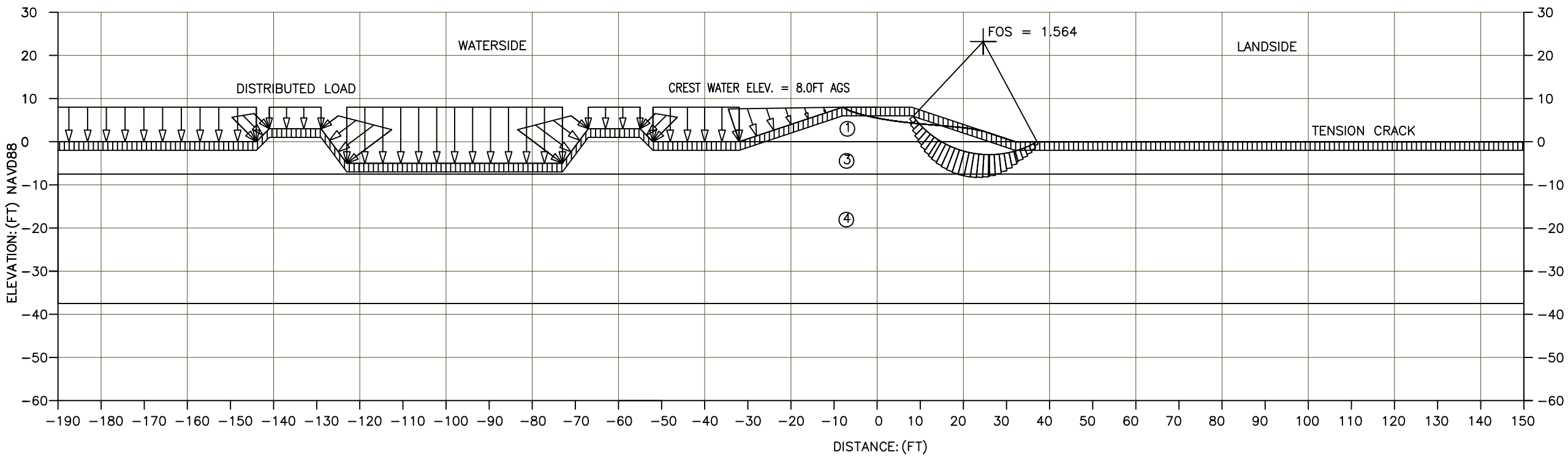
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
NED WITH PROJECT CONDITIONS
STA 38+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	1 of 17

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 3:54:49pm
DRAWING: F:\Orestimba\Drawings\Reach A\Reach A 38+00 NED DWSE.dwg

EAST LEVEE ALIGNMENT
STA 86 + 00
REACH B
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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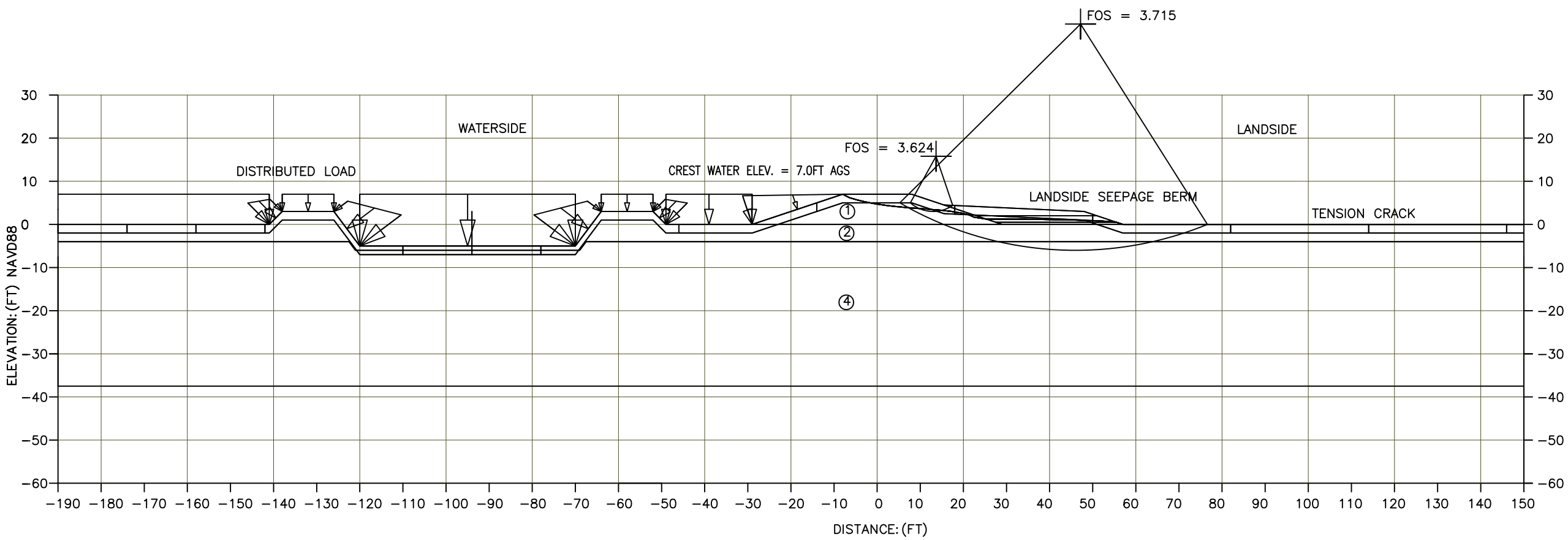
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
NED WITH PROJECT CONDITIONS
STA 86+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	2 of 17

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 4:31:36pm
DRAWING: F:\Orestimba\Drawings\Reach B\Reach B 86+00 NED DWSE.dwg

EAST LEVEE ALIGNMENT
STA 125 + 00
REACH C
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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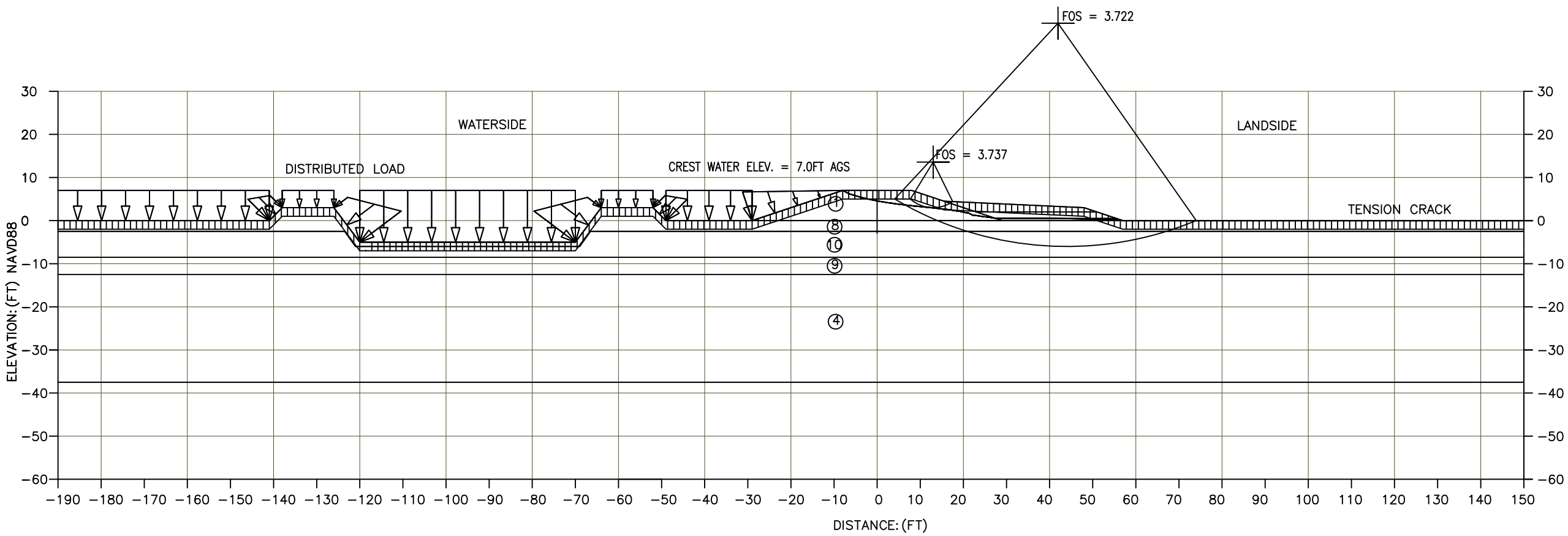
ORESTIMBA LEVEE ALIGNMENT
NED WITH PROJECT CONDITIONS
STA 125+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	3 of 17

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 5:54:25pm
DRAWING: F:\Orestimba\Drawings\Reach C\125+00\Reach C 125+00 NED DWSE with berm.dwg

EAST LEVEE ALIGNMENT
STA 151 + 00
REACH C
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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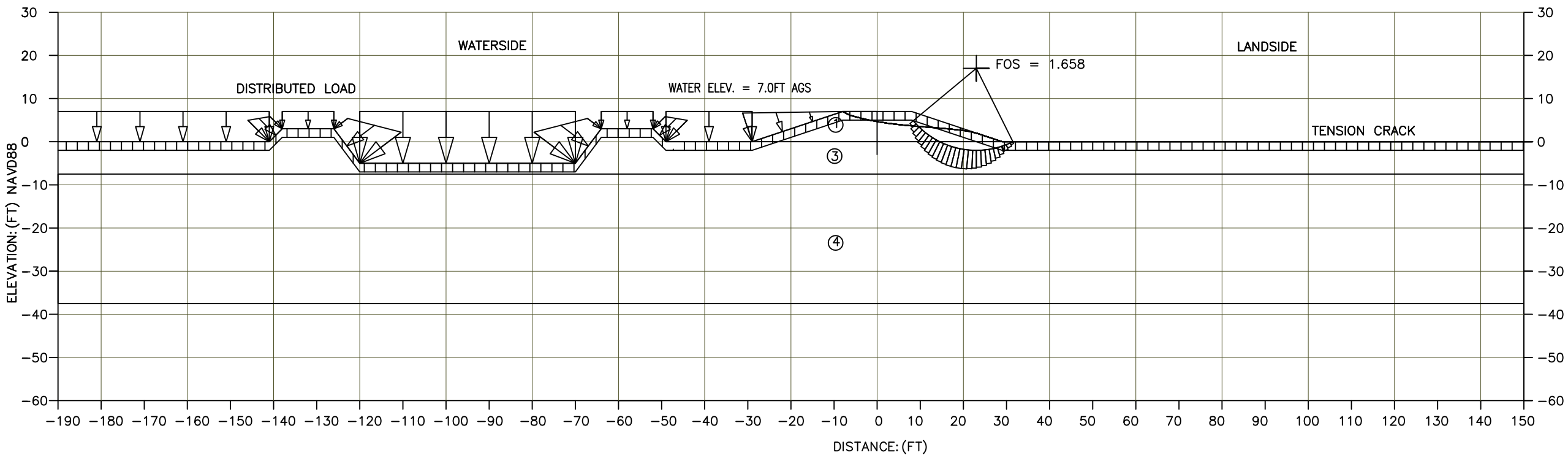
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
NED WITH PROJECT CONDITIONS
STA 151+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	4 of 17

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 6:53:56pm
DRAWING: F:\Orestimba\Drawings\Reach C\151+00\Reach C 151+00 NED DWSE with berm.dwg

EAST LEVEE ALIGNMENT
STA 195 + 00
REACH D
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

DEPARTMENT OF THE ARMY
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CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

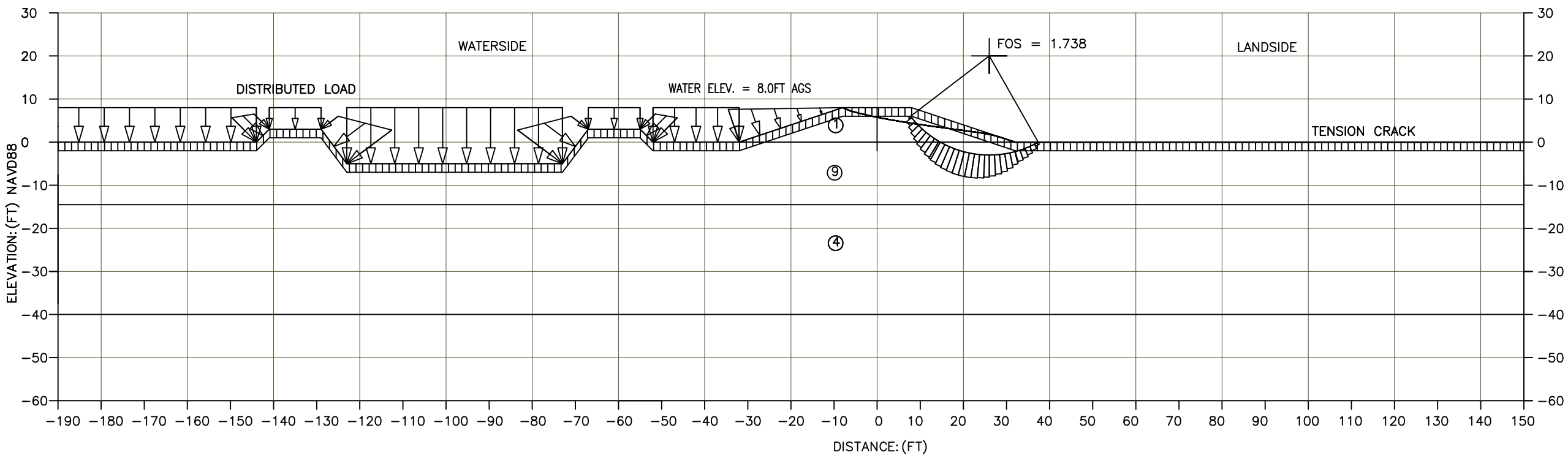
SACRAMENTO CALIFORNIA

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
NED WITH PROJECT CONDITIONS
STA 195+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	5 of 17

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 71:9:56pm
DRAWING: F:\Orestimba\Drawings\Reach D\Reach D 195+00 NED DWSE.dwg

EAST LEVEE ALIGNMENT
STA 232 + 00
REACH E
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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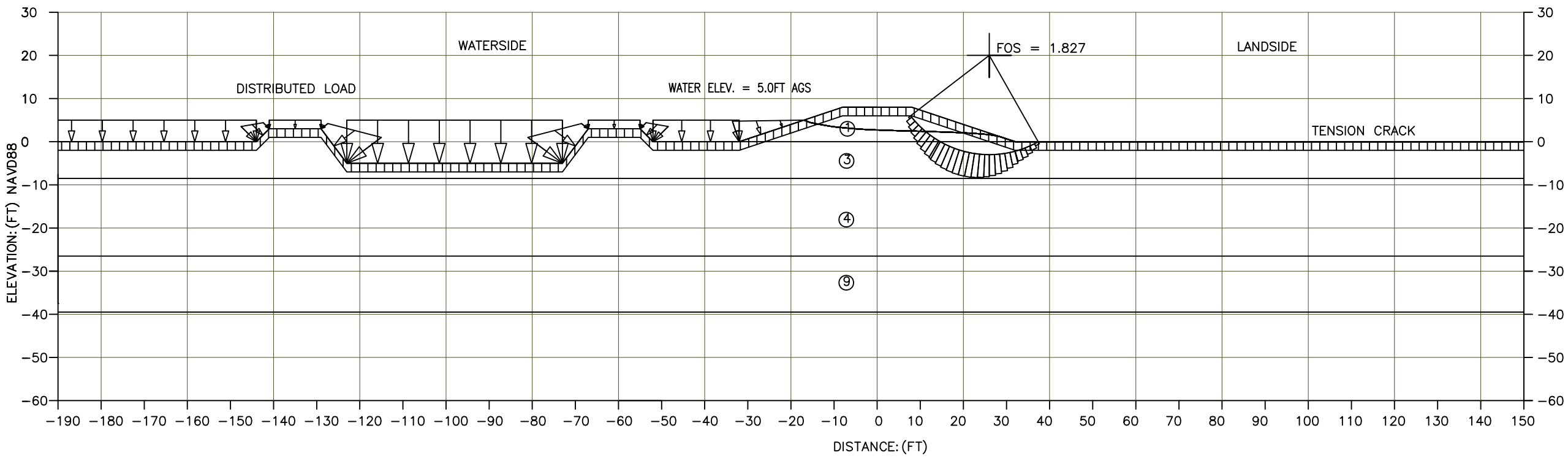
SACRAMENTO CALIFORNIA

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
NED WITH PROJECT CONDITIONS
STA 232+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	6 of 17

PLOT BY: L2EDGGAJ - Nov 16, 2011 - 7:50:00pm
DRAWING: F:\Orestimba\Drawings\Reach E\Reach E 232+00 NED DWSE.dwg

EAST LEVEE ALIGNMENT
STA 38 + 00
REACH A
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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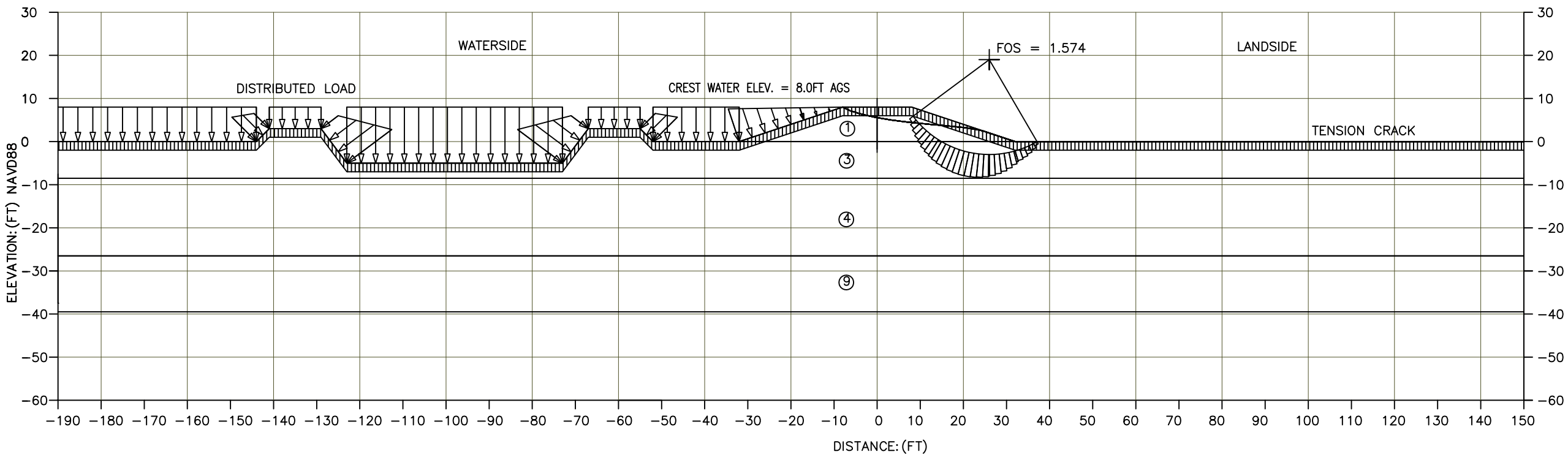
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 38+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	7 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 6:33:05am
DRAWING: F:\Orestimba\Drawings\Reach A\Reach A 38+00 LPP DWSE.dwg

EAST LEVEE ALIGNMENT
STA 38 + 00
REACH A
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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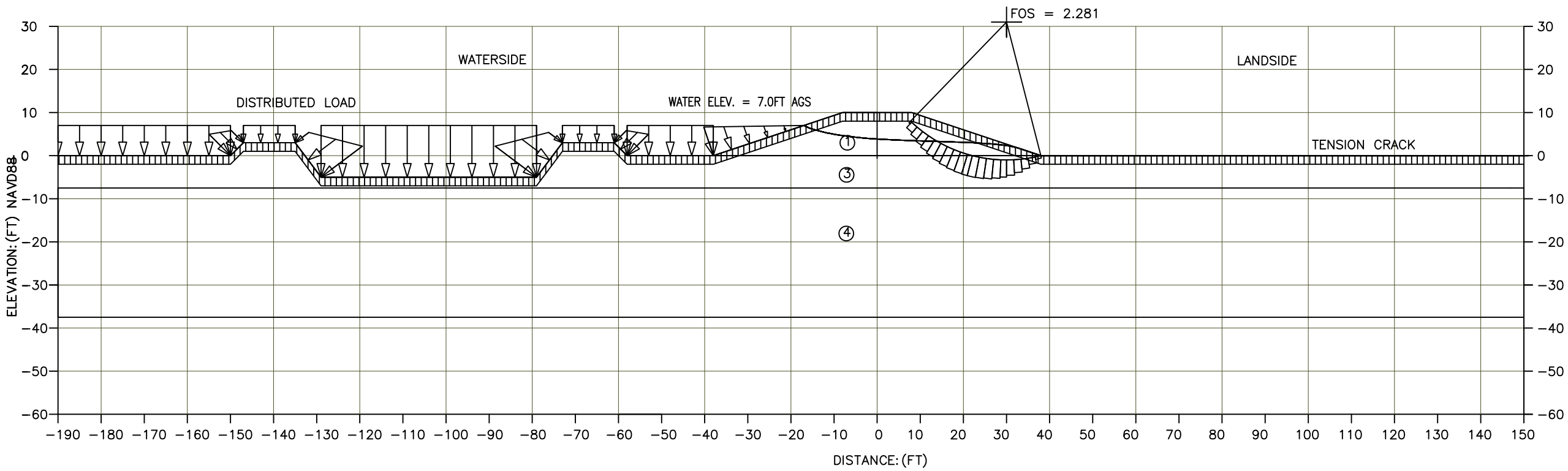
SACRAMENTO CALIFORNIA

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 38+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	8 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:06:20am
DRAWING: F:\Orestimba\Drawings\Reach A\Reach A 38+00 LPP Top of Levee.dwg

EAST LEVEE ALIGNMENT
STA 86 + 00
REACH B
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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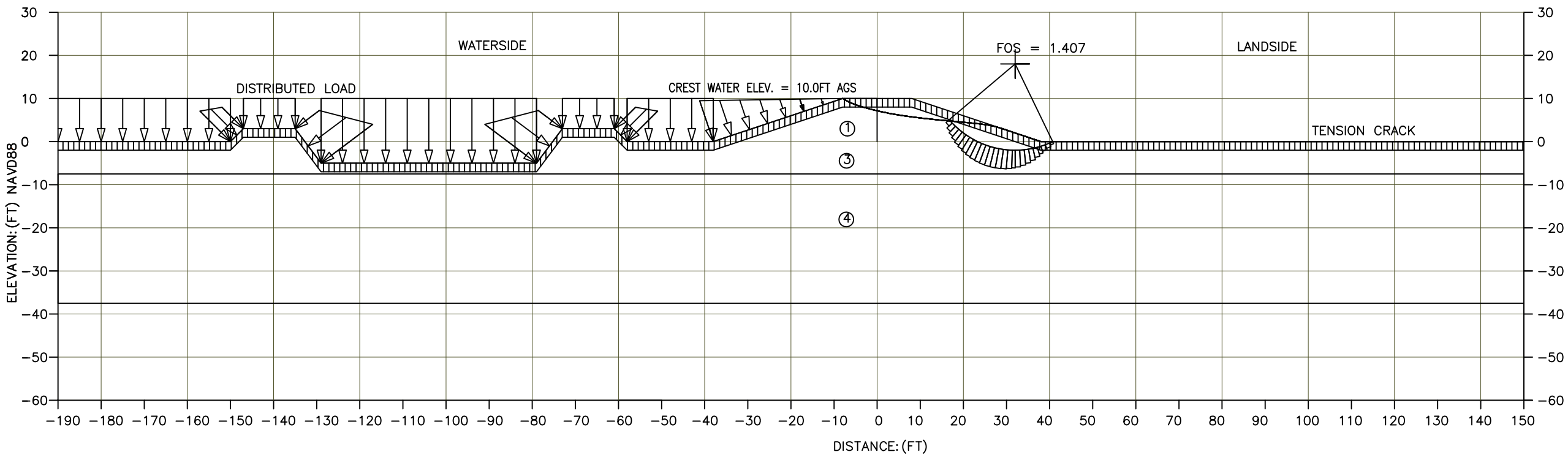
SACRAMENTO CALIFORNIA

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 86+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	9 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:08:51am
DRAWING: F:\Orestimba\Drawings\Reach B\Reach B 86+00 LPP DWSE.dwg

EAST LEVEE ALIGNMENT
STA 86 + 00
REACH B
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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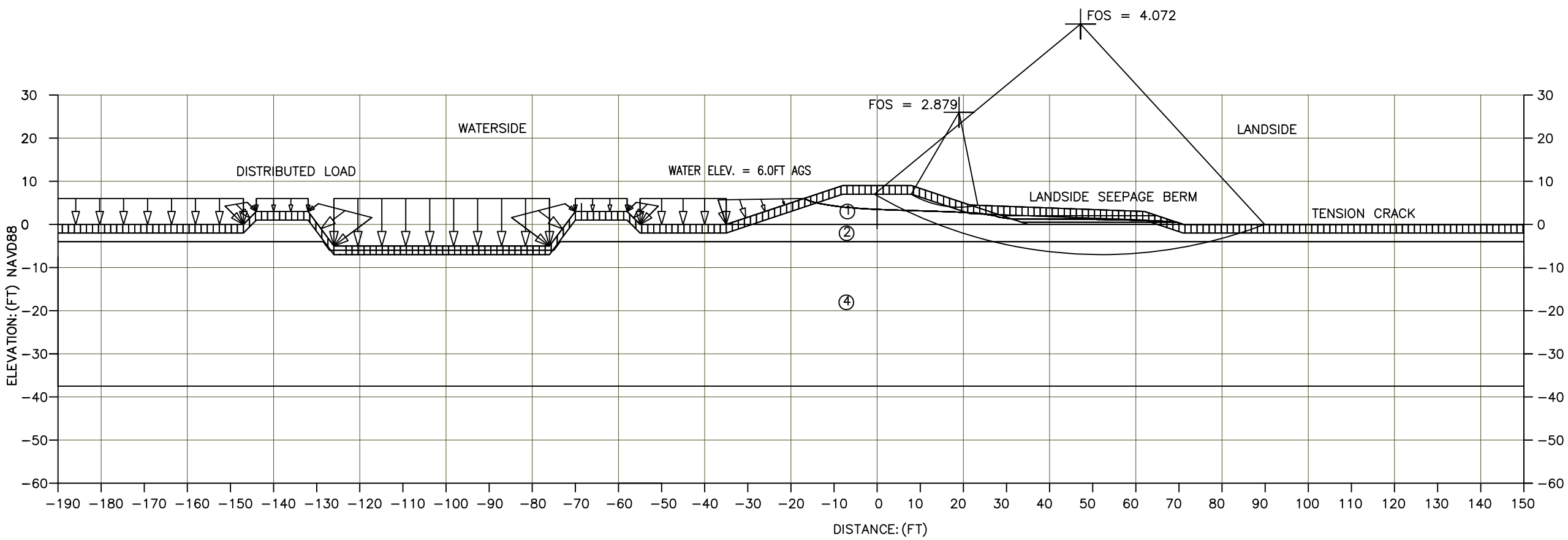
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 86+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	10 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:11:42am
DRAWING: F:\Orestimba\Drawings\Reach B\Reach B 86+00 LPP Top of Levee.dwg

EAST LEVEE ALIGNMENT
STA 125 + 00
REACH C
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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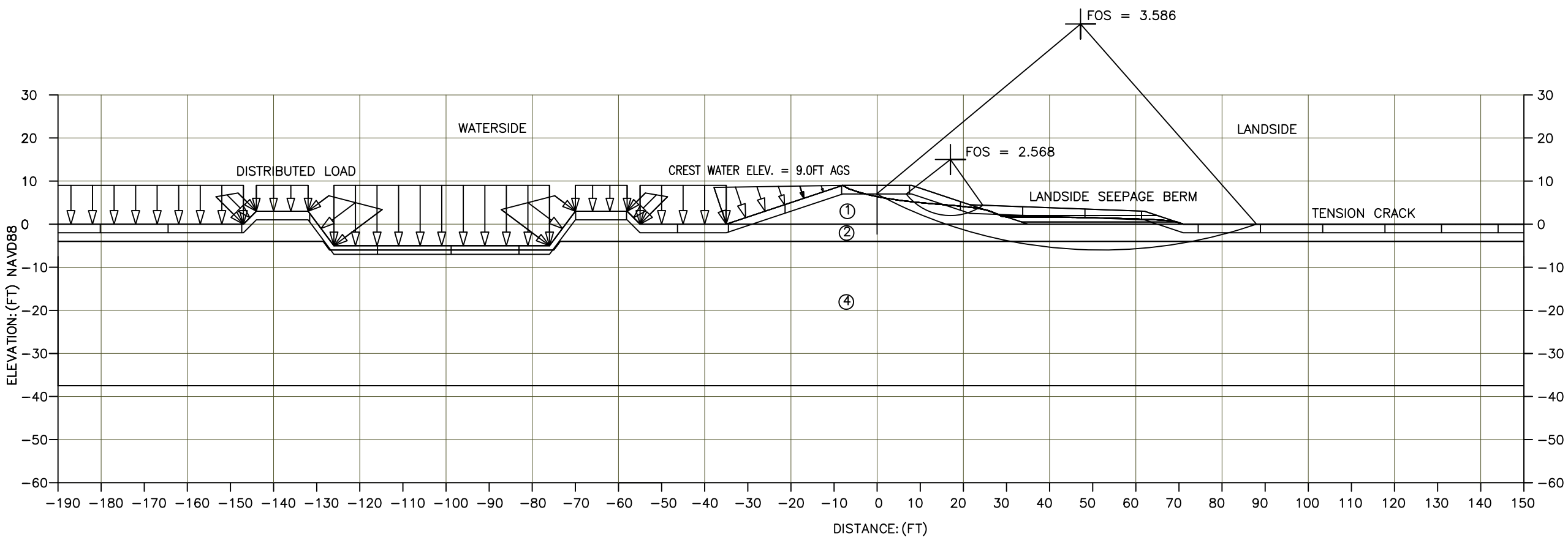
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 125+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	11 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 71:17:50am
DRAWING: F:\Orestimba\Drawings\Reach C\125+00\Reach C 125+00 LPP DWSE.dwg

EAST LEVEE ALIGNMENT
STA 125 + 00
REACH C
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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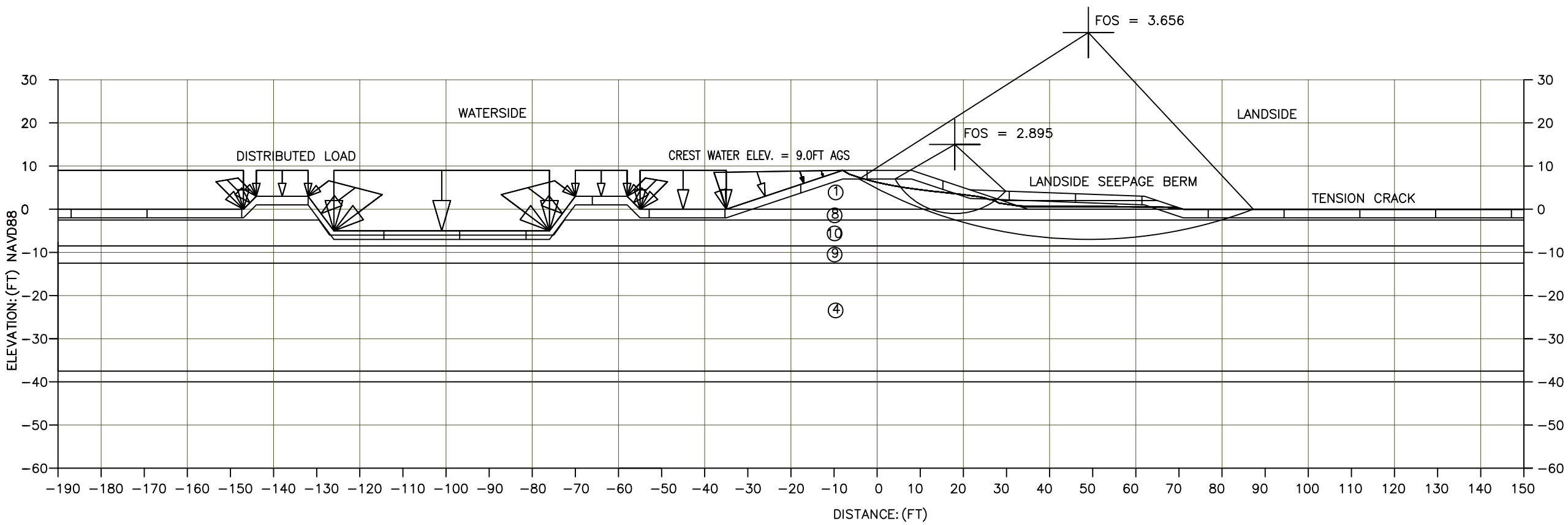
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 125+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	12 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:21:05am
DRAWING: F:\Orestimba\Drawings\Reach C\125+00\Reach C 125+00 LPP Top of Levee.dwg

EAST LEVEE ALIGNMENT
STA 151 + 00
REACH C
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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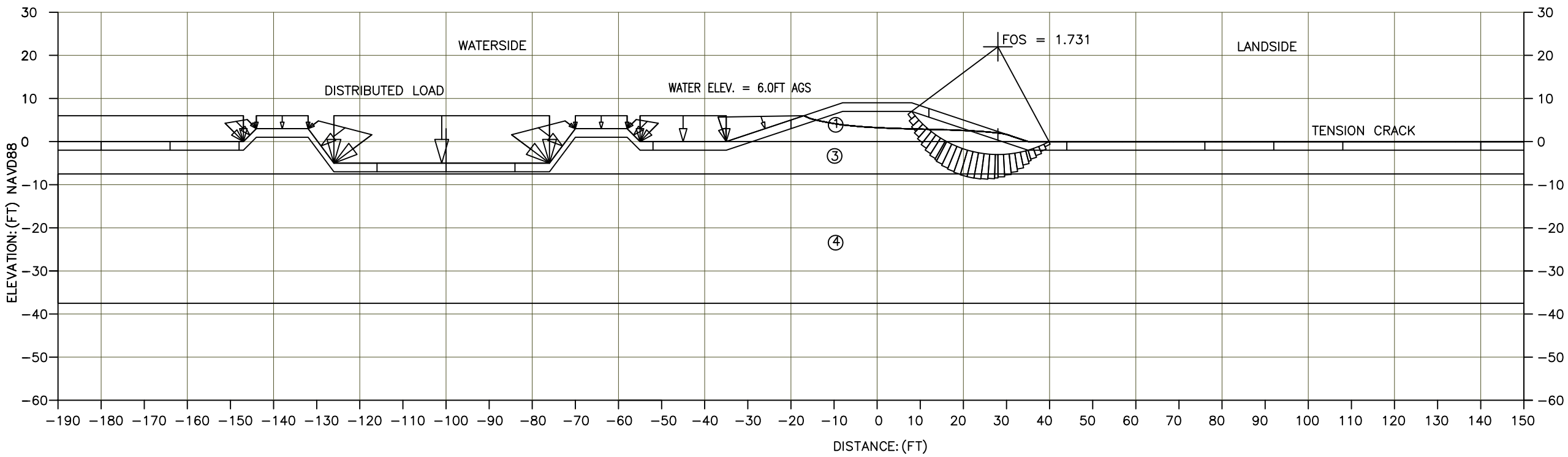
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 151+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	13 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:47:58am
DRAWING: F:\Orestimba\Drawings\Reach C\151+00\Reach C 151+00 LPP Top of Levee.dwg

EAST LEVEE ALIGNMENT
STA 195 + 00
REACH D
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

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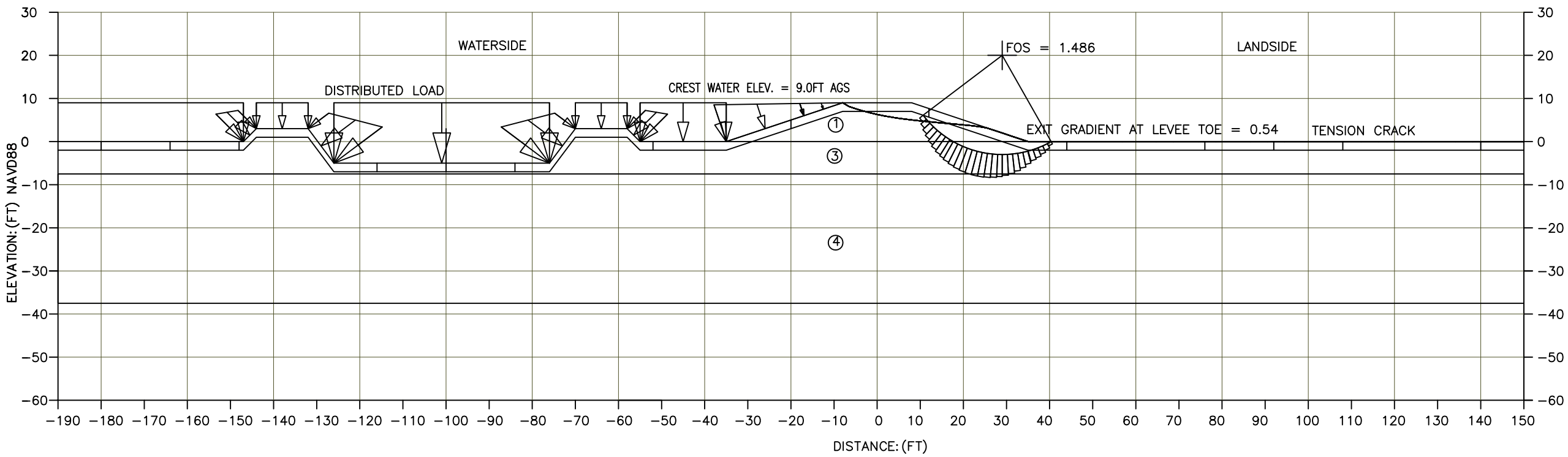
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 195+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	14 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:50:44am
DRAWING: F:\Orestimba\Drawings\Reach D\Reach D 195+00 LPP DWSE.dwg

EAST LEVEE ALIGNMENT
STA 195 + 00
REACH D
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

DEPARTMENT OF THE ARMY
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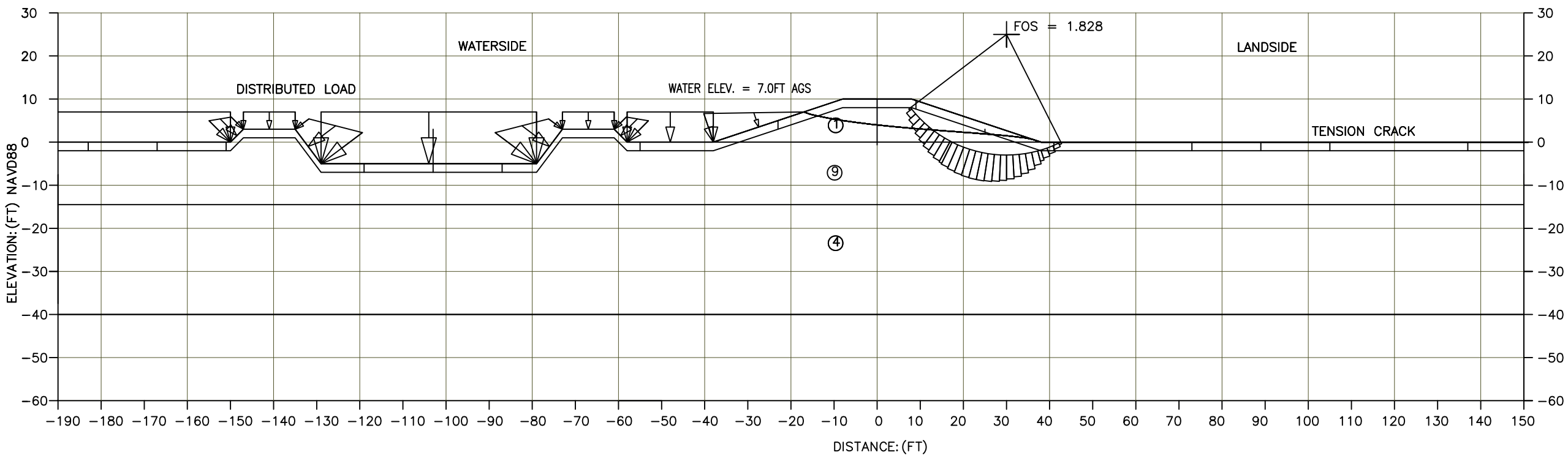
ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 195+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	15 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:53:02am
DRAWING: F:\Orestimba\Drawings\Reach D\Reach D 195+00 LPP Top of Levee.dwg

EAST LEVEE ALIGNMENT
STA 232 + 00
REACH E
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP−SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

DEPARTMENT OF THE ARMY
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SACRAMENTO, CALIFORNIA

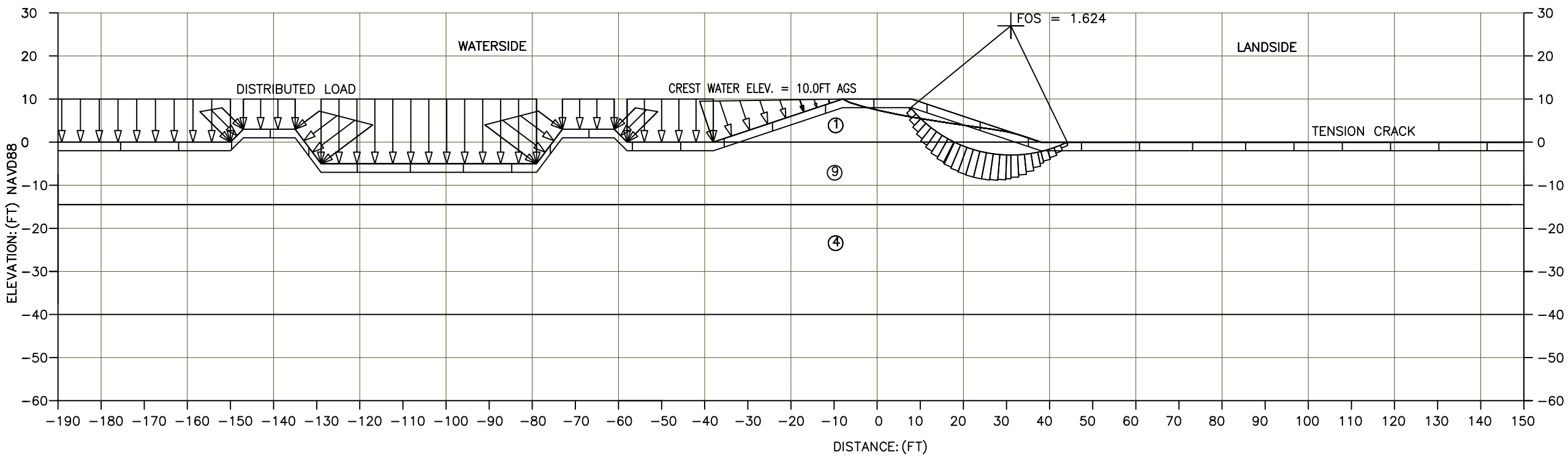
SACRAMENTO CALIFORNIA

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 232+00 DWSE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	16 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:55:00am
DRAWING: F:\Orestimba\Drawings\Reach E\Reach E 232+00 LPP DWSE.dwg

EAST LEVEE ALIGNMENT
STA 232 + 00
REACH E
STABILITY ANALYSIS



NO.	DESCRIPTION	UNIT WEIGHT (pcf)	Estimated Permeability for Seepage Analysis			Estimated Strength Parameters	
			Horizontal Kh (Kx) ft/day	Anisotropy Ration Kh/Kv	Vertical Kv (Ky) ft/day	Phi	Cohesion
1	Levee CL	120	.0284	4	.007	28	50
2	Blanket <5ft CL/CH	120	.0284	0.1	.284	28	50
3	5ft<Blanket CL/CH<10ft	120	.0284	1	.0284	28	50
4	SP–SM	130	28.0	10	2.8	33	0
5	BEDDING SP	125	14.0	10	1.4	35	0
6	DRAIN ROCK GW	135	71.0	10	7.1	35	0
7	SEEPAGE BERM CL	120	.0284	4	.007	28	50
8	CLAYEY SAND SC	120	0.14	4	.035	28	0
9	CLAY FOUNDATION CL	120	.0284	4	.007	28	50
10	SILTY SAND SM	125	2.8	4	.71	30	0

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SACRAMENTO CALIFORNIA

ORESTIMBA PROJECT NEWMAN CALIFORNIA
FEASIBILITY REPORT CROSS-SECTIONS
ORESTIMBA LEVEE ALIGNMENT
LPP WITH PROJECT CONDITIONS
STA 232+00 TOP OF LEVEE

DATE:	SCALE:	SHEET NO.
14 NOVEMBER 2011	AS SHOWN	17 of 17

PLOT BY: L2EDGGAJ - Nov 17, 2011 - 7:56:36am
DRAWING: F:\Orestimba\Drawings\Reach E\Reach E 232+00 LPP Top of Levee.dwg

APPENDIX C.4
COST ENGINEERING

1. BASIS OF DESIGN

This estimate is based on the draft feasibility report (and its updates thus far):
Orestimba Creek
West Stanislaus County, CA
F4 Milestone Conference Report
Draft Interim Feasibility Study

The type of solicitation is expected to be unrestricted IFB.

Civil Design quantities are per feasibility level plans and associated quantities ('bid item lists') as provided by Civil Design Section B, US Army Corps of Engineers, Sacramento District. Sacramento District, Real Estate provided information on building structures (homes, barns, etc) to be removed.
A site visit was also conducted.

2. PROJECT SCOPE/DESCRIPTION

The project area is located to the North and West of Newman, CA. The project consists primarily of new levee construction, a riprapped berm on the downstream side of existing railroad tracks to the East of Hwy 33 (a NNW-SSE route passing through Newman), and railroad/road closure structures (stoplogs or swing gates to hold back flood waters). There are multiple utility relocations for penetrations through the levee (irrigation facilities and drainage structures). The site is typically farmland or orchards and relatively flat, except at road crossings, where the road is typically several feet higher than the adjacent land. Most of the new levee is very near to an existing irrigation canal (CCID canal) but the canal needs to remain in-service throughout the period of construction and the construction of the existing canal was done many years ago and not to COE specifications. Costs for both the NED and locally preferred plan (LPP) have been developed.

3. TOTAL PROJECT COSTS (SEE ATTACHED)

The costs shown in the attached Total Project Cost (TPC) summary sheets are developed from the feasibility level plans and associated. Costs were developed primarily through the use of MII and the local 'database' of construction methods (labor, equipment, and materials cost data, construction crews and anticipated production rate, anticipated borrow and disposal sites, etc). These are relatively up-to-date (November 2011 Davis-Bacon rates, recent quotes for bulk materials, but only 2009 MII equipment rates). First Costs are based on 1 Oct 2011 price levels. Fully funded costs are first costs escalated to the midpoint of design or construction (as per the anticipated construction schedule). The Total Project

Cost Summary (TPCS) reflects the 80% confidence level per the Cost & Schedule Risk Analysis.

Total Project Costs are subdivided into federal and non-federal costs relative to the Civil Works Work Breakdown Structure (CWWBS). PED Costs (Feature Level/Account 30) and Construction Management (Feature Level/Account 31) reflect historic estimates made by the Sacramento District for the Central Valley region of California (18% for the 30 account, 8.5% for the 31 account).

4. MII COST ESTIMATE (SEE ATTACHED) - NOTES & ASSUMPTIONS

OVERTIME
Overtime is not included in this estimate.

ACQUISITION PLAN
Construction Contracts are assumed to be invitation for bid (IFB), lowest competitive price.

CONTRACTING PLAN
The prime contractor is expected to be an earthwork contractor responsible for the general site work, borrow site excavation, and levee construction to the new levee height.
Miscellaneous/General Subcontractors are expected to be utilized for some utility relocations, paving and hydroseeding.

PROJECT CONSTRUCTION
The project consists primarily of new levee construction (a chevron levee to the West and North of Newman). Much of the site is currently farmland and orchards so clearing, grubbing and tree removal must be timed for minimal disturbance to farm production. Likewise, the multiple irrigation lines requiring relocation must be relocated during off-farming periods. Several structures lie along the levee alignment and must be removed prior to levee construction. Construction of the road closure structures must be completed prior to the levee placement in the area of the structure. Two drip irrigation systems with sand filters must be relocated and this will require coordination with the farmers as the relocation must follow the levee placement.
Should the LPP ultimately be constructed, the levee will be 2 or 3 feet higher with corresponding increase in earthwork and size of closure structures.

SITE ACCESS
The project site lies almost completely within farmland and orchards. There are several roads (including one ‘farm’ road) crossing the project site every mile or so and therefore access is expected to not require separate turnaround areas.

BORROW \ DISPOSAL AREAS
The borrow site is anticipated to be the Fink Road Landfill. Local sponsors have indicated at PDT meetings that there will be no ‘royalties’ required for the borrow

material. Disposal of debris is considered normal and anticipated to be at the landfill as well. Materials generated from stripping farmland/orchards is anticipated to be spread in the 'ditch' created between the new levee and the CCID canal levee.

CONSTRUCTION METHODOLOGY
The construction methodologies are considered standard.

UNUSUAL CONDITIONS
No unusual conditions.

UNIQUE TECHNIQUES OF CONSTRUCTION
No unique construction techniques are anticipated to be required.

EQUIPMENT AND LABOR AVAILABILITY & DISTANCE TRAVELED
Newman is approximately 40 miles from Stockton, CA and 75 miles from Sacramento. Therefore, equipment and labor is readily available within a 100 mile radius of the site.

ENVIRONMENTAL CONCERNS
Environmental protection requires consideration of air, water, and land, and involves noise, solid-waste management and management of other pollutants. In order to prevent or provide for abatement and control of any environmental pollution arising from the work activities, the Contractor and his subcontractors in the performance of this contract, shall comply with all applicable Federal, State, and local laws, and regulations concerning environmental pollution control and abatement. The Contractor shall use best management practices at all times to minimize the potential for environmental impacts. A running 2% markup on construction equipment is provided to account for air quality considerations.

LABOR RATES, EQUIPMENT RATES, MATERIAL COSTS & SALES TAX
This estimate meets Davis Bacon wage rates for Davis Bacon wage determinations for the state of California, General Decision Numbers: CA 20100003 03/26/2010, CA 20100006 03/12/2010, CA 20100009 11/18/2011 and CA 20100026 03/12/2010.

Equipment unit costs were obtained from the MII/MCACES Equipment Library (2009).

Material prices were obtained from Quotes, supply catalogs, previous similar estimates, and the MII/MCACES Cost Book.

Sales tax is applied at 7.75%.

PRODUCTION RATES

For most work involving equipment with loading & hauling, work durations are typically based on daily setup time for equipment plus production of 50 minutes/hr. See the notes within the MII files. Also, a markup has been added based on anticipated productivity of 90% for the project.

Note: Gasoline and diesel fuel costs used in the estimate are the average costs in the Newman area as of December 2011. Off-road diesel costs are assumed at $0.35 per gallon less than on-road.

5. CONTRACTOR MARKUPS

For the prime contractor, profit is based on Profit Weighted Guidelines (8.48%). Home Office Overhead is considered to be 7% for this project. Job/Field Office Overhead (JOOH) is calculated from a list of typical overhead items and based on the duration per the total project & construction schedule. Small Tool Markup is set at 2%. Bond is calculated based on Bond Class B. Calculated JOOH varies for the NED vs. LPP as the construction duration and amount of testing are different.

Miscellaneous/General Subcontractors have profit set at of 10%, Home Office Overhead at 10% and Job Office Overhead at 15%. Bond is set at 1%.

6. CONSTRUCTION SCHEDULE (SEE ATTACHED)

CONSTRUCTION WINDOWS
Because this work is for new levee construction that is relatively far from the creek and only subject to flooding every few years, this estimate does not consider seasonal construction windows. It is acknowledged that there is some chance of flooding during the period of construction and that is considered in the cost and schedule risk analysis. The flood control provided by the project will not be permanently established until construction completion.

TOTAL PROJECT SCHEDULE (including Construction)
A total project schedule for both the NED & LPP was developed using MS Project with construction durations based on those developed in MII. The schedule includes design, pre-construction, construction and post construction. The schedule is used to insure the project design and construction could be completed within 3 years (NED) and with the anticipated crews. The schedule was developed anticipating that demolition, site clearing, and most utility relocations would be performed first, and done in late winter or very early spring so that impacts to the farming production capability will be minimal. A list of typical requirements for PED was followed with duration anticipated to be about 1 year. Real Estate acquisition is assumed to take place during this period as well. All the primary tasks from the MII file with most sub-tasks were placed into the schedule as well, utilizing the durations based on anticipated production rates.

7. COST UNCERTAINTIES

There are inherent uncertainties in the costs at the feasibility level of design since there is no detailed design, plans or specs. There are also inherent uncertainties as the construction contractor(s) are responsible for obtaining most construction materials, accomplishing the work in a timely manner as per his due date, the use of overtime to accomplish the same, etc. There are also many cost uncertainties relative to risk analysis (see Paragraph 8 below).

For this project, more than 50% of the costs for this project are directly related to levee construction. A large percentage of this is obtaining and hauling fill material. For the purposes of the cost estimate, the assumption has been made that materials will come from the Fink Road Landfill as noted above. Cost using a local supplier were also determined. Cost differences were within a few percent, so the landfill remains assumed, but the contractor is free to obtain borrow wherever he sees fit.

Another item of large cost and some uncertainty is haul costs. Haul costs are considered conservative at this time. Haul costs in MII have been determined assuming semi end-dumps or transfer trucks, both assumed at 20 CY capacity. When a typical crew is set up in MII, the actual unit cost per hour is higher than what typical trucking companies are charging at this time in California.

8. COST & SCHEDULE RISK ANALYSIS (SEE ATTACHED)

A Cost & Schedule Risk Analysis (CSRA) was performed for the project Jan/Feb 2012. A meeting was first held with the project manager and most PDT members. Project risks were identified and a risk register developed. Risk models were developed for items of moderate or high risks. Some of these items were mitigated by further design and additions to the MII cost estimate. The remaining risks were used to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The study does not include consideration for operation and maintenance or life cycle costs.

Contingencies were determined to be 24% for the NED plan and 23% for the LPP per the CSRA. The TPCS reflects the 80% confidence level per the report. See the attached CSRA report for further information.

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: Orestimba Creek NED PLAN
LOCATION: West Stanislaus County, CA

DISTRICT: Sacramento
POC: CHIEF, COST ENGINEERING,

PREPARED: 4/20/2012

This Estimate reflects the scope and schedule in report; Orestimba Creek Feasibility Study

Program Year (Budget EC): 2014
Effective Price Level Date: 1 OCT 13

WBS NUMBER	Civil Works Feature & Sub-Feature Description	ESTIMATED COST COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	PROJECT FIRST COST ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	TOTAL PROJECT COST (FULLY FUNDED) Spent Thru: 1-Oct-11 ($K)		COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*
02	RELOCATIONS	$3,968	$952	24%	$4,920	3.5%	$4,105	$985	**$5,091**			$4,251	$1,020	$5,272
11	LEVEES & FLOODWALLS	$16,580	$3,979	24%	$20,559	3.5%	$17,154	$4,117	**$21,271**			$17,763	$4,263	$22,027
	CONSTRUCTION ESTIMATE TOTALS:	$20,548	$4,932		**$25,480**	3.5%	$21,259	$5,102	**$26,361**			$22,015	$5,284	$27,298
01	LANDS AND DAMAGES	$2,180	$501	23%	$2,681	3.5%	$2,255	$519	**$2,774**			$2,294	$528	$2,822
18	CULTURAL RESCOURCES	$225	$56	25%	$281	3.5%	$233	$58	**$291**			$241	$60	$301
30	PLANNING, ENGINEERING & DESIGN	$3,698	$888	24%	$4,586	4.4%	$3,859	$926	**$4,786**			$3,728	$895	$4,622
31	CONSTRUCTION MANAGEMENT	$1,767	$424	24%	$2,191	4.4%	$1,844	$443	**$2,287**			$1,792	$430	$2,222
	PROJECT COST TOTALS:	$28,418	$6,801	24%	**$35,219**	3.6%	$29,451	$7,048	**$36,499**			$30,069	$7,196	$37,265

ESTIMATED FEDERAL COST:	65%	**$24,222**
ESTIMATED NON-FEDERAL COST:	35%	**$13,043**
ESTIMATED TOTAL PROJECT COST:		**$37,265**

_____ CHIEF, COST ENGINEERING,

_____ PROJECT MANAGER,

_____ CHIEF, REAL ESTATE,

_____ CHIEF, PLANNING,

_____ CHIEF, ENGINEERING,

_____ CHIEF, OPERATIONS,

_____ CHIEF, CONSTRUCTION,

_____ CHIEF, CONTRACTING,

_____ CHIEF, PM-PB,

_____ CHIEF, DPM,

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Orestimba Creek NED PLAN
LOCATION: West Stanislaus County, CA
This Estimate reflects the scope and schedule in report; Orestimba Creek Feasibility Study

DISTRICT: Sacramento
POC: CHIEF, COST ENGINEERING,
PREPARED: 4/20/2012

Estimate Prepared: 18-Apr-12
Effective Price Level: 1-Oct-11

Program Year (Budget EC): 2014
Effective Price Level Date: 1 OCT 13

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1													
02	RELOCATIONS	$3,968	$952	24%	$4,920	3.5%	$4,105	$985	$5,091	2016Q1	3.6%	$4,251	$1,020	$5,272
11	LEVEES & FLOODWALLS	$16,580	$3,979	24%	$20,559	3.5%	$17,154	$4,117	$21,271	2016Q1	3.6%	$17,763	$4,263	$22,027
	CONSTRUCTION ESTIMATE TOTALS:	$20,548	$4,932	24%	**$25,480**		$21,259	$5,102	$26,361			$22,015	$5,284	$27,298
01	LANDS AND DAMAGES	$2,180	$501	23%	$2,681	3.5%	$2,255	$519	$2,774	2015Q1	1.7%	$2,294	$528	$2,822
18	CULTURAL RESCOURCES	$225	$56	25%	$281	3.5%	$233	$58	$291	2016Q1	3.6%	$241	$60	$301
30	PLANNING, ENGINEERING & DESIGN													
1.9%	Project Management	$390	$94	24%	$484	4.4%	$407	$98	$505	2012Q3	-3.6%	$393	$94	$487
1.5%	Planning & Environmental Compliance	$308	$74	24%	$382	4.4%	$321	$77	$399	2012Q3	-3.6%	$310	$74	$384
6.3%	Engineering & Design	$1,295	$311	24%	$1,606	4.4%	$1,352	$324	$1,676	2012Q3	-3.6%	$1,303	$313	$1,616
1.5%	Engineering Tech Review ITR & VE	$308	$74	24%	$382	4.4%	$321	$77	$399	2012Q3	-3.6%	$310	$74	$384
1.5%	Contracting & Reprographics	$308	$74	24%	$382	4.4%	$321	$77	$399	2012Q3	-3.6%	$310	$74	$384
2.3%	Engineering During Construction	$473	$114	24%	$587	4.4%	$494	$118	$612	2013Q1	-2.9%	$480	$115	$595
1.5%	Planning During Construction	$308	$74	24%	$382	4.4%	$321	$77	$399	2013Q1	-2.9%	$312	$75	$387
1.5%	Project Operations	$308	$74	24%	$382	4.4%	$321	$77	$399	2012Q3	-3.6%	$310	$74	$384
31	CONSTRUCTION MANAGEMENT													
6.0%	Construction Management	$1,233	$296	24%	$1,529	4.4%	$1,287	$309	$1,596	2013Q1	-2.9%	$1,250	$300	$1,550
1.1%	Project Operation:	$226	$54	24%	$280	4.4%	$236	$57	$292	2013Q1	-2.9%	$229	$55	$284
1.5%	Project Management	$308	$74	24%	$382	4.4%	$321	$77	$399	2013Q1	-2.9%	$312	$75	$387
	CONTRACT COST TOTALS:	$28,418	$6,801		**$35,219**		$29,451	$7,048	$36,499			$30,069	$7,196	**$37,265**

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: Orestimba Creek LPP PLAN
LOCATION: West Stanislaus County, CA

DISTRICT: Sacramento
POC: CHIEF, COST ENGINEERING,

PREPARED: 4/20/2012

This Estimate reflects the scope and schedule in report; Orestimba Creek Feasibility Study

Program Year (Budget EC): 2014
Effective Price Level Date: 1 OCT 13

WBS NUMBER	Civil Works Feature & Sub-Feature Description	ESTIMATED COST COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	PROJECT FIRST COST ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	TOTAL PROJECT COST (FULLY FUNDED) Spent Thru: 1-Oct-11 ($K)		COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
02	RELOCATIONS	$4,821	$1,109	23%	$5,930	3.5%	$4,988	$1,147	**$6,135**			$5,165	$1,188	$6,353
11	LEVEES & FLOODWALLS	$21,523	$4,950	23%	$26,473	3.5%	$22,268	$5,122	**$27,389**			$23,059	$5,304	$28,363
	CONSTRUCTION ESTIMATE TOTALS:	$26,344	$6,059		**$32,403**	3.5%	$27,256	$6,269	**$33,524**			$28,224	$6,492	$34,716
01	LANDS AND DAMAGES	$2,180	$501	23%	$2,681	3.5%	$2,255	$519	**$2,774**			$2,294	$528	$2,822
18	CULTURAL RESCOURCES	$282	$71	25%	$353	3.5%	$292	$73	**$365**			$302	$76	$378
30	PLANNING, ENGINEERING & DESIGN	$4,742	$1,091	23%	$5,833	4.4%	$4,949	$1,138	**$6,087**			$5,103	$1,174	$6,276
31	CONSTRUCTION MANAGEMENT	$2,265	$521	23%	$2,786	4.4%	$2,364	$544	**$2,908**			$2,550	$587	$3,137
	PROJECT COST TOTALS:	$35,813	$8,243	23%	**$44,056**	3.6%	$37,116	$8,542	**$45,658**			$38,474	$8,855	$47,329

ESTIMATED FEDERAL COST:	65%	**$30,764**
ESTIMATED NON-FEDERAL COST:	35%	**$16,565**
ESTIMATED TOTAL PROJECT COST:		**$47,329**

_____ CHIEF, COST ENGINEERING,

_____ PROJECT MANAGER,

_____ CHIEF, REAL ESTATE, xxx

_____ CHIEF, PLANNING,

_____ CHIEF, ENGINEERING,

_____ CHIEF, OPERATIONS,

_____ CHIEF, CONSTRUCTION,

_____ CHIEF, CONTRACTING,

_____ CHIEF, PM-PB, xxxx

_____ CHIEF, DPM,

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Orestimba Creek LPP PLAN
LOCATION: West Stanislaus County, CA
This Estimate reflects the scope and schedule in report; Orestimba Creek Feasibility Study

DISTRICT: Sacramento
POC: CHIEF, COST ENGINEERING,

PREPARED: 4/20/2012

Estimate Prepared: 18-Apr-12
Effective Price Level: 1-Oct-11

Program Year (Budget EC): 2014
Effective Price Level Date: 1 OCT 13

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	PHASE 1													
02	RELOCATIONS	$4,821	$1,109	23%	$5,930	3.5%	$4,988	$1,147	$6,135	2016Q1	3.6%	$5,165	$1,188	$6,353
11	LEVEES & FLOODWALLS	$21,523	$4,950	23%	$26,473	3.5%	$22,268	$5,122	$27,389	2016Q1	3.6%	$23,059	$5,304	$28,363
	CONSTRUCTION ESTIMATE TOTALS:	$26,344	$6,059	23%	**$32,403**		$27,256	$6,269	$33,524			$28,224	$6,492	$34,716
01	LANDS AND DAMAGES	$2,180	$501	23%	$2,681	3.5%	$2,255	$519	$2,774	2015Q1	1.7%	$2,294	$528	$2,822
18	CULTURAL RESCOURCES	$282	$71	25%	$353	3.5%	$292	$73	$365	2016Q1	3.6%	$302	$76	$378
30	PLANNING, ENGINEERING & DESIGN													
1.9%	Project Management	$501	$115	23%	$616	4.4%	$523	$120	$643	2014Q3	1.8%	$532	$122	$655
1.5%	Planning & Environmental Compliance	$395	$91	23%	$486	4.4%	$412	$95	$507	2014Q3	1.8%	$420	$97	$516
6.3%	Engineering & Design	$1,660	$382	23%	$2,042	4.4%	$1,732	$398	$2,131	2014Q3	1.8%	$1,764	$406	$2,170
1.5%	Engineering Tech Review ITR & VE	$395	$91	23%	$486	4.4%	$412	$95	$507	2014Q3	1.8%	$420	$97	$516
1.5%	Contracting & Reprographics	$395	$91	23%	$486	4.4%	$412	$95	$507	2014Q3	1.8%	$420	$97	$516
2.3%	Engineering During Construction	$606	$139	23%	$745	4.4%	$632	$145	$778	2016Q1	7.9%	$682	$157	$839
1.5%	Planning During Construction	$395	$91	23%	$486	4.4%	$412	$95	$507	2016Q1	7.9%	$445	$102	$547
1.5%	Project Operations	$395	$91	23%	$486	4.4%	$412	$95	$507	2014Q3	1.8%	$420	$97	$516
31	CONSTRUCTION MANAGEMENT													
5.9%	Construction Management	$1,554	$357	23%	$1,911	4.4%	$1,622	$373	$1,995	2016Q1	7.9%	$1,750	$402	$2,152
1.2%	Project Operation:	$316	$73	23%	$389	4.4%	$330	$76	$406	2016Q1	7.9%	$356	$82	$438
1.5%	Project Management	$395	$91	23%	$486	4.4%	$412	$95	$507	2016Q1	7.9%	$445	$102	$547
	CONTRACT COST TOTALS:	$35,813	$8,243		**$44,056**		$37,116	$8,542	$45,658			$38,474	$8,855	**$47,329**

Estimated by	CESPK-ED-SC
Designed by	CESPK-ED-DB
Prepared by	Robert Vrchoticky
Preparation Date	2/1/2012
Effective Date of Pricing	2/1/2012
Estimated Construction Time	Days

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Date	Author	Note
4/11/2012	Vrchoticky	File Location: CostEng on “Crystal\Engineering\EDPublic” F:\CivWorks\Bob\Data\CPF2012\Orestimba Cr_CWE File Name: CWE-Orestimba_“date of latest revision”.mlp BASIS OF DESIGN This estimate is based on site visits, draft plans and quantities as developed for the draft report: Orestimba Creek West Stanislaus County, CA Feasibility Study The type of solicitation is expected to be unrestricted IFB. Note: Civil Design quantities are per Civil Design Section B. Real Estate provided information on building structures (homes, barns, etc) to be removed. PROJECT SCOPE/DESCRIPTION The project area is located to the North and West of Newman, CA. The project consists primarily of new levee construction, a riprapped berm on the downstream side of existing railroad tracks to the East of Hwy 33 (a NNW-SSE route passing through Newan), and railroad/road closure structures (stoplogs or swing gates to hold back flood waters). There are multiple utility relocations for penetrations through the levee (irrigation facilities and drainage structures). The site is typically farmland or orchards and relatively flat, except at road crossings, where the road is typically several feet higher than the adjacent land. Most of the new levee is very near to an existing irrigation canal (CCID canal) but the canal needs to remain in-service throughout the period of construction and the construction of the existing canal was done many years ago and not to COE specifications Costs for both the NED and locally preferred plan (LPP) have been developed. CONSTRUCTION SCHEDULE A total project schedule including design, pre-construction, construction and post construction was developed using MS Project with construction durations based on those developed in MII. The schedule is used to insure the project design and construction could be completed within 3 years (NED) and with the anticipated crews. The schedule was developed anticipating that demolition, site clearing, and most utility relocations would be performed first, and done in late winter or very early spring so that impacts to the farming production capability will be minimal. CONSTRUCTION WINDOWS Because this work is for new levee construction that is relatively far from the creek and only subject to flooding every few years, this estimate does not consider seasonal construction windows. It is acknowledged that there is some chance of flooding during the period of construction and that is considered in the cost and schedule risk analysis. The flood control provided by the project will not be permanently established until construction completion. OVERTIME

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Overtime is not included in this estimate.

ACQUISITION PLAN
The construction contract is assumed to be invitation for bid (IFB), lowest competitive price.

CONTRACTING PLAN
The prime contractor is expected to be an earthwork contractor responsible for the general site work, borrow site excavation, and levee construction to the new levee height.
Miscellaneous/General Subcontractors are expected to be utilized for some utility relocations, paving and hydroseeding.

PROJECT CONSTRUCTION
The project consists primarily of new levee construction (a chevron levee to the West and North of Newman). Much of the site is currently farmland and orchards so clearing, grubbing and tree removal must be timed for minimal disturbance to farm production. Likewise, the multiple irrigation lines requiring relocation must be relocated during off-farming periods. Several structures lie along the levee alignment and must be removed prior to levee construction. Construction of the road closure structures must be completed prior to the levee placement in the area of the structure. Two drip irrigation systems with sand filters must be relocated and this will require coordination with the farmers as the relocation must follow the levee placement.
Should the LPP ultimately be constructed, the levee will be 2 or 3 feet higher with corresponding increase in earthwork and size of closure structures.

SITE ACCESS
The project site lies almost completely within farmland and orchards. There are several roads (including one ‘farm’ road) crossing the project site every mile or so and therefore access is expected to not require separate turnaround areas.

BORROW \ DISPOSAL AREAS
The borrow site is anticipated to be the Fink Road Landfill. Local sponsors have indicated at PDT meetings that there will be no ‘royalties’ required for the borrow material. Disposal of debris is considered normal and anticipated to be at the landfill as well. Materials generated from stripping farmland/orchards is anticipated to be spread in the ‘ditch’ created between the new levee and the CCID canal levee.

CONSTRUCTION METHODOLOGY
The construction methodologies are considered standard.

UNUSUAL CONDITIONS
No unusual conditions.

UNIQUE TECHNIQUES OF CONSTRUCTION
No unique construction techniques are anticipated to be required.

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EQUIPMENT AND LABOR AVAILABILITY & DISTANCE TRAVELED
Newman is approximately 40 miles from Stockton, CA and 75 miles from Sacramento. Therefore, equipment and labor is readily available within a 100 mile radius of the site.

ENVIRONMENTAL CONCERNS
Environment protection requires consideration of air, water, and land, and involves noise, solid-waste management and management of other pollutants. In order to prevent or provide for abatement and control of any environmental pollution arising from the work activities, the Contractor and his subcontractors in the performance of this contract, shall comply with all applicable Federal, State, and local laws, and regulations concerning environmental pollution control and abatement. The Contractor shall use best management practices at all times to minimize the potential for environmental impacts. A running 2% markup on construction equipment is provided to account for air quality considerations.

STORM WATER POLLUTION PREVENTION (SWPP)
Assumptions:
The pre and post hydrology, specifications and associated plans are not included in this initial estimate. Application of erosion control BMPs will be required over 10% of the project area and consist of a mix of mulch, seed, and binder for 90% of that disturbed area, and geotextiles and mats for 10% of the disturbed area. The primary sediment control BMP is fiber rolls placed at a maximum interval of 15 ft for slope inclinations between 4:1 and 2:1. Though there are slopes flatter than 4:1 (which would allow for a max spacing of 20 ft), the more conservative interval of 15 ft is used to provide more effective erosion control. Silt fences will be used in conjunction with fiber rolls for further sediment control. A 25% factor is applied to both the erosion and sediment control BMP's to account for repairs/replacements due to wear and loss of effectiveness. The following references are relative to the SWPP portion of this cost estimate:
<http://www.douglaswatertruckservice.com/index.html>
<http://cfpub.epa.gov/npdes/stormwater/menuofbmps>2009 CASQA Construction Handbook

LABOR RATES, EQUIPMENT RATES, MATERIAL COSTS & SALES TAX
This estimate meets Davis Bacon wage rates for Davis Bacon wage determinations for the state of California, General Decision Numbers: CA 20100003 03/26/2010, CA 20100006 03/12/2010, CA 20100009 11/18/2011 (Heavy Construction) and CA 20100026 03/12/2010.

Equipment unit costs were obtained from the MII Cost Book (2009).

Material prices were obtained from Quotes, supply catalogs, previous similar estimates, and the MII Cost Book (2010). In some cases, MII cost book prices were updated from RSMeans 2011 Cost Data books.

Sales tax is applied at 7.75%.

CONTRACTOR MARKUPS

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For the prime contractor, profit is based on Profit Weighted Guidelines (8.48%). Home Office Overhead is considered to be 7% for this project. Job/Field Office Overhead (JOOH) is calculated from a list of typical overhead items and based on the duration per the total project & construction schedule. Small Tool Markup is set at 2%. Bond is calculated based on Bond Class B. Calculated JOOH varies for the NED vs. LPP as the construction duration and testing requirements are different.

Miscellaneous/General Subcontractors have profit set at of 10%, Home Office Overhead at 10% and Job Office Overhead at 15%. Bond is set at 1%.

For most work involving equipment with hauling, work durations are typically based on daily setup time for equipment plus production of 50 minutes/hr. See the notes within the MII files. Also, a markup has been added based on anticipated productivity of 90% for the project.

QUOTES
By far, the largest volume of material will be earth fill for the levees. As noted above, fill is expected to come from the Fink Road Landfill with no royalty fees. Other materials where specific quotes are warranted are judged to be the rock and paving materials. These items have a fair percentage of costs relative to others.

Note: Gasoline and diesel fuel costs used in the estimate are the average costs in the Newman area as of December 2011. Off-road diesel costs are assumed at $0.35 lower than on-road.

Revision History

2009 - Work on the project commenced in early 2009. Design anticipated were channel modifications to Orestimba Creek to increase creek discharge capacity and a Chevron Levee to the West and North of Newman to protect the city.

November-December, 2009 - CWEs were reviewed for DQC (Sherman Fong, SPK) and initial coordination on ATR (Glenn Matlock, NWW). Comments by Fong were ‘over the shoulder’, those by Matlock were very general comments and primarily outlined the requirements for feasibility level ATR

2010 - Following the F4 conference in early 2010 there was a period of very limited work activity due to funding constraints.

2011 - Work began to pick up again in early 2011. Since that time, most cost engineering work has been relative to ATR requirements and updated cost estimates (several iterations as design progressed). There have been bi-weekly or monthly PDT meetings. A significant major change is that the channel modifications have been dropped from the project due. Economic analysis indicates those modifications are not incrementally justified.

January 2012 - CWEs and total project schedule (including construction) for both the NED and LPP were submitted for DQC (Joe Reynolds, SPK). The comments were received via notes made to a pdf file of a detailed MII report. Cost Estimator noted all comments in

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a Word file and all comments were addressed, corrections performed and comments backchecked.

January 2012 - A Cost & Schedule Risk Analysis meeting was held, resulting in multiple additions to the estimate, including wellhead raises, culverts, ramps, pipe gates, and railroad removal and replacement for seepage control as well as multiple changes to quantities. Roughly 50 percent of the quantities had some changes, most significant, the inspection trench excavating and demolition of houses & farm buildings.

Historical Changes
ATR comments led to several changes to the estimate. These include:
- changes to reflect consistent unit prices for spread & compaction (except in very small or scattered areas where the unit price is much higher
- providing further justifictation for fiber roll & silt fence production and costs
- remvoal of flagment from JOOH items as the traffic control is handled within the estimate
- removal of the engineers assigned to JOOH for QA/QC (two were previously included)
- updating costs and inconsistend notes for sand placement (seepage berm and sand filter)
- removing the markup for productivity
- changing notes to reflect 8 hr workdays

Description	Quantity	UOM	CostToPrime	JOOH_PRM	HOOH_PRM	Profit_PRM	Bond_PRM	ContractCost
Prime Contractor Cost or Bid Cost w/o Esc			36,983,686	3,098,312	2,805,740	3,663,124	339,157	46,890,019
1 NED	1.00	LS	16,162,320	1,398,008	1,229,223	1,606,476	151,355	20,547,381
1.1 Chevron Levee	1.00	EA	16,162,320	1,398,008	1,229,223	1,606,476	151,355	20,547,381
1.1.2 Relocations (Non-Fed)	1.00	LS	3,101,721	276,508	236,476	319,649	33,569	3,967,923
1.1.2.1 Roads	1.00	LS	440,993	37,868	33,520	43,450	3,977	559,808
1.1.2.2 Railroads	1.00	LS	44,962	3,861	3,418	4,430	405	57,076
1.1.2.3 Utilities	1.00	LS	1,882,301	161,433	143,061	185,440	16,964	2,389,200
1.1.2.4 Utilities - Power Poles	1.00	LS	733,465	73,347	56,477	86,329	12,223	961,840
1.1.3 Levees and Floodwalls	1.00	LS	13,060,599	1,121,499	992,747	1,286,827	117,785	16,579,457
1.1.3.1 Levees	1.00	LS	13,060,599	1,121,499	992,747	1,286,827	117,785	16,579,457
2 LPP	1.00	LS	20,821,367	1,700,304	1,576,517	2,056,648	187,802	26,342,638
2.1 Chevron Levee	1.00	EA	20,821,367	1,700,304	1,576,517	2,056,648	187,802	26,342,638
2.1.2 Relocations	1.00	LS	3,787,440	320,694	287,569	385,878	38,916	4,820,497
2.1.2.1 Roads	1.00	LS	798,358	64,661	60,411	78,307	6,978	1,008,715
2.1.2.2 Railroads	1.00	LS	44,962	3,642	3,402	4,410	393	56,809
2.1.2.3 Utilities	1.00	LS	2,210,655	179,045	167,279	216,832	19,322	2,793,133
2.1.2.4 Utilities - Power Poles	1.00	LS	733,465	73,347	56,477	86,329	12,223	961,840
2.1.3 Levees and Floodwalls	1.00	LS	17,033,926	1,379,610	1,288,948	1,670,771	148,886	21,522,141
2.1.3.1 Levees	1.00	LS	17,033,926	1,379,610	1,288,948	1,670,771	148,886	21,522,141

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	OtherCosts	SubCMU	CostToPrime
Detail Cost			14,094,622.22	13,351,452.89	5,814,689.09	2,882,304.38	20,000.00	820,617.76	36,983,686.34
1 NED	1.00	LS	6,176,351.39	5,710,301.99	2,570,882.92	1,375,889.40	10,000.00	318,893.97	16,162,319.66
1.1 Chevron Levee	1.00	EA	6,176,351.39	5,710,301.99	2,570,882.92	1,375,889.40	10,000.00	318,893.97	16,162,319.66
1.1.2 Relocations (Non-Fed)	1.00	LS	1,053,822.09	356,294.36	1,293,584.52	226,543.24	0.00	171,476.49	3,101,720.70
1.1.2.1 Roads	1.00	LS	183,290.50	93,220.56	82,984.42	44,821.04	0.00	36,676.73	440,993.26
1.1.2.2 Railroads	1.00	LS	14,772.34	3,337.37	5,062.10	8,820.00	0.00	12,969.96	44,961.76
1.1.2.3 Utilities	1.00	LS	581,568.52	188,868.40	817,131.58	172,902.20	0.00	121,829.80	1,882,300.51
1.1.2.4 Utilities - Power Poles	1.00	LS	274,190.72	70,868.03	388,406.43	0.00	0.00	0.00	733,465.18
1.1.3 Levees and Floodwalls	1.00	LS	5,122,529.30	5,354,007.63	1,277,298.40	1,149,346.16	10,000.00	147,417.48	13,060,598.96
1.1.3.1 Levees	1.00	LS	5,122,529.30	5,354,007.63	1,277,298.40	1,149,346.16	10,000.00	147,417.48	13,060,598.96
2 LPP	1.00	LS	7,918,270.84	7,641,150.90	3,243,806.17	1,506,414.98	10,000.00	501,723.79	20,821,366.68
2.1 Chevron Levee	1.00	EA	7,918,270.84	7,641,150.90	3,243,806.17	1,506,414.98	10,000.00	501,723.79	20,821,366.68
2.1.2 Relocations	1.00	LS	1,292,699.75	603,785.39	1,455,793.91	244,375.42	0.00	190,785.81	3,787,440.28
2.1.2.1 Roads	1.00	LS	335,364.73	220,235.16	129,248.50	56,395.62	0.00	57,114.27	798,358.28
2.1.2.2 Railroads	1.00	LS	14,772.34	3,337.37	5,062.10	8,820.00	0.00	12,969.96	44,961.76
2.1.2.3 Utilities	1.00	LS	668,371.96	309,344.84	933,076.90	179,159.80	0.00	120,701.58	2,210,655.07
2.1.2.4 Utilities - Power Poles	1.00	LS	274,190.72	70,868.03	388,406.43	0.00	0.00	0.00	733,465.18
2.1.3 Levees and Floodwalls	1.00	LS	6,625,571.09	7,037,365.51	1,788,012.26	1,262,039.56	10,000.00	310,937.99	17,033,926.40
2.1.3.1 Levees	1.00	LS	6,625,571.09	7,037,365.51	1,788,012.26	1,262,039.56	10,000.00	310,937.99	17,033,926.40

ID	Task Name	Quantity	Unit	Duration	Start
1	**Orestimba FS (NED)**	**0**		**709 days**	**Tue 10/1/13**
2	**Design & Construction (NED)**	**0**		**709 days**	**Tue 10/1/13**
3	**Construction Contract**	**0**		**709 days**	**Tue 10/1/13**
19	**NED Construction**	**1**	**LS**	**339 days**	**Mon 2/2/15**
20	**Chevron Levee**	**1**	**EA**	**339 days**	**Mon 2/2/15**
226	**Levees and Floodwalls**	**1**	**LS**	**339 days**	**Mon 2/2/15**
227	**Levees**	**1**	**LS**	**339 days**	**Mon 2/2/15**
262	**Embankment (imported)**	**231750**	**CY**	**241.5 days**	**Wed 3/11/15**
287	**EMBANKMENT (BORROW)**	**231750**	**CY**	**203.25 days**	**Tue 4/7/15**
288	**LOAD & HAUL - BORROW PIT TO LEVEE**	**231750**	**CY**	**200.25 days**	**Thu 4/9/15**
289	EXCAVATING & LOADING - BORROW PIT TO LEVEE	1602	HR	200.25 days	Thu 4/9/15
290	**Hauling, from stockpiles, 20 cy trucks, 10 mi, 40 mph**	**231750**	**LCY**	**200.25 days**	**Thu 4/9/15**
291	Semi End Dump, 20 CY	19224	HR	200.25 days	Thu 4/9/15
294	**SPREAD & COMPACT**	**231750**	**CY**	**200.25 days**	**Fri 4/10/15**
295	Labor & Equipment	1602	HR	200.25 days	Fri 4/10/15
329	**Aggregate Base Course (Levee, 16' w, 6" t)**	**15688**	**TON**	**13 days**	**Mon 1/18/16**
330	**Import & Place**	**15688**	**TON**	**12.5 days**	**Mon 1/18/16**
334	Labor & Equipment, Place & Compact Aggregates	96	HR	12 days	Mon 1/18/16
335	**Finish Grade**	**393600**	**SF**	**6.75 days**	**Tue 1/26/16**
336	Labor & Equipment, Finish Grade	54	HR	6.75 days	Tue 1/26/16
337	**Erosion Control Seeding**	**124**	**ACR**	**34 days**	**Thu 2/4/16**

Project: NatomasPACRConstrSchedul
Date: Wed 4/11/12

Critical	Baseline	Project Summary
Critical Split	Baseline Split	External Tasks
Critical Progress	Baseline Milestone	External Milestone
Task	Milestone	Deadline
Split	Summary Progress	
Task Progress	Summary	

ID	Task Name	Quantity	Unit	Duration	Start
338	**Placement**	**600160**	**SY**	**34 days**	**Thu 2/4/16**
339	Labor & Equipment	540	HR	34 days	Thu 2/4/16
639	Weather Delays	20	day	20 days	Wed 3/23/16
644	**Inspection and Construction per Punch List**	**0**		**17 days**	**Wed 4/20/16**
645	PreFinal Inspection	0		1 day	Wed 4/20/16
646	Contractor Implement Punch List Items	0		5 days	Thu 4/21/16
647	Demobilization, General (Contractor Storage Area, etc)	1	LS	10 days	Thu 4/28/16
648	Final Inspection	0		1 day	Thu 5/12/16
649	Construction Physical Completion	0		0 days	Thu 5/12/16
650	**Project Closeout**	**0**		**26 days**	**Fri 5/13/16**
652	Contractors Complete As-Builts	0		25 days	Fri 5/13/16
653	Submit As-Builts	0		1 day	Fri 6/17/16
654	Notice of Completion/Assumption of OMRR&R	0		0 days	Fri 6/17/16
655	Project Fiscally Complete	0		0 days	Fri 6/17/16

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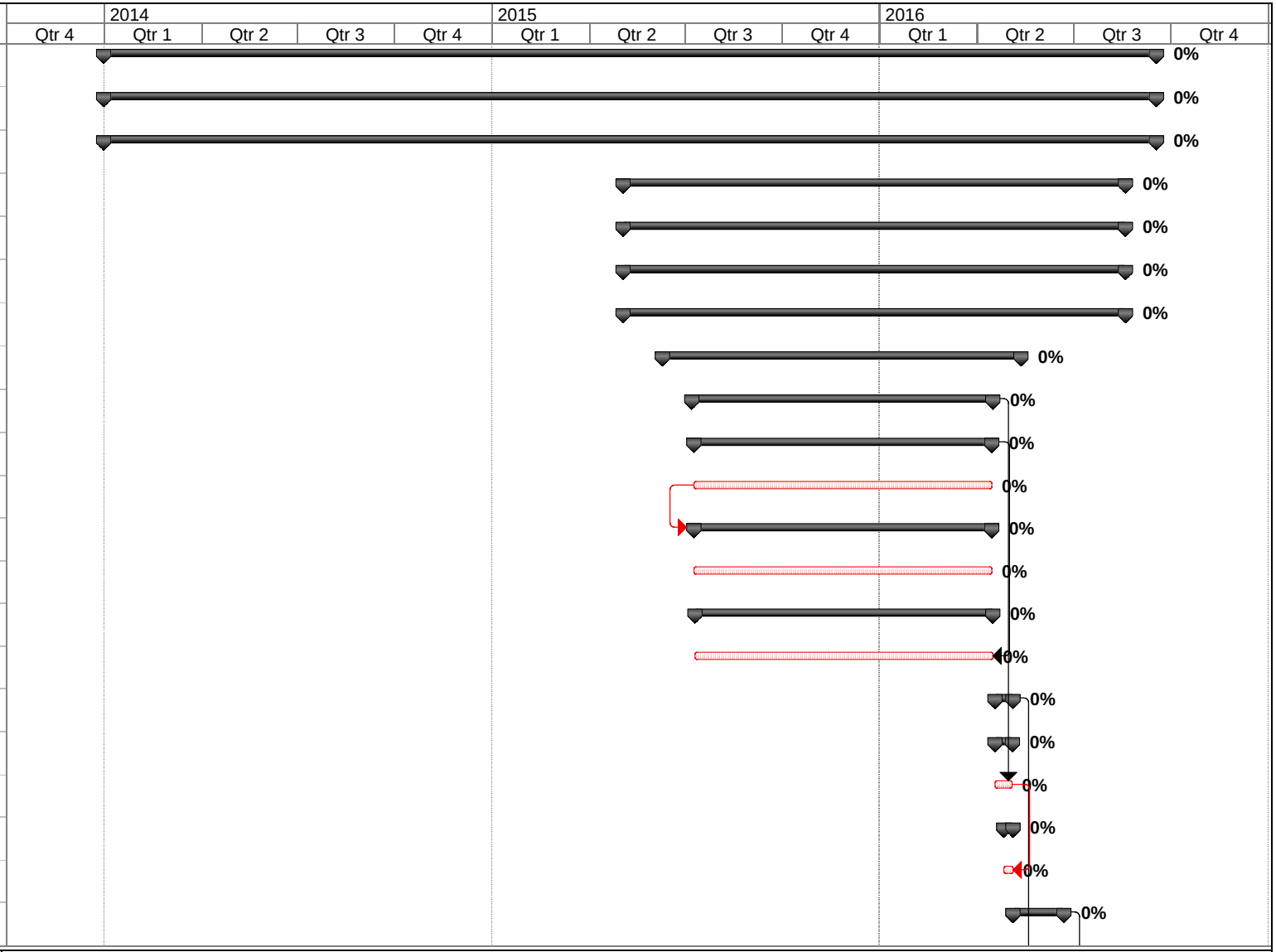
Critical		Baseline		Project Summary	
Critical Split		Baseline Split		External Tasks	
Critical Progress		Baseline Milestone		External Milestone	
Task		Milestone		Deadline	
Split		Summary Progress			
Task Progress		Summary			

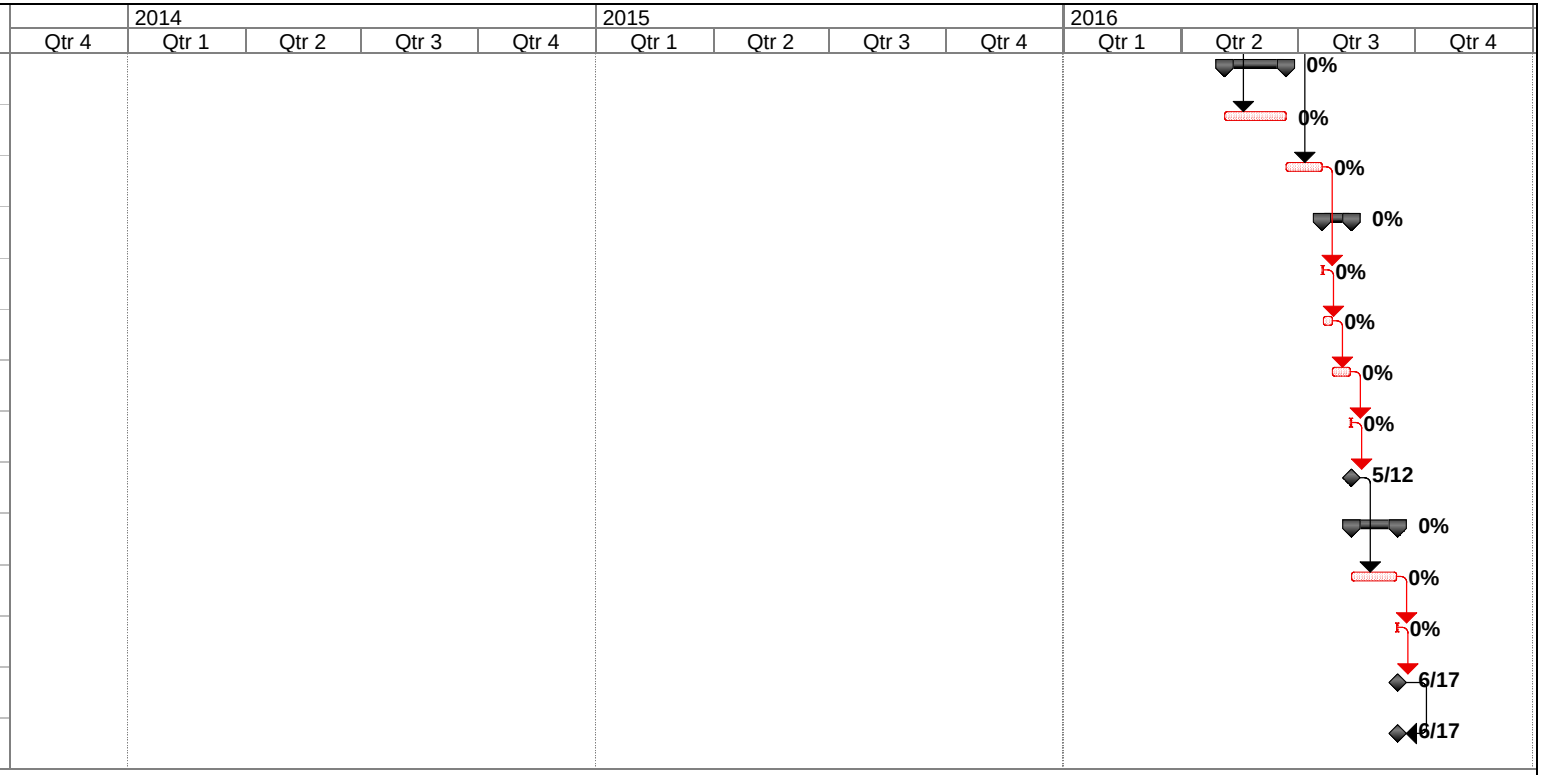
Finish	Predecessors
Fri 6/17/16	
Fri 6/17/16	
Fri 6/17/16	
Thu 5/19/16	
Thu 5/19/16	
Thu 5/19/16	
Thu 5/19/16	
Thu 2/11/16	
Fri 1/15/16	
Thu 1/14/16	
Thu 1/14/16	292SS+2 days
Thu 1/14/16	**289SS**
Thu 1/14/16	
Fri 1/15/16	
Fri 1/15/16	288FF+1 day
Wed 2/3/16	
Wed 2/3/16	
Tue 2/2/16	287
Wed 2/3/16	
Wed 2/3/16	334FF+1 day
Tue 3/22/16	



Project: NatomasPACRConstrSchedul
Date: Wed 4/11/12

Critical		Baseline		Project Summary	
Critical Split		Baseline Split		External Tasks	
Critical Progress		Baseline Milestone		External Milestone	
Task		Milestone		Deadline	
Split		Summary Progress			
Task Progress		Summary			

Finish	Predecessors
Tue 3/22/16	
Tue 3/22/16	329
Tue 4/19/16	337
Thu 5/12/16	
Wed 4/20/16	639
Wed 4/27/16	645
Wed 5/11/16	646
Thu 5/12/16	647
Thu 5/12/16	648
Fri 6/17/16	
Thu 6/16/16	649
Fri 6/17/16	652
Fri 6/17/16	653
Fri 6/17/16	654FF



Project: NatomasPACRConstrSchedul
Date: Wed 4/11/12

Critical		Baseline		Project Summary	
Critical Split		Baseline Split		External Tasks	
Critical Progress		Baseline Milestone		External Milestone	
Task		Milestone		Deadline	
Split		Summary Progress			
Task Progress		Summary			

ID	Task Name	Quantity	Unit	Duration	Start
1	**Orestimba FS (LPP)**	**0**		**809 days**	**Tue 10/1/13**
2	**Design & Construction (LPP)**	**0**		**809 days**	**Tue 10/1/13**
3	**Construction Contract**	**0**		**809 days**	**Tue 10/1/13**
19	**LPP Construction, Federal**	**1**	**LS**	**439 days**	**Mon 2/2/15**
20	**Chevron Levee**	**1**	**EA**	**439 days**	**Mon 2/2/15**
254	**Levees and Floodwalls**	**1**	**LS**	**439 days**	**Mon 2/2/15**
255	**Levees**	**1**	**LS**	**439 days**	**Mon 2/2/15**
290	**Embankment (imported)**	**324000**	**CY**	**336.25 days**	**Wed 3/11/15**
315	**EMBANKMENT (BORROW)**	**324000**	**CY**	**283 days**	**Fri 4/17/15**
316	**LOAD & HAUL - BORROW PIT TO LEVEE**	**324000**	**CY**	**280 days**	**Tue 4/21/15**
317	EXCAVATING & LOADING - BORROW PIT TO LEVEE	2240	HR	280 days	Tue 4/21/15
318	**Hauling, from stockpiles, 20 cy trucks, 10 mi, 40 mph**	**324000**	**LCY**	**280 days**	**Tue 4/21/15**
319	Semi End Dump, 20 CY	26880	HR	280 days	Tue 4/21/15
322	**SPREAD & COMPACT**	**324000**	**CY**	**280 days**	**Wed 4/22/15**
323	Labor & Equipment	2240	HR	280 days	Wed 4/22/15
357	**Aggregate Base Course (Levee, 16' w, 6" t)**	**15688**	**TON**	**13 days**	**Wed 5/18/16**
358	**Import & Place**	**15688**	**TON**	**12.5 days**	**Wed 5/18/16**
362	Labor & Equipment, Place & Compact Aggregates	96	HR	12 days	Wed 5/18/16
363	**Finish Grade**	**393600**	**SF**	**6.75 days**	**Thu 5/26/16**
364	Labor & Equipment, Finish Grade	54	HR	6.75 days	Thu 5/26/16
365	**Asphalt Concrete Paving, 2-1/2"**	**6148**	**TON**	**12.5 days**	**Mon 6/6/16**

Project: NatomasPACRConstrSchedul
Date: Wed 4/11/12

Critical		Baseline		Project Summary	
Critical Split		Baseline Split		External Tasks	
Critical Progress		Baseline Milestone		External Milestone	
Task		Milestone		Deadline	
Split		Summary Progress			
Task Progress		Summary			

ID	Task Name	Quantity	Unit	Duration	Start
366	**Place 2-1/2" Asphaltic Concrete**	**393472**	**SF**	**10.5 days**	**Mon 6/6/16**
367	**Place 2-1/2" asphalt concrete**	**393472**	**SF**	**10.5 days**	**Mon 6/6/16**
368	**Import & Place Open grade material**	**6148**	**TON**	**10.5 days**	**Mon 6/6/16**
373	**Place & Compact Aggregates**	**6148**	**TON**	**10.5 days**	**Mon 6/6/16**
374	Labor & Equipment	84	HR	10.5 days	Mon 6/6/16
375	**Final sweep**	**43719**	**SY**	**2 days**	**Tue 6/21/16**
376	Power Broom	16	HR	2 days	Tue 6/21/16
377	**Erosion Control Seeding**	**124**	**ACR**	**34 days**	**Thu 6/23/16**
378	**Placement**	**600160**	**SY**	**34 days**	**Thu 6/23/16**
379	Labor & Equipment	540	HR	34 days	Thu 6/23/16
681	Weather Delays	20	day	20 days	Wed 8/10/16
686	**Inspection and Construction per Punch List**	**0**		**17 days**	**Wed 9/7/16**
687	PreFinal Inspection	0		1 day	Wed 9/7/16
688	Contractor Implement Punch List Items	0		5 days	Thu 9/8/16
689	Demobilization, General (Contractor Storage Area, etc)	1	LS	10 days	Thu 9/15/16
690	Final Inspection	0		1 day	Thu 9/29/16
691	Construction Physical Completion	0		0 days	Thu 9/29/16
692	**Project Closeout**	**0**		**26 days**	**Fri 9/30/16**
694	Contractors Complete As-Builts	0		25 days	Fri 9/30/16
695	Submit As-Builts	0		1 day	Fri 11/4/16
696	Notice of Completion/Assumption of OMRR&R	0		0 days	Fri 11/4/16

Project: NatomasPACRConstrSchedul
Date: Wed 4/11/12

Critical		Baseline		Project Summary	
Critical Split		Baseline Split		External Tasks	
Critical Progress		Baseline Milestone		External Milestone	
Task		Milestone		Deadline	
Split		Summary Progress			
Task Progress		Summary			

ID		Task Name	Quantity	Unit	Duration	Start
697		Project Fiscally Complete	0		0 days	Fri 11/4/16

Project: NatomasPACRConstrSchedul
Date: Wed 4/11/12

Critical		Baseline		Project Summary	
Critical Split		Baseline Split		External Tasks	
Critical Progress		Baseline Milestone		External Milestone	
Task		Milestone		Deadline	
Split		Summary Progress			
Task Progress		Summary			

Finish	Predecessors
Fri 11/4/16	
Fri 11/4/16	
Fri 11/4/16	
Thu 10/6/16	
Thu 10/6/16	
Thu 10/6/16	
Thu 10/6/16	
Thu 6/23/16	
Wed 5/18/16	
Tue 5/17/16	
Tue 5/17/16	320SS+2 days
Tue 5/17/16	**317SS**
Tue 5/17/16	
Wed 5/18/16	
Wed 5/18/16	316FF+1 day
Mon 6/6/16	
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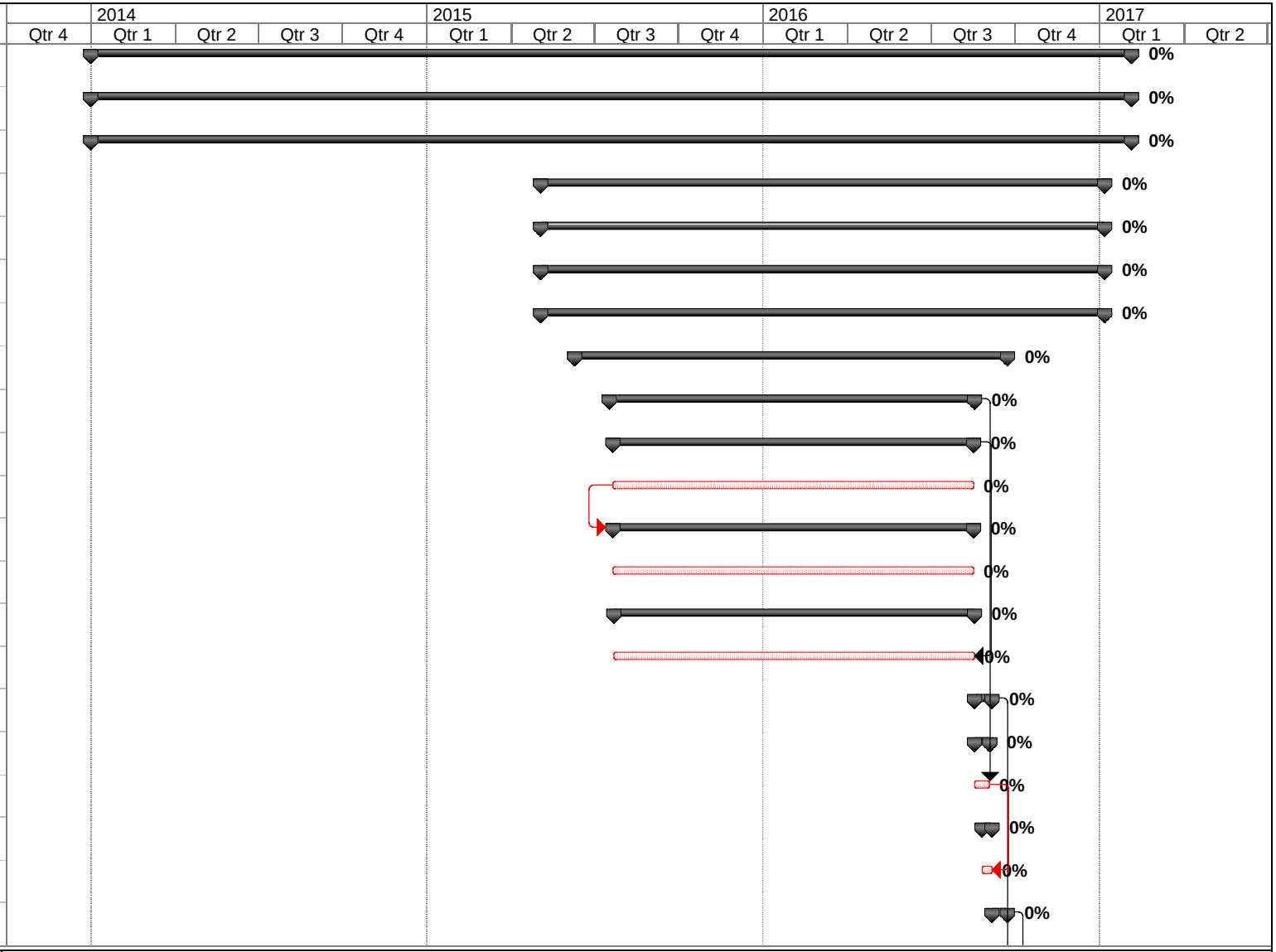
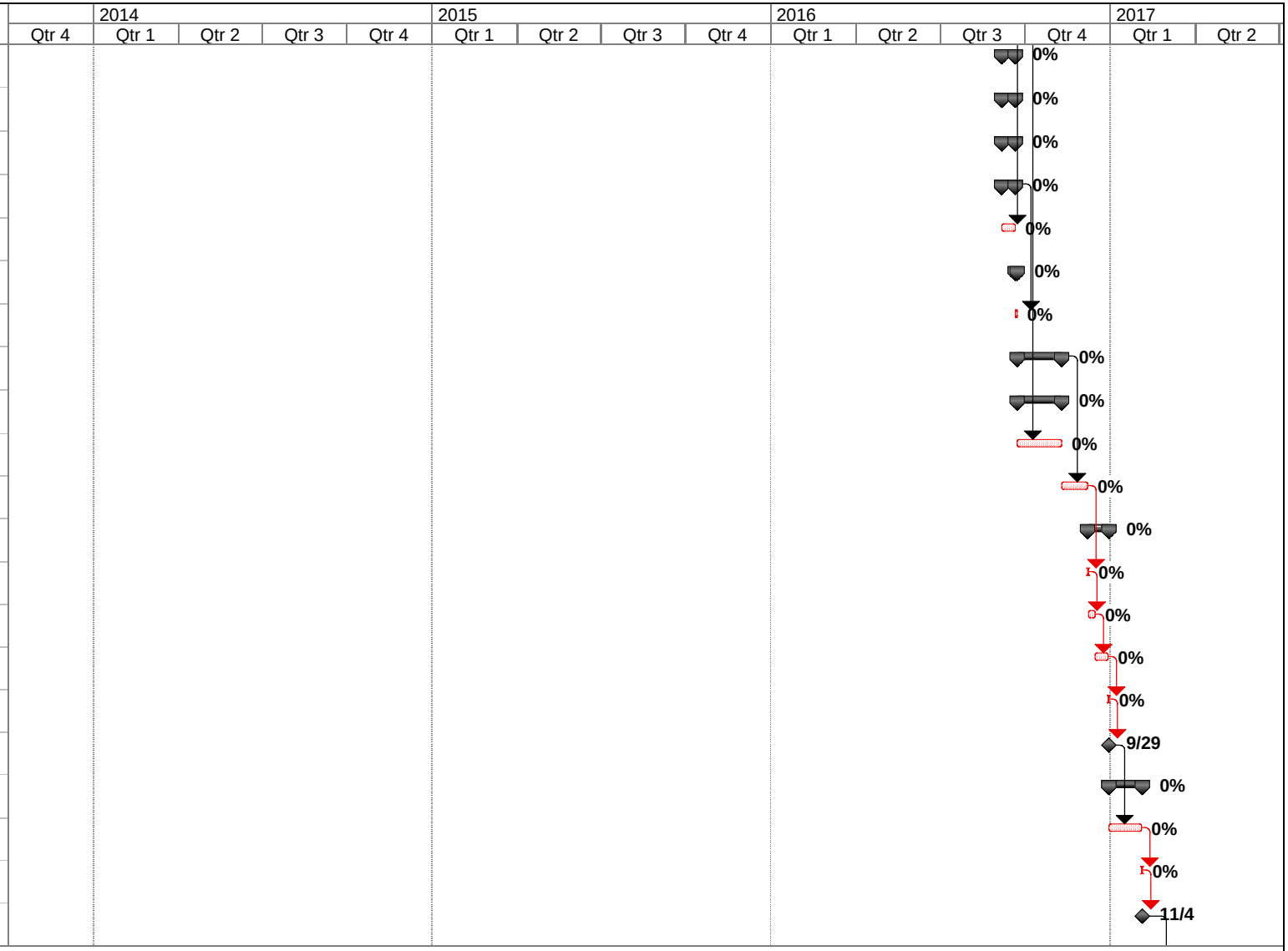
Fri 6/3/16	315
Mon 6/6/16	
Mon 6/6/16	362FF+1 day
Wed 6/22/16	



Project: NatomasPACRConstrSchedul
Date: Wed 4/11/12

Critical		Baseline		Project Summary	
Critical Split		Baseline Split		External Tasks	
Critical Progress		Baseline Milestone		External Milestone	
Task		Milestone		Deadline	
Split		Summary Progress			
Task Progress		Summary			

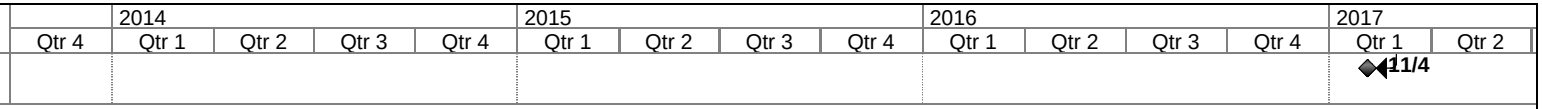
Finish	Predecessors
Mon 6/20/16	
Mon 6/20/16	
Mon 6/20/16	
Mon 6/20/16	
Mon 6/20/16	357
Wed 6/22/16	
Wed 6/22/16	373
Tue 8/9/16	
Tue 8/9/16	
Tue 8/9/16	365
Tue 9/6/16	377
Thu 9/29/16	
Wed 9/7/16	681
Wed 9/14/16	687
Wed 9/28/16	688
Thu 9/29/16	689
Thu 9/29/16	690
Fri 11/4/16	
Thu 11/3/16	691
Fri 11/4/16	694
Fri 11/4/16	695



Project: NatomasPACRConstrSchedul
Date: Wed 4/11/12

Critical		Baseline		Project Summary	
Critical Split		Baseline Split		External Tasks	
Critical Progress		Baseline Milestone		External Milestone	
Task		Milestone		Deadline	
Split		Summary Progress			
Task Progress		Summary			

Finish	Predecessors
Fri 11/4/16	696FF



Project: NatomasPACRConstrSchedul
Date: Wed 4/11/12

Critical		Baseline		Project Summary	
Critical Split		Baseline Split		External Tasks	
Critical Progress		Baseline Milestone		External Milestone	
Task		Milestone		Deadline	
Split		Summary Progress			
Task Progress		Summary			

US Army Corps
of Engineers®

Orestimba Creek Feasibility Report
Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
Sacramento District

Prepared by:

U.S. Army Corps of Engineers
Cost Engineering TCX, Walla Walla District

April 23 2012

For Official Use Only

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EXECUTIVE SUMMARY

This report presents a recommendation for the total project cost and schedule contingencies for the Orestimba Creek Feasibility Study. At the request of Sacramento District, a formal risk analysis study was conducted for the development of contingency on the total project cost. The purpose of this risk analysis study was to establish project contingencies by identifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated total project cost. Because of the development of a National Economic Development Plan (NED) and a Locally Preferred Plan (LPP), a risk register and cost/schedule risk model was developed separately for each project.

The project area is located to the North and West of Newman, CA. The project consists primarily of new levee construction, and a riprap protected berm on the downstream side of existing railroad tracks to the East of Hwy 33. Multiple road and a railroad closure structure are required. There are multiple utility relocations for penetrations through the levee (irrigation facilities and drainage structures). The site is typically farmland or orchards and relatively flat, except at road crossings, where the road is typically several feet higher than the adjacent land. Most of the new levee is very near to an existing irrigation canal (CCID canal) but the canal needs to remain in-service throughout the period of construction. The schedule was developed anticipating that demolition, site clearing, and most utility relocations would be performed first, and done in late winter or very early spring so that impacts to the farming production capability will be minimal. The basic schedule and assumptions for each project are the same with the assumption that the contractor for the LPP would increase the equipment onsite in order to maintain the approximate same schedule for each.

The risk results from the two studies are very similar due to the similar estimating and risks analysis approaches. The LPP is constructed at a slightly higher elevation than the NED plan and as such involves a larger quantity of earth fill to construct the levees. This is the largest cost increase item in going from the NED to the LPP plan (approx $4M). The next cost increase between the plans is in Relocations (approx $1M) due to the extra footprint required to facilitate the higher levee in the LPP plan (i.e., relocations costs for the roads, utilities, etc are slightly higher.)

Specific to the NED Plan, the most likely constant dollar program year cost (First Cost at FY14 Price level) is approximately $36.5 million including a contingency of $7 million dollars or approximately 24%. For the LPP plan, the constant dollar program year cost is approximately $46 million including a contingency of approximately $8.9 million dollars or approximately 23%.

The following table ES-1 and ES-2 portray the costs of the facility based on the Civil Works Breakdown Structure (CWBS) at the. The costs are intended to address the programmatic cost and schedule necessary to implement the project. The contingency is based on an 80% confidence level, as per accepted USACE Civil Works guidance.

Table ES-1. Cost Summary NED Plan

CWBS	FEATURE	FIRST COSTS			FULLY FUNDED		
	Orestimba Creek NED Plan	COST ($K)	CNTG ($K)	First Cost ($K)	COST ($K)	CNTG ($K)	Fully Funded ($K)
02	RELOCATIONS	$4,105	$985	$5,091	$4,251	$1,020	$5,272
11	LEVEES & FLOODWALLS	$17,154	$4,117	$21,271	$17,763	$4,263	$22,027
	CONSTRUCTION FEATURE TOTALS:	$21,259	$5,102	$26,361	$22,015	$5,284	$27,298
01	LANDS AND DAMAGES	$2,265	$522	$2,787	$2,305	$531	$2,835
18	CULTURAL RESCOURCES	$233	$58	$291	$241	$60	$301
30	PLANNING, ENGINEERING & DESIGN	$3,859	$926	$4,786	$3,728	$895	$4,622
31	CONSTRUCTION MANAGEMENT	$1,844	$443	$2,287	$1,792	$430	$2,222
	TOTALS	$29,461	$7,051	$36,512	$30,079	$7,199	$37,278

Table ES-2. Cost Summary LPP Plan

CWBS	FEATURE	FIRST COSTS			FULLY FUNDED		
	Orestimba Creek LPP Plan	COST ($K)	CNTG ($K)	First Cost ($K)	COST ($K)	CNTG ($K)	Fully Funded ($K)
02	RELOCATIONS	$4,988	$1,147	$6,135	$5,165	$1,188	$6,353
11	LEVEES & FLOODWALLS	$22,268	$5,122	$27,389	$23,059	$5,304	$28,363
	CONSTRUCTION FEATURE TOTALS:	$27,256	$6,269	$33,524	$28,224	$6,492	$34,716
01	LANDS AND DAMAGES	$2,255	$519	$2,774	$2,294	$528	$2,822
18	CULTURAL RESCOURCES	$292	$73	$365	$302	$76	$378
30	PLANNING, ENGINEERING & DESIGN	$4,949	$1,138	$6,087	$5,103	$1,174	$6,276
31	CONSTRUCTION MANAGEMENT	$2,364	$544	$2,908	$2,550	$587	$3,137
	TOTALS	$37,116	$8,542	$45,658	$38,474	$8,855	$47,329

KEY RISK FINDINGS/OBSERVATIONS/RECOMMENDATIONS

The key **cost risk drivers** identified through sensitivity analysis are Funding Stream risk and Embankment Borrow Source which together are nearly 70% of the statistical cost variance. The funding stream may impact the project by causing the current one contract approach to be changed to acquisition through multiple smaller contracts. The borrow source for the project is relatively well defined, however, there is considerable concern that by the time the project is executed it may not be able to provide fill at low/no cost and that haul distance and/or borrow costs would increase. There are several other risk areas that should be mentioned as they could have relatively large impacts on cost: Ground Survey not completed, Lands acquisition, Coordination with railroad, as well as limited boring data completed. The current project survey is based on LIDAR data and is subject to nominal variations in elevations. Over the entire levee system this small inaccuracy could result in significant quantity variations in fill required. Lands acquisition could also pose issues with valuable farmland and disputes over values, access, and easements. Coordination with railroads historically has been problematic as they generally want to self perform work on their lines. This requires significant coordination between USACE the construction contractor and the railroad. It is recommended that coordination be conducted as soon as possible to minimize future issues. The design depth of the levee is based on a small number of actual borings. Actual conditions encountered could result in a design depth change to tie the levee into impermeable soils.

The key **schedule drivers** identified are Funding Stream Risk, Cost Share Sponsor Change, and Coordination with the Railroad. These three items together contribute over 85% of the statistical schedule variance. Funding stream may cause the project to be broken up into several smaller projects, adding additional administration as well as contract costs. The Cost share sponsor most likely will shift from the local level to the state. This actually could be a benefit to the project schedule as the state generally has a better position to ability to coordinate and fund the project resulting in the project being able to move forward earlier. Coordination with the railroad has not yet started. Historically the railroads do not like to deal with coordination until the project is actually funded and scheduled. This could cause a delay in project completion due to coordination and scheduling of a railroad outage in the area.

Recommendations, as detailed within the main report, include the completion of further borings in the area to confirm the depth of tie-in required a survey to verify the LIDAR data, and to commence coordination with the railroad in order to mitigate later impacts. As the project progress, It is recommended that the PDT further the development of mitigation plans to reduce cost and schedule contingencies, conduct further iterative study of risks throughout the project life-cycle, potential mitigation throughout the remaining construction, and proactive monitoring and control of risk identified in this study.

Table ES-1. Construction Contract Estimate Cost Contingency Summary

Risk Analysis Forecast	Base Estimate ($K)	Total Contingency ($K)	Total Contingency (%)
50% Confidence Level			
NED	$20,548	$4,110	20%
LPP	$26,344	$4,742	18%
80% Confidence Level			
NED	$20,548	$4,932	24%
LPP	$26,344	$6,059	23%
100% Confidence Level			
NED	$20,548	$7,808	38%
LPP	$26,344	$9,484	36%

MAIN REPORT

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), Sacramento District, this report presents a recommendation for the total project cost and schedule contingencies for the Orestimba Creek Feasibility Report.

2.0 BACKGROUND

The project area is located to the North and West of Newman, CA. The project consists primarily of new levee construction, and a riprap protected berm on the downstream side of existing railroad tracks to the East of Hwy 33. Multiple road crossings and a railroad closure structure are required. There are multiple utility relocations for penetrations through the levee (irrigation facilities and drainage structures). The site is typically farmland or orchards and relatively flat, except at road crossings, where the road is typically several feet higher than the adjacent land. Most of the new levee is very near to an existing irrigation canal but the canal needs to remain in-service throughout the period of construction. The schedule was developed anticipating that demolition, site clearing, and most utility relocations would be performed first, and done in late winter or very early spring so that impacts to the farming production capability will be minimal. The basic schedule and assumptions for each project are the same with the assumption that the contractor for the LPP would increase the equipment onsite in order to maintain the same schedule for each.

3.0 REPORT SCOPE

The scope of this report is to calculate cost estimate contingencies using the risk analysis process, as required by USACE. The report presents the results as a comparison of total project cost, including contingencies and escalation. The study and presentation excludes consideration for operation and maintenance or life cycle costs.

3.1 Project Scope

The process included a risk analysis meeting for of the PDT for risk identification and the development of the risk register. The analysis process evaluated the base case Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule, and funding profiles using Crystal Ball software to conduct a Monte Carlo simulation and statistical sensitivity analysis, per cost regulation requirements (ER 1110-1-1300 and ER 1110-2-1302) and the guidance in Engineer Technical Letter (ETL)

CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project plans, specifications, estimates and schedules developed by Sacramento District serve as the basis for the risk analysis.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering TCX. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering TCX.

- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Cost Engineering TCX provided a PDT member to develop the risk model, also relying on the project manager and PDT staff to further augment expertise and information gathering.

The Cost Engineering Team facilitated a risk identification and qualitative analysis meeting with the PDT on 5 January 2012. The risk identification and qualitative analysis process did result in some revisions to the estimate and schedule. The estimates were also undergoing an ATR type cost review simultaneously. A draft risk register was forwarded for review by the PDT team after the meeting and a preliminary model of the risk analysis was developed. The estimate and schedule were completed on 16 March. The risk analysis was updated after adjusting for the updated estimate and schedule..

The risk analysis process used is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence. A parallel process was also used to determined the probability of various project schedule duration outcomes and quantify the required schedule contingency (float) needed in the schedule to achieve any desired level of schedule confidence.

In simple terms, contingency is an amount added to an estimate (cost or schedule) to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Engineering TCX guidance for cost and schedule risk analysis generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. The P80 confidence level is the standard normally provided to Congress by USACE and other agencies.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. The cost estimates were developed in an MII 3.0 (MCACES) format, and information was extracted into Microsoft Excel for cost risk analysis purposes. The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project, or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT was obtained using creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable and was considered.

A PDT meeting was held at the Sacramento District office for the purposes of identifying and assessing risk factors. The meeting (conducted Feb 16, 2011) included numerous members of the Product Delivery Team.

The meeting focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. The meeting also included risk factor assessment and quantification.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors

- Affected cost estimate and schedule elements

The resulting product from the PDT discussions was captured within a risk register as presented in Section 6 for. Note that the risk register records the PDT's risk concerns, discussions related to those concerns and potential impacts to the current cost and or schedule estimates.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency was analyzed using the Crystal Ball software as an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations were performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Cost variances were calculated by estimating the risks probable effects to the construction cost estimate. Contingencies were calculated by applying probability of cost variance, and by risk of occurrence. Each resultant risk is summed to determine the total cost risk for the project. The contingency is calculated as the difference between the sum of the risks and the base cost estimate.

For schedule contingency analysis, the potential delays for moderate and high impact schedule risks are modeled with the same likelihood of occurrences for the cost risk. . Risk impacts were modeled in the primavera scheduling software by imposing the estimated effect and running the schedule. The resultant schedule effect is entered into the crystal ball model as the potential schedule variance. The sum of the models schedule variances models is the resultant schedule risk. The contingency for schedule is calculated as the difference between the sum of the risks and the base cost estimate.

5.0 KEY ASSUMPTIONS

Key assumptions are those that are most likely to affect significantly the determinations and/or estimates of risk presented in the risk analysis. The key assumptions are important to help ensure that project leadership and other decision makers understand the steps, logic, limitations, and decisions made in the risk analysis, as well as any resultant limitations on the use of outcomes and results.

The Cost Engineering Team has identified the following key assumptions for the risk analysis:

1. Level of Design: The cost comparisons and risk analyses performed and reflected within this report are based upon design scope and estimates that are at feasibility level of design and dated 2009.

2. Design Scope: Scope of the project is well defined however some areas have had very little design development. Details of the design required the estimator to make assumptions to a reasonable course of action and resultant cost.

3. Operation and Maintenance: Operation and maintenance activities are not included in the cost estimate or schedules. Therefore, a full lifecycle risk analysis was not performed. It is assumed that the results or conclusions of the inclusion of Operations and Maintenance activities would not result in significantly different conclusions for the construction acquisition.

4. Contract Acquisition Strategy: It is assumed that the acquisition will be conducted through a typical full and open competition bidding process. Any changes in this could result in different acquisition risks and outcomes.

5. Confidence Levels: The Cost Engineering TCX guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk adverse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to completely capture actual project costs.

6. Impacts Studied: Moderate and High impacts, as identified in the risk meeting and entered into the risk register, were considered for the purposes of calculating cost contingency. Moderate and high level risk impacts were only applied to critical path and near critical path schedule tasks for the purposes of calculating schedule contingency. Low and moderate level risk impacts may need further study and should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk “watch list” for further monitoring and evaluation.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The risk register reflects the results of risk factor identification and assessment, risk factor quantification, and contingency analysis. The actual risk registers for each structure are provided in Appendix A. The risk registers in include all identified risks, as well as additional information regarding the specific nature and impacts of each risk. Table 3 includes a draft risk summary and mitigation recommendations for consideration in reducing project cost and schedule duration as well as risks.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project lifecycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting risk analysis feedback and project control input.
- Identifying risk transfer, elimination or mitigation actions required for implementation of risk management plans.

No mathematical correlations between individual risks were established. Schedule risk and cost lists utilized the same probability of occurrence models linking the results together. All modeled schedule risks are assigned cost values within the cost model, however, not all cost risks have associated schedule risks.

6.2 Cost Contingency and Sensitivity Analysis

Table 1 provides the various construction cost contingencies calculated for the P50, P80, and P100 confidence levels are shown for both the NED and LPP.

Table 1. Construction Contract Estimate Contingency Summary

Risk Analysis Forecast	Base Estimate ($K)	Total Contingency ($K)	Total Contingency (%)
50% Confidence Level			
NED	$20,548	$4,110	20%
LPP	$26,344	$4,742	18%
80% Confidence Level			
NED	$20,548	$4,932	24%
LPP	$26,344	$6,059	23%
100% Confidence Level			
NED	$20,548	$7,808	38%
LPP	$26,344	$9,484	36%

6.2.1 Sensitivity Analysis

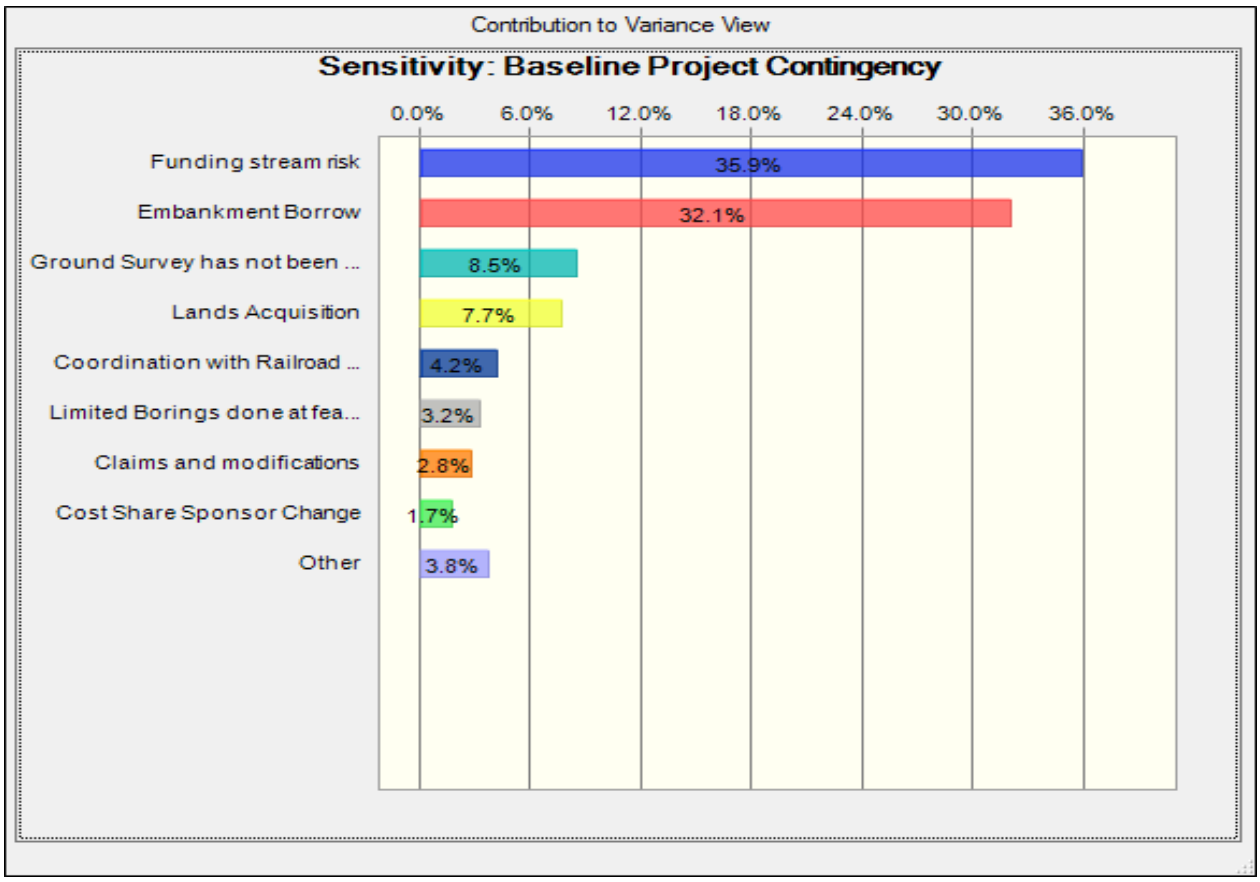
Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to total project cost. Because of the similarity of the two risk registers, the results from each are essentially the same. Below in Figure 1 is the cost sensitivity chart for the NED alternative.

Figure 1



6.3 Schedule Risk Analysis

Table 2 provides the schedule duration contingencies calculated for the P50, P80, and P100 confidence levels. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes. The Schedule duration contingency was quantified as approximately 16 months based on the P80 level of confidence. The schedule contingencies were calculated by applying the moderate and high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks. A schedule risk model was developed separately for each project; however, the resultant schedule risk for both the alternatives is essentially the same

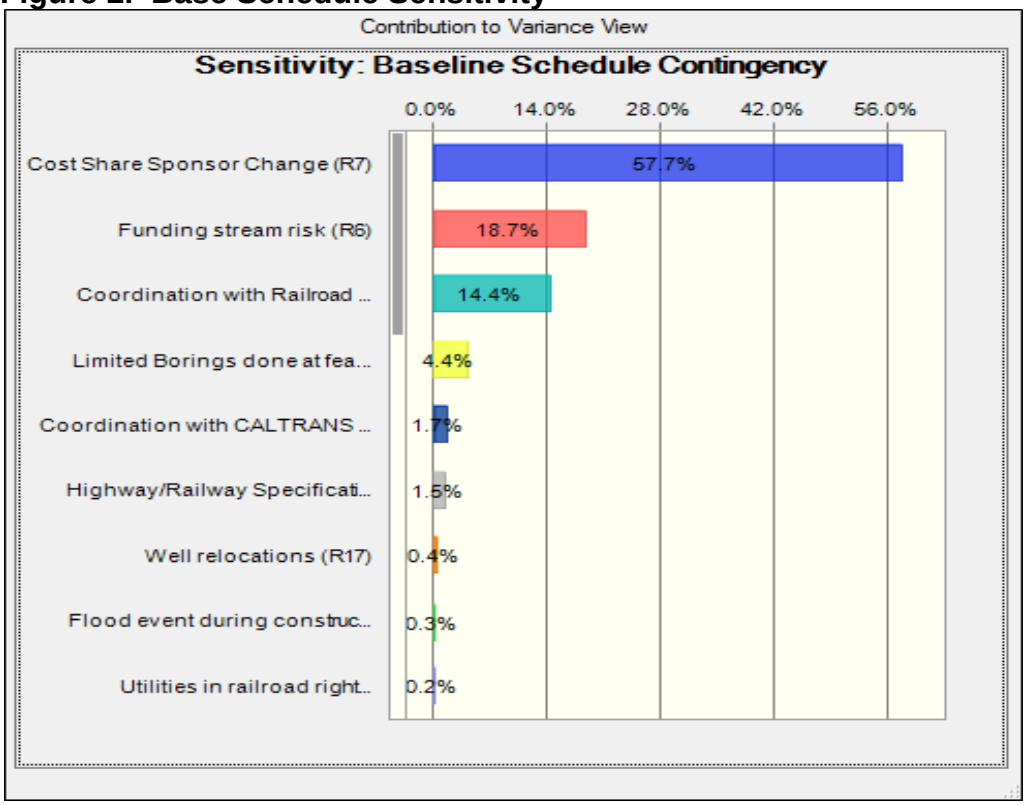
Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Months	Months	Total Contingency (%)
50% Confidence Level			
NED	40	51	28%

80% Confidence Level			
NED	40	57	39%
100% Confidence Level			
NED	40	72	79%

Figure 2 below shows the schedule sensitivity for NED plan. (LPP similar)

Figure 2. Base Schedule Sensitivity



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also

reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Major findings and observations of the project and risk analysis are listed below:

The key cost risk drivers identified through sensitivity analysis are Funding Stream risk and Embankment Borrow Source which together are nearly 70% of the statistical cost variance. The funding stream may impact the project by causing the current one contract approach to be change to acquisition through multiple smaller contract. The borrow source for the project is relatively well defined, however, there is considerable concern that by the time the project is executed it may not be able to provide fill at low/no cost and that haul and or borrow costs would increase. There are several other risk areas that should be mentioned as they could have relatively large impacts on cost: Ground Survey not completed, Lands acquisition, Coordination with railroad, as well as limited boring data completed. The current project survey is based on LIDAR data and is subject to nominal variations in elevations. Over the entire levee system this small inaccuracy could result in significant quantity variations in fill required. Lands acquisition could also pose issues with valuable farmland and disputes over values, access, and easements. Coordination with railroads historically has been problematic as they generally want to self perform work on their lines. This requires significant coordination between USACE the construction contractor and the railroad.

Key schedule drivers identified are Funding Stream Risk, Cost Share Sponsor Change, and Coordination with the Railroad. These three items together contribute over 85% of the statistical schedule variance. Funding stream may cause the project to be delayed and or broken up into several smaller projects, adding additional administration as well as contract costs. The Cost share sponsor most likely will shift from the local level to the state. This actually could be a benefit to the project schedule as the state generally has a better position to ability to coordinate and fund the project resulting in the project being able to move forward earlier. Coordination with the railroad has not yet started. Historically the railroads do not like to deal with coordination until the project is actually funded and scheduled. This could cause a delay in project completion due to coordination and scheduling of a railroad outage in the area.

7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project."

Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all-inclusive.

Key Risk Drivers:

1. Cost Risk: The key cost risk drivers are funding stream risk and Embankment Borrow source. The funding stream risk is an area that is beyond the PDT's scope of influence. However, the borrow source as well as several of the lower impact risk items are within the teams influence. It is recommended that coordination with the sponsor for additional borrow sources be investigated as well as verification of survey data and additional investigative borings be done.

2. Schedule Risk: Key schedule drivers identified are Funding Stream Risk, Cost Share Sponsor Change, and Coordination with the Railroad. Both the funding stream and the sponsor change are beyond the scope of the project delivery teams influence. Early coordination with the Railroad may be problematic at best. As the project progress from authorization to funding. This coordination will be critical to the project schedule and should be maintained on a risk watch list.

3. Risk Management: Cost Engineering TCX recommends use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings. As an example, recommended uses of the risk register include:

    - Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.

    - Providing project sponsors, stakeholders and leadership/management with a documented framework from which risk status can be reported in the context of project controls.

    - Communicating risk management issues.

- Providing a mechanism for eliciting risk analysis feedback and project control input.

- Identifying risk transfer, elimination or mitigation actions required for implementation of risk management plans.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

Appendix 1

Orestimba Creek NED Plan CSRA

Oristemba Creek NED Risk Register

Risk Level

Likelihood of Occurrence	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost			Project Schedule			Responsibility/POC
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*	
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)										
	PROJECT & PROGRAM MGMT									
PPM-1	Funding stream risk	Level of annual funding could cause project to be split up into smaller contract.	Some uncertainty of funding could cause project to be split up into smaller contracts. Current estimated annual burn rate of ~12M/year could cause projects to go SBA or have project split up.	Likely	Marginal	MODERATE	Likely	Critical	HIGH	District Management
PPM-2	Work windows	No specific work window currently identified	It is assumed that there are no specific construction windows required. Work should be able to be conducted during irrigation season but will require temporary pumping.	Unlikely	Negligible	LOW	Unlikely	Marginal	LOW	Environmental
PPM-3	Cost Share Sponsor Change	Current Sponsor may change from County to State	State lead times can be lengthy. State can be easier to work with than the county. This could mitigate funding issues.	Very Likely	Marginal	MODERATE	Very Unlikely	Marginal	LOW	Project Manager
PPM-4	LPP- Newman Wasteway	Does LPP plan include adequate costs to ensure the existing local levee is adequate to meet the LPP goal.	Future evaluation of the LPP system relative to FEMA standards would need to include an evaluation of the Newman wasteway levee and its reliability. This most likely would not effect the federal cost but could impact the sponsors cost.	Very Unlikely	Marginal	LOW	Very Unlikely	Marginal	LOW	Project Sponsor(s)
PPM-5	Coordination with Railroad	Flood control project will intersect railroad right of way. Will require coordination.	PDT has had minimal contact with railroad. Railroad generally not easy to work with at early design stages. Issue is their structure not necessarily designed as a flood control structure and will require some modification to be integrated into the flood control project. Significant coordination will be required with railroad.	Very Likely	Marginal	MODERATE	Very Likely	Significant	HIGH	Project Manager
PPM-6	Coordination with CALTRANS	Coordination with CALTRANS will be required for road raises	Not thought to be significant issue.	Very Likely	Negligible	LOW	Very Likely	Marginal	MODERATE	
PPM-7	CCID board may resist approving project	CCID buy in and approval of the project will be required at future PPA updates.	Future maintenance of irrigation systems that pass thru the federal levee system will require coordination with USACE and most likely will have a higher standards -most likely more oversight and coordination will be required at a minimum. This may meet with some opposition by affected farmers or the board.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Project Manager
	CONTRACT ACQUISITION RISKS									
CA-1	Certifications and Documentation	Timely completion of documentation, easements, approvals, etc could delay advertisement and or contract award	Mainly could cause schedule delay prior to awarding contract after completion of feasibility phase.	Unlikely	Negligible	LOW	Unlikely	Marginal	LOW	Project Manager
CA-2	Solicitation Type	Will contracts be awarded as best value, IFB, LPTA?	Currently assumed as IFB large business. Most likely will not require elaborate SSP and or solicitation.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	TASB
CA-3	Highway/Railway Specification issues	Coordination with Caltrans and RR will be required to ensure all agencies specifications and or contract requirements are met	Designs may be required to be done to other agencies specifications and may require coordination and or contracting with other agencies will be required.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Project Manager
	TECHNICAL RISKS									

TL-1	Interior Drainage area between levee and structures	Strip of land between levee and roads may hold water	Culverts and or pumps may need to be placed to parallel to levee eliminate water pooling between culvert and new levee system.	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW	Geotechnical/Civil Design
TL-2	Ground Survey has not been completed	Risk of quantities being inaccurate due to lack of survey	LIDAR data used to develop elevations and quantities for fill. Data could be plus or minus .3ft effecting overall quantities of fill.	Very Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW	Geotechnical/Civil Design
TL-3	Railroad crossing under seepage.	May need seepage control under tracks at intersection of tracks and levee	May need slurry wall under short section of tracks. Train runs once a day so some disruption will be required if tracks need to be displaced temporarily. Recommendation is to demo tracks, build levee thru railroad line then build railroad back over levee. Will need some reformulation of estimate. This may require an inspection trench also.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW	Hydrology/Hydraulic Design
TL-4	Highway 33 raise	Highway 33 will need to be raised. Coordination will be required with CALTRANS.	Raise required- height varies with option- may be utilities involved with highway. There may some difference in CALTRANS specifications from the current design.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW	Geotechnical/Civil Design
TL-5	Stuhr Road Culvert	Design may need some revision	Estimate based on estimators judgment. May need some revision. Current outlet appears to be a 36" diameter but there is some uncertainty as to what size is required.	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW	Hydrology/Hydraulic Design
TL-6	Well relocations	Wells will need to be flood proofed.	11 Well pumps near the toe of the new levee. There is some uncertainty as how to deal with these- These could cause the alignment to change or the wells or may need to be raised. - Add wellhead raise to the estimate.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW	Hydrology/Hydraulic Design
TL-7	Expletory trench	Current exploratory trench is 4' deep 6' is required	May need waiver? Recommend changing estimate to 6'	Very Likely	Negligible	LOW	Very Likely	Negligible	LOW	
TL-8	Limited Borings done at feasibility	Minimal borings were done at feasibility	Borings done on the west side of the canal. Current plan has alignment on the east side of canal. This could effect construction of seepage berms. Need costs of borings added to estimate and need to evaluate risk of poor soils. Currently 25% needs berm could be as high as 50%.	Very likely	Marginal	MODERATE	Very Likely	Marginal		
	LANDS AND DAMAGES RISKS									
LD-1	Lands Acquisition	100ft easement owned by irrigation district around canal, however, the flood control project will require acquisition of small pieces of many properties along the alignment.	It is believed that the affected farmers will be cooperative. Some additional lands beyond the existing easement will be required for both construction as well as incorporation into the final project footprint.	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE	Real Estate
LD-2	Building/Residence Removal	At least 4 residences located adjacent to new system	Some more analysis may need to be done as to requirements for them being removed. - May reduce demolition costs in estimate?	Very Likely	Negligible	LOW	Unlikely	Negligible	LOW	Real Estate
LD-3	Utilities in railroad right of way	Utilities supposedly abandoned- natural gas line may be active. Utility survey not completed.	Abandoned oil pipeline in right of way HTRW concern of disturbing pipeline and finding something as well as likelihood of unknown utilities. May need to revise estimate and add some hand digging	Very Likely	Significant	HIGH	Very Likely	Marginal	MODERATE	Real Estate
LD-4	Road crossings may have unknown utilities that may need to be moved or worked around.	Utility survey is incomplete.	There may be utilities that may need relocation at road intersections.	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW	Geotechnical/Civil Design
	REGULATORY AND ENVIRONMENTAL RISKS									
RE-1	Loss of farmland due to construction	Mitigation may be required for elimination of prime farmland (in excess of 50 acres)	Environmental has not been able to contact state about costs/recommendation for loss of farmland. Could require purchase of land to offset loss on state side. There may be some resolution to this already? Josh Garcia?	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW	Environmental
RE-2	Air quality	Low likelihood of exceeding NOX emissions	If emissions are exceeded, project may need to be phased out over 2 years or more years.	Very Unlikely	Marginal	LOW	Very Unlikely	Significant	LOW	Environmental
RE-3	Endangered Species	Raptors, Kitfox, and Swenson's Hawks may be in the area	March timeframe is beginning of nesting season. Orchard areas are probably of higher concern. 1/2 mile standoff required.	Very Unlikely	Significant	LOW	Very Unlikely	Critical	LOW	Environmental
RE-4	LPP performance risk	LPP criteria may end up being more restrictive	LPP plan could require some rework due to more stringent requirements due to the definition of product performance. I.e. 200year flood plus 3 feet. This could require "exacting" height restrictions vice more of a probabilistic approach.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Technical Lead
RE-6	Future development	City of Newman wants to build recreational trail on top of new levee	It is not anticipated that this will cause issues at this time	Very Likely	Negligible	LOW	Very Likely	Negligible	LOW	Project Manager

	CONSTRUCTION RISKS									
CON-1	Flood event during construction	Flooding could impact construction.	Flooding would have to top CCID canal. Areas near the railroad may be an issue but overall this appears to be low risk	Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE	Project Manager
CON-2	Claims and modifications	Standard risk assumed	Typical contract modifications and claims can run from 3-7% of construction cost	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Construction
CON-3	Hazmat/HTRW	Potential to discover small dump sites that may contain hazmat.	Typical risk of encountering small dumps containing waste, debris, etc around farmland.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Construction
CON-4	Cultural Resources	Some risk of encountering cultural resources sites in farmland	Typical risk of encountering cultural resource items. Initial survey of structures does not indicate that there are any significant structures involved.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Construction
CON-5	Abandoned oil pipeline	There is an abandoned oil pipeline in the RR right of way	This pipeline may have leaked or may still contain small amounts of petrochemicals that may need remediation.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Environmental
	ESTIMATE AND SCHEDULE RISKS									
EST-1	Irrigation	Irrigation may be interrupted by construction	Timing of work may effect irrigation, Sand filters may need replaced. May need to provide temporary irrigation pumping. Work may need to be scheduled and outside of growing season and may need added into estimate. It is assumed tha irrigation season starts in Mar. This needs verification.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW	Project Manager
EST-2	SWPP Estimate	Design by Estimator	May need revisions but estimators feel pricing is conservative. Monitoring costs may need to be added to ensure water quality is maintained during storms and construction.	Very Likely	Negligible	LOW	Very Likely	Negligible	LOW	Environmental
EST-3	Demo of houses	Estimate revised	There may be an opportunity to reduce costs if houses can be moved or left in place. Estimate was revised and this risk is not considered significant	Likely	Marginal	MODERATE	Likely	Negligible	LOW	Cost Engineering
EST-4	Embankment Borrow	Assumed from Fink landfill	Fill assumed provided at no cost in estimate- By the time project is built, there is some risk that the fill may not be available and will have to be purchased. Fill may need to be mixed. There is an alternate source closer but haul decrease and fill purchase offset so no cost change.	Very Likely	Critical	HIGH	Likely	Negligible	LOW	Cost Engineering
EST-5	Rock Riprap Qty	Quantity could be reduced from current P&S	May be an opportunity to reduce costs Not a significant cost	Likely	Negligible	LOW	Likely	Negligible	LOW	Cost Engineering
EST-6	Stoplog Storage Area	Not currently in P&S	75k allowance for storage structure in estimate. Gated structure may be a better option. Project may need to include means of handling stoplogs or potentially a change in design to gated structures.	Very Likely	Significant	HIGH	Very Likely	Negligible	LOW	Hydrology/Hydraulic Design
EST-7	Access road ramps	Access road ramps gates not included in current quantities	Added to estimate.	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE	Geotechnical/Civil Design
	Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)									
PR-1	Program Priority	Project is currently not "critical" and most likely will have to compete against higher priority projects for funding.	Not studied as this would stop the project.			0			0	District Management

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

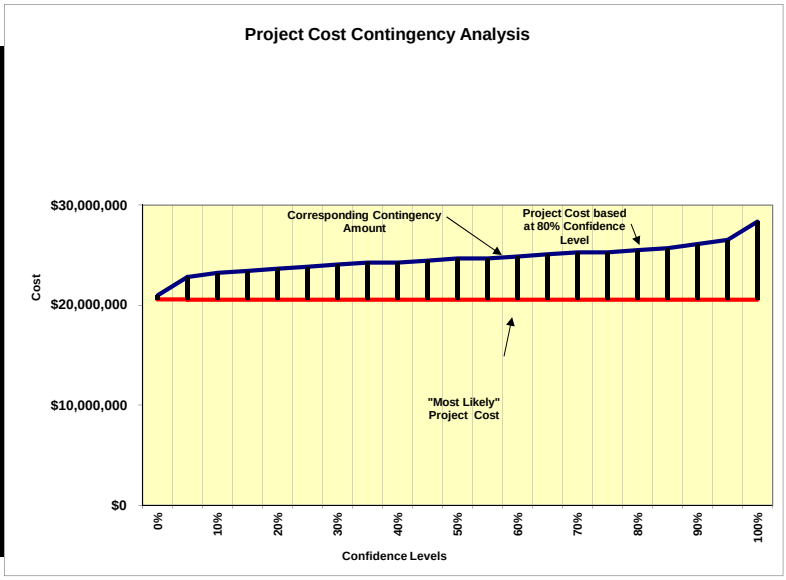
Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost(MCACES) ->	**$20,548,000**
Baseline Estimate Cost Contingency Amount ->	$4,931,520
Baseline Estimate Construction Cost (80% Confidence) ->	**$25,479,520**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration(Deterministic Date) ->	**40.0 Months**
Schedule Contingency Duration ->	15.7 Months
Project Schedule Duration (80% Confidence) ->	**55.7 Months**

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

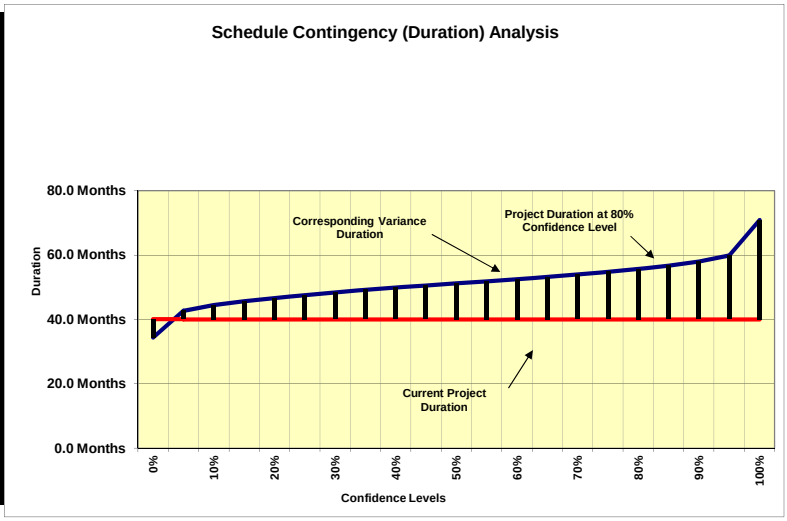
Baseline Construction Cost Estimate	$20,548,000	
Confidence Level	**Value**	**Contingency**
0%	$20,958,960	2%
5%	$22,808,280	11%
10%	$23,219,240	13%
15%	$23,424,720	14%
20%	$23,630,200	15%
25%	$23,835,680	16%
30%	$24,041,160	17%
35%	$24,246,640	18%
40%	$24,246,640	18%
45%	$24,452,120	19%
50%	$24,657,600	20%
55%	$24,657,600	20%
60%	$24,863,080	21%
65%	$25,068,560	22%
70%	$25,274,040	23%
75%	$25,274,040	23%
80%	**$25,479,520**	**24%**
85%	$25,685,000	25%
90%	$26,095,960	27%
95%	$26,506,920	29%
100%	$28,356,240	38%



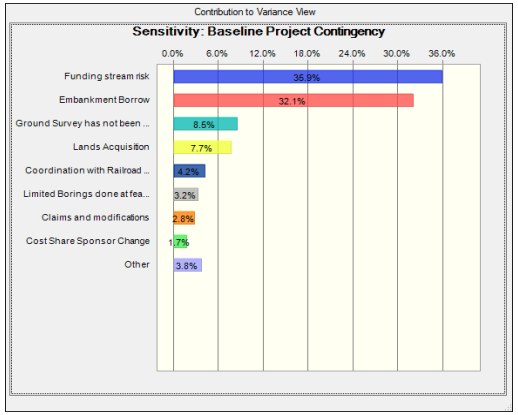
- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

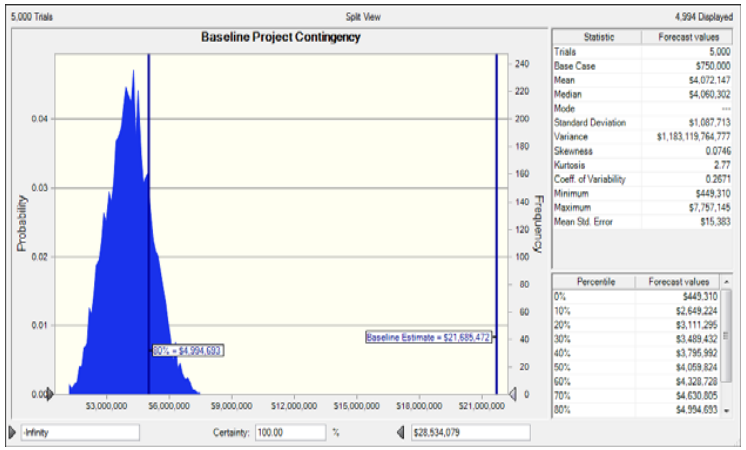
Contingency Analysis

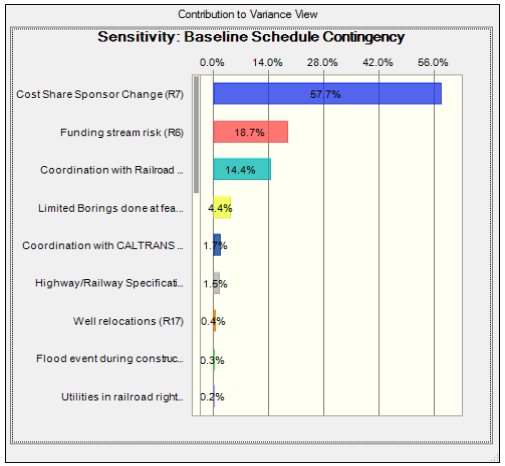
Base Schedule Duration	40.0 Months	
Confidence Level	**Value**	**Contingency**
0%	34.4 Months	-14.08%
5%	42.7 Months	6.72%
10%	44.4 Months	11.06%
15%	45.7 Months	14.16%
20%	46.7 Months	16.66%
25%	47.6 Months	18.95%
30%	48.4 Months	20.96%
35%	49.2 Months	23.04%
40%	49.9 Months	24.69%
45%	50.5 Months	26.33%
50%	51.2 Months	28.07%
55%	51.8 Months	29.60%
60%	52.5 Months	31.22%
65%	53.2 Months	32.98%
70%	53.9 Months	34.67%
75%	54.8 Months	36.90%
80%	**55.7 Months**	**39.20%**
85%	56.7 Months	41.75%
90%	58.0 Months	44.97%
95%	59.9 Months	49.66%
100%	70.8 Months	77.10%

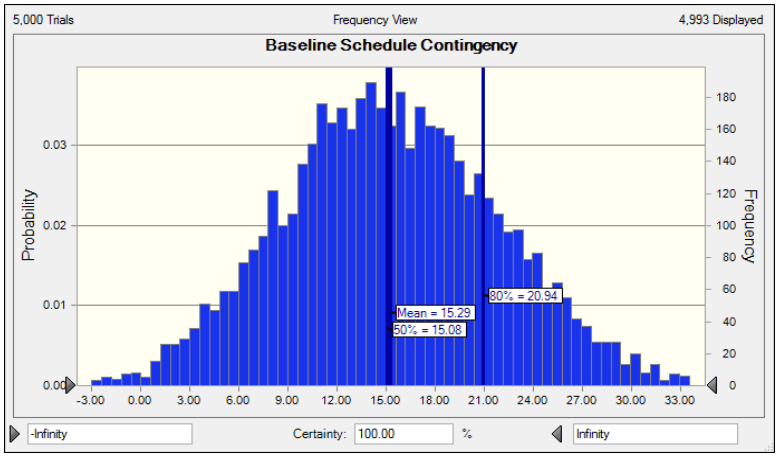


Oristmeba NED Plan









Orestimba NED CSRA Model

Risk No.	Risk/Opportunity Event	Shape	Probability	Project Cost: Likelihood*	Project Cost: Impact*	Project Cost: Risk Level*	Crystal Ball Simulation: Low	Crystal Ball Simulation: Most Likely	Crystal Ball Simulation: High	Cost Risk	Project Schedule: Likelihood*	Project Schedule: Impact*	Project Schedule: Risk Level*	Crystal Ball Simulation: Low	Crystal Ball Simulation: Most Likely	Crystal Ball Simulation: High	Schedule Risk
PROJECT & PROGRAM MGMT																	
PPM-1	Funding stream risk	Triangular	1	Likely	Marginal	MODERATE	$0	$0	$2,842,800	0	Likely	Critical	HIGH	0	0	12	0
PPM-3	Cost Share Sponsor Change	Triangular	1	Very Likely	Marginal	MODERATE	($568,560)	$0	$0	0	Very Unlikely	Marginal	LOW	-12	0	0	0
PPM-5	Coordination with Railroad for crossing	Triangular	1	Very Likely	Marginal	MODERATE	$0	$342,140	$1,202,840	0	Very Likely	Significant	HIGH	0	2	12	0
PPM-6	Coordination with CALTRANS	Triangular	1	Very Likely	Negligible	LOW	$0	$0	$284,280	0	Very Likely	Marginal	MODERATE	0	0	4	0
CONTRACT ACQUISITION RISKS																	
CA-3	Highway/Railway Specification/Jurisdiction issues	Triangular	1	Likely	Marginal	MODERATE	$0	$0	$213,210	0	Likely	Marginal	MODERATE	0	0	3	0
TECHNICAL RISKS																	
TL-2	Ground Survey has not been completed	Triangular	1	Very Likely	Marginal	MODERATE	($800,000)	$0	$800,000	0	Very Unlikely	Negligible	LOW	0	0	0	0
TL-3	Railroad crossing under seepage.	Triangular	1	Very Likely	Marginal	MODERATE	$0	$200,000	$350,000	0	Very Likely	Negligible	LOW	0	0	0	0
TL-4	Highway 33 raise	Triangular	1	Very Likely	Marginal	MODERATE	$0	$0	$200,000	0	Very Likely	Negligible	LOW	0	0	1	0
TL-5	Stuhr Road Culvert	Triangular	1	Likely	Marginal	MODERATE	$0	$0	$115,000	0	Unlikely	Negligible	LOW	0	0	0	0
TL-6	Well relocations	Triangular	1	Very Likely	Marginal	MODERATE	($250,000)	$0	$50,000	0	Very Likely	Negligible	LOW	0	0	2	0
TL-8	Limited Borings done at feasibility could cause a design change	Triangular	1	Very likely	Marginal	MODERATE	$0	$0	$900,720	0	Very Likely	Marginal	MODERATE	0	0	6	0
LANDS AND DAMAGES RISKS																	
LD-1	Lands Acquisition	Triangular	1	Very Likely	Marginal	MODERATE	$0	$0	$1,250,000	0	Very Likely	Marginal	MODERATE	0	0	0	0
LD-3	Utilities in railroad right of way	Triangular	1	Very Likely	Significant	HIGH	$0	$0	$344,760	0	Very Likely	Marginal	MODERATE	0	0	2	0
CONSTRUCTION RISKS																	
CON-1	Flood event during construction	Triangular	1	Unlikely	Marginal	LOW	$0	$0	$200,000	0	Unlikely	Significant	MODERATE	0	0	1	0
CON-2	Claims and modifications	Triangular	1	Likely	Marginal	MODERATE	$0	$410,960	$1,027,400	0	Likely	Marginal	MODERATE	0	0	0	0
CON-3	Hazmat/HTRW	Triangular	1	Likely	Marginal	MODERATE	$0	$0	$147,380	0	Likely	Marginal	MODERATE	0	0	1	0
ESTIMATE AND SCHEDULE RISKS																	
EST-1	Irrigation	Triangular	1	Very Likely	Marginal	MODERATE	$0	$120,000	$240,000	0	Very Likely	Negligible	LOW				
EST-4	Embankment Borrow	yes/no	0.6	Very Likely	Critical	HIGH	$0	$0	$1,250,000	750000	Likely	Negligible	LOW				
EST-6	Stoplog Storage Area	Triangular	1	Very Likely	Marginal	MODERATE	$0	$100,000	$200,000	0	Very Likely	Negligible	LOW				
								$750,000		$20,548,000						40	0

Estimate $20,548,000
Rom TPC $28,428,000

ROUNDED PROJECT CONTINGENCY BASELINE COST ESTIMATE	Percentile	Baseline	Contingency	Baseline w/	Contingency %
	0%	$20,548,000	$410,960	$20,958,960	2%
	5%	$20,548,000	$2,260,280	$22,808,280	11%
	10%	$20,548,000	$2,671,240	$23,219,240	13%
	15%	$20,548,000	$2,876,720	$23,424,720	14%
	20%	$20,548,000	$3,082,200	$23,630,200	15%
	25%	$20,548,000	$3,287,680	$23,835,680	16%
	30%	$20,548,000	$3,493,160	$24,041,160	17%
	35%	$20,548,000	$3,698,640	$24,246,640	18%
	40%	$20,548,000	$3,698,640	$24,246,640	18%
	45%	$20,548,000	$3,904,120	$24,452,120	19%
	50%	$20,548,000	$4,109,600	$24,657,600	20%
	55%	$20,548,000	$4,109,600	$24,657,600	20%
	60%	$20,548,000	$4,315,080	$24,863,080	21%
	65%	$20,548,000	$4,520,560	$25,068,560	22%
	70%	$20,548,000	$4,726,040	$25,274,040	23%
	75%	$20,548,000	$4,726,040	$25,274,040	23%
	80%	$20,548,000	$4,931,520	$25,479,520	24%
	85%	$20,548,000	$5,137,000	$25,685,000	25%
	90%	$20,548,000	$5,547,960	$26,095,960	27%
	95%	$20,548,000	$5,958,920	$26,506,920	29%
	100%	$20,548,000	$7,808,240	$28,356,240	38%

PROJECT CONTINGENCY BASELINE SCHEDULE	Percentile	Baseline	Contingency	Baseline w/	Continge
	0%	40.0 Months	-5.6 Months	34.4 Months	-14.08%
	5%	40.0 Months	2.7 Months	42.7 Months	6.72%
	10%	40.0 Months	4.4 Months	44.4 Months	11.06%
	15%	40.0 Months	5.7 Months	45.7 Months	14.16%
	20%	40.0 Months	6.7 Months	46.7 Months	16.66%
	25%	40.0 Months	7.6 Months	47.6 Months	18.95%
	30%	40.0 Months	8.4 Months	48.4 Months	20.96%
	35%	40.0 Months	9.2 Months	49.2 Months	23.04%
	40%	40.0 Months	9.9 Months	49.9 Months	24.69%
	45%	40.0 Months	10.5 Months	50.5 Months	26.33%
	50%	40.0 Months	11.2 Months	51.2 Months	28.07%
	55%	40.0 Months	11.8 Months	51.8 Months	29.60%
	60%	40.0 Months	12.5 Months	52.5 Months	31.22%
	65%	40.0 Months	13.2 Months	53.2 Months	32.98%
	70%	40.0 Months	13.9 Months	53.9 Months	34.67%
	75%	40.0 Months	14.8 Months	54.8 Months	36.90%
	80%	40.0 Months	15.7 Months	55.7 Months	39.20%
	85%	40.0 Months	16.7 Months	56.7 Months	41.75%
	90%	40.0 Months	18.0 Months	58.0 Months	44.97%
	95%	40.0 Months	19.9 Months	59.9 Months	49.66%
	100%	40.0 Months	30.8 Months	70.8 Months	77.10%

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
PPM-1	Funding stream risk	$0	$0	$2,842,800	0 mo	0 mo	12 mo
		[redacted]					

Notes: This item captures the risk that the funding stream will change. The funding stream could cause the project to be split up over two or more years and result in the project being split

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes the project is spread over 2 years and split into two contracts. Assume this would add 10% to the overall TPC.

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
PPM-3	Cost Share Sponsor Change	($568,560)	$0	$0	-12 mo	0 mo	0 mo
		[redacted]					

Notes: Most likely the cost share sponsor will change to be the state. This most likely would help the project as the state most likely is in a better position to fund the project.

Likely Likely assumes no change from the baseline estimate.

Low

Low- The state may be able to fund their portion sooner than the current sponsor advancing the project up to a year. Causing 1 year esc savings of approx 2%

High

High- No Changes to baseline estimate

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
PPM-5	Coordination with Railroad	$0	$342,140	$1,202,840	0 mo	2 mo	12 mo

Notes: This item captures the risk that coordination with the railroad could cause a delay. Coordination usually takes 12-18 months minimum. Usually the railroad does not like to

Likely Likely assumes that there will be 2 months additional time added to the critical path due to coordination with the railroad, as well as 200k in changes to the design

Low Low- No change to critical path of schedule due to coordination

High High assumes the delay could be as high as 12 months and the design could increase 350k

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
PPM-6	Coordination with CALTRANS	$0	$0	$284,280	0 mo	0 mo	4 mo

Notes: This item models the risk that coordination will CALTRANS will cause a delay to the project.

Likely Likely assumes no change from the baseline estimate.

Low

Low- No change to the estiamte or schedule.

High

High- Assumes no significant design changes but a 4 month delay to the project for coordination.

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
CA-3	Highway/Railway work	$0	$0	$213,210	0 mo	0 mo	3 mo
		[redacted]					

Notes: This item captures the risk that due to the project involving multiple agencies having different requirements that there may be additional reviews and coordination required prior

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes a 90 day delay for additional coordination and review

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-2	Ground Survey has not been completed	($800,000)	$0	$800,000	0 mo	0 mo	0 mo

Notes: This item captures the risk that since the quantities are based off of LIDAR vs. an actual survey that they could be 4-5 inches in error.

Likely Likely assumes no change from the baseline estimate.

Low

Low- If the area is higher than the survey approx 30000lcy could be reduced from the fill quantities saving approx 800k

High

If the area is low an extra 30000 lcy would be required or approx 800k

26.5 per yard
30000 approx qty
795000 rom cost

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-3	Railroad crossing under seepage.		$200,000	$350,000	0 mo	0 mo	0 mo

Notes:

Inspection trench is added to estimate still need 200k or so for seepage issues

Likely Most likely some sort of additional work will be requried to address seepage under the

Low

Costs in estimate are adequate to cover seepage issues at railroad crossing.

High

$350k will be required to fix railroad crossing seepage issues

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-4	Highway 33 raise	$0	$0	$200,000	0 mo	0 mo	1 mo

Notes: This item captures the risk that there may be additional costs in raising the highway either through changed specifications and or unknown utilities in the area

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes that the 50k in the estimate for fill for raising the highway could quadruple due to utilities and or additional quantities. Up to a 1 month schedule delay could occur

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-5	Stuhr Road Culvert	$0	$0	$115,000	0 mo	0 mo	

Notes: This item captures the risk that the estimators assumed culvert size may not be adequate to pass the required flow

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes that the 115k currently in the estimate for the culvert is not adequate and could double in cost. No schedule impact assumed.

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-6	Well relocations	($250,000)	$0	$50,000	0 mo	0 mo	2 mo
		[redacted]					

Notes: This item captures the risk that the 10 wells along the alignment may need work to be waterproofed and or moved. There are costs for replacing motors etc..

Likely Likely assumes estimate is adequate to cover the cost

Low

Low- assumes 50% less than estimated due to not replacing well pumps.

High

High assumes estimate wells need to be relocated at 50k plus estimate cost

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-8	Limited Borings done at feasibility	$0	$0	$900,720	0 mo	0 mo	6 mo

Notes: This item captures the risk that adequate borings may not have been completed and that the geotechnical conditions may be different.

Likely Likely assumes no change from the baseline estimate.

Low

Low assumes no change.

High

High assumes that the construction cost of the levee 3% due to additional measures due to geotechnical conditions. This could cause a 6 mo delay for redesign.

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
LD-1	Lands Acquisition	$0	$0	$1,250,000	0 mo	0 mo	0 mo

Notes: This is combined with RE-1 This assumes that either additional land for right of way may need to be procured and or additional lands need to be purchased to offset

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes an additional 50acers at 25000/acre may need to be purchased to offset the loss of farmland. This is not assumed to impact the critical path.

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
LD-3/4	Unknown utilities	$0	$0	$344,760	0 mo	0 mo	2 mo

Notes: This captures the risk that there are unknown utilities in the railroad right of way and or in the roadway.

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes that there are additional utilities that could require relocation costing up to 250k and 2 months delay

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
CON-1	Flood event during construction	$0	$0	$200,000	0 mo	0 mo	1 mo

Notes:

This item captures the risk that there could be a flood event during construction

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes that the contractor may have to demobilize, remobilize and perform some limited repairs. Assume 200k and 1 month delay

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
CON-2	Claims and modifications	$0	$410,960	$1,027,400	0 mo	0 mo	0 mo
		[redacted]					

Notes: This item captures the risk that claims and modifications can typically add 3-5% to a contract

Likely Likely assumes 2% of contract in claims

Low

Low- same as likely

High

High assumes 5% in claims

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
CON-3	HTRW	$0	$0	$147,380	0 mo	0 mo	1 mo

Notes: This item captures the risk that there may be HTRW encountered. Either small abandoned dumpsites or even leakage from the oil pipeline

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes that 100k is required to clean up HTRW encountered. 1 month delay assumed plus delay cost.

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
EST-1	Irrigation	$0	$120,000	$240,000	0 mo	0 mo	0 mo

Notes: Sand filters and temporary irrigation at major intersections are added into estimate. Small culverts may need temporary pumping. There are approximatly 24 small culverts that may

Likely Likely 12 of the culverts will need puping

Low

Low- no need pumping.

High

All 24 need pumping

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
EST-4	Embankment Borrow	$0	$0	$1,250,000	0 mo	0 mo	0 mo

Notes: There are two potential borrow sources available however it is not a guarantee that they will be able to supply all of the 250,000 yards

Likely Borrow can be had from existing sources with no additional cost

Low

Borrow can be had from existing sources at no additional costs

High Worst case is that only half of the material can be obtained from the two potential sources and that it will cost $5/yard over what is in the estimate to do the makeup. No schedule delay assumed

250000

Orestimba NED CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
EST-6	Stoplog Storage Area	$0	$100,000	$200,000	0 mo	0 mo	0 mo

Notes:

There is currently no provision for stoplog storage in the design

Likely Assume 100k for stoplog storage provision

Low

Sponsor will stow logs in some existing area at no cost

High

Assume 200k for stoplog storage

Appendix 2

Orestimba Creek LPP Plan CSRA

Oristemba LPP Plan Risk Register

Risk Level

Likelihood of Occurrence	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost			Project Schedule			Responsibility/POC
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*	
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)										
	PROJECT & PROGRAM MGMT									
PPM-1	Funding stream risk	Level of annual funding could cause project to be split up into smaller contract.	Some uncertainty of funding could cause project to be split up into smaller contracts. Current estimated annual burn rate of ~12M/year could cause projects to go SBA or have project split up.	Likely	Marginal	MODERATE	Likely	Critical	HIGH	District Management
PPM-2	Work windows	No specific work window currently identified	It is assumed that there are no specific construction windows required. Work should be able to be conducted during irrigation season but will require temporary pumping.	Unlikely	Negligible	LOW	Unlikely	Marginal	LOW	Environmental
PPM-3	Cost Share Sponsor Change	Current Sponsor may change from County to State	State lead times can be lengthy. State can be easier to work with than the county. This could mitigate funding issues.	Very Likely	Marginal	MODERATE	Very Unlikely	Marginal	LOW	Project Manager
PPM-4	LPP- Newman Wasteway	Does LPP plan include adequate costs to ensure the existing local levee is adequate to meet the LPP goal.	Future evaluation of the LPP system relative to FEMA standards would need to include an evaluation of the Newman wasteway levee and its reliability. This most likely would not effect the federal cost but could impact the sponsors cost.	Very Unlikely	Marginal	LOW	Very Unlikely	Marginal	LOW	Project Sponsor(s)
PPM-5	Coordination with Railroad	Flood control project will intersect railroad right of way. Will require coordination.	PDT has had minimal contact with railroad. Railroad generally not easy to work with at early design stages. Issue is their structure not necessarily designed as a flood control structure and will require some modification to be integrated into the flood control project. Significant coordination will be required with railroad.	Very Likely	Marginal	MODERATE	Very Likely	Significant	HIGH	Project Manager
PPM-6	Coordination with CALTRANS	Coordination with CALTRANS will be required for road raises	Not thought to be significant issue.	Very Likely	Negligible	LOW	Very Likely	Marginal	MODERATE	
PPM-7	CCID board may resist approving project	CCID buy in and approval of the project will be required at future PPA updates.	Future maintenance of irrigation systems that pass thru the federal levee system will require coordination with USACE and most likely will have a higher standards -most likely more oversight and coordination will be required at a minimum. This may meet with some opposition by affected farmers or the board.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Project Manager
	CONTRACT ACQUISITION RISKS									
CA-1	Certifications and Documentation	Timely completion of documentation, easements, approvals etc could delay advertisement and or contract award	Mainly could cause schedule delay prior to awarding contracts after completion of feasibility phase.	Unlikely	Negligible	LOW	Unlikely	Marginal	LOW	Project Manager
CA-2	Solicitation Type	Will contracts be awarded as best value, IFB, LPTA?	Currently assumed as IFB large business. Most likely will not require elaborate SSP and or solicitation.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	TASB

CA-3	Highway/Railway Specification issues	Coordination with Caltrans and RR will be required to ensure all agencies specifications and or contract requirements are met	Designs may be required to be done to other agencies specifications and may require coordination and or contracting with other agencies will be required.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Project Manager
	TECHNICAL RISKS									
TL-1	Interior Drainage area between levee and structures	Strip of land between levee and roads may hold water	Culverts and or pumps may need to be placed to parallel to levee eliminate water pooling between culvert and new levee system.	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW	Geotechnical/Civil Design
TL-2	Ground Survey has not been completed	Risk of quantities being inaccurate due to lack of survey	LIDAR data used to develop elevations and quantities for fill. Data could be plus or minus .3ft effecting overall quantities of fill.	Very Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW	Geotechnical/Civil Design
TL-3	Railroad crossing under seepage.	May need seepage control under tracks at intersection of tracks and levee	May need slurry wall under short section of tracks. Train runs once a day so some disruption will be required if tracks need to be displaced temporarily. Recommendation is to demo tracks, build levee thru railroad line then build railroad back over levee. Will need some reformulation of estimate. This may require an inspection trench also.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW	Hydrology/Hydraulic Design
TL-4	Highway 33 raise	Highway 33 will need to be raised. Coordination will be required with CALTRANS.	Raise required- height varies with option- may be utilities involved with highway. There may some difference in CALTRANS specifications from the current design.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW	Geotechnical/Civil Design
TL-5	Stuhr Road Culvert	Design may need some revision	Estimate based on estimators judgment. May need some revision. Current outlet appears to be a 36" diameter but there is some uncertainty as to what size is required.	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW	Hydrology/Hydraulic Design
TL-6	Well relocations	Wells will need to be flood proofed.	11 Well pumps near the toe of the new levee. There is some uncertainty as how to deal with these- These could cause the alignment to change or the wells or may need to be raised. - Add wellhead raise to the estimate.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW	Hydrology/Hydraulic Design
TL-7	Expletory trench	Current exploratory trench is 4' deep 6' is required	May need waiver? Recommend changing estimate to 6'	Very Likely	Negligible	LOW	Very Likely	Negligible	LOW	
TL-8	Limited Borings done at feasibility	Minimal borings were done at feasibility	Borings done on the west side of the canal. Current plan has alignment on the east side of canal. This could effect construction of seepage berms. Need costs of borings added to estimate and need to evaluate risk of poor soils. Currently 25% needs berm could be as high as 50%.	Very likely	Marginal	MODERATE	Very Likely	Marginal		
	LANDS AND DAMAGES RISKS									
LD-1	Lands Acquisition	100ft easement owned by irrigation district around canal, however, the flood control project will require acquisition of small pieces of many properties along the alignment.	It is believed that the affected farmers will be cooperative. Some additional lands beyond the existing easement will be required for both construction as well as incorporation into the final project footprint.	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE	Real Estate
LD-2	Building/Residence Removal	At least 4 residences located adjacent to new system	Some more analysis may need to be done as to requirements for them being removed. - May reduce demolition costs in estimate?	Very Likely	Negligible	LOW	Unlikely	Negligible	LOW	Real Estate
LD-3	Utilities in railroad right of way	Utilities supposedly abandoned- natural gas line may be active. Utility survey not completed.	Abandoned oil pipeline in right of way HTRW concern of disturbing pipeline and finding something as well as likelihood of unknown utilities. May need to revise estimate and add some hand digging	Very Likely	Significant	HIGH	Very Likely	Marginal	MODERATE	Real Estate
LD-4	Road crossings may have unknown utilities that may need to be moved or worked around.	Utility survey is incomplete.	There may be utilities that may need relocation at road intersections.	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW	Geotechnical/Civil Design
	REGULATORY AND ENVIRONMENTAL RISKS									
RE-1	Loss of farmland due to construction	Mitigation may be required for elimination of prime farmland (in excess of 50 acres)	Environmental has not been able to contact state about costs/recommendation for loss of farmland. Could require purchase of land to offset loss on state side. There may be some resolution to this already? Josh Garcia?	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW	Environmental
RE-2	Air quality	Low likelihood of exceeding NOX emissions	If emissions are exceeded, project may need to be phased out over 2 years or more years.	Very Unlikely	Marginal	LOW	Very Unlikely	Significant	LOW	Environmental
RE-3	Endangered Species	Raptors, Kitfox, and Swenson's Hawks may be in the area	March timeframe is beginning of nesting season. Orchard areas are probably of higher concern. 1/2 mile standoff required.	Very Unlikely	Significant	LOW	Very Unlikely	Critical	LOW	Environmental

RE-4	LPP performance risk	LPP criteria may end up being more restrictive	LPP plan could require some rework due to more stringent requirements due to the definition of product performance. I.e. 200year flood plus 3 feet. This could require "exacting" height restrictions vice more of a probabilistic approach.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Technical Lead
RE-6	Future development	City of Newman wants to build recreational trail on top of new levee	It is not anticipated that this will cause issues at this time	Very Likely	Negligible	LOW	Very Likely	Negligible	LOW	Project Manager
	CONSTRUCTION RISKS									
CON-1	Flood event during construction	Flooding could impact construction.	Flooding would have to top CCID canal. Areas near the railroad may be an issue but overall this appears to be low risk	Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE	Project Manager
CON-2	Claims and modifications	Standard risk assumed	Typical contract modifications and claims can run from 3-7% of construction cost	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Construction
CON-3	Hazmat/HTRW	Potential to discover small dump sites that may contain hazmat.	Typical risk of encountering small dumps containing waste, debris, etc around farmland.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Construction
CON-4	Cultural Resources	Some risk of encountering cultural resources sites in farmland	Typical risk of encountering cultural resource items. Initial survey of structures does not indicate that there are any significant structures involved.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Construction
CON-5	Abandoned oil pipeline	There is an abandoned oil pipeline in the RR right of way	This pipeline may have leaked or may still contain small amounts of petrochemicals that may need remediation.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Environmental
	ESTIMATE AND SCHEDULE RISKS									
EST-1	Irrigation	Irrigation may be interrupted by construction	Timing of work may effect irrigation, Sand filters may need replaced. May need to provide temporary irrigation pumping. Work may need to be scheduled and outside of growing season and may need added into estimate. It is assumed that irrigation season starts in Mar. This needs verification.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW	Project Manager
EST-2	SWPP Estimate	Design by Estimator	May need revisions but estimators feel pricing is conservative. Monitoring costs may need to be added to ensure water quality is maintained during storms and construction.	Very Likely	Negligible	LOW	Very Likely	Negligible	LOW	Environmental
EST-3	Demo of houses	Estimate revised	There may be an opportunity to reduce costs if houses can be moved or left in place. Estimate was revised and this risk is not considered significant	Likely	Marginal	MODERATE	Likely	Negligible	LOW	Cost Engineering
EST-4	Embankment Borrow	Assumed from Fink landfill	Fill assumed provided at no cost in estimate- By the time project is built, there is some risk that the fill may not be available and will have to be purchased. Fill may need to be mixed. There is an alternate source closer but haul decrease and fill purchase offset so no cost change.	Very Likely	Critical	HIGH	Likely	Negligible	LOW	Cost Engineering
EST-5	Rock Riprap Qty	Quantity could be reduced from current P&S	May be an opportunity to reduce costs Not a significant cost	Likely	Negligible	LOW	Likely	Negligible	LOW	Cost Engineering
EST-6	Stoplog Storage Area	Not currently in P&S	75k allowance for storage structure in estimate. Gated structure may be a better option. Project may need to include means of handling stoplogs or potentially a change in design to gated structures.	Very Likely	Significant	HIGH	Very Likely	Negligible	LOW	Hydrology/Hydraulic Design
EST-7	Access road ramps	Access road ramps gates not included in current quantities	Added to estimate.	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE	Geotechnical/Civil Design
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)										
PR-1	Program Priority	Project is currently not "critical" and most likely will have to compete against higher priority projects for funding.	Not studied as this would stop the project.			0			0	District Management

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -**Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impac**Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

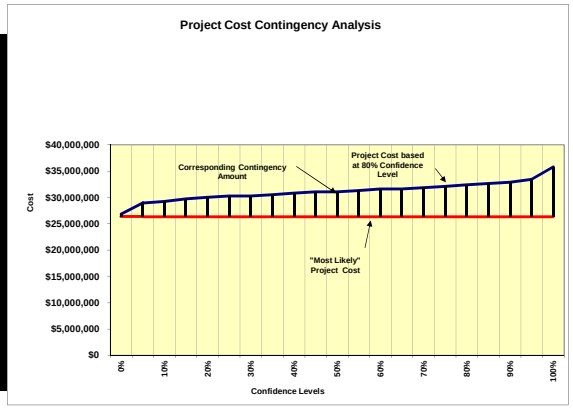
Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$26,344,000**
Baseline Estimate Cost Contingency Amount ->	$6,059,120
Baseline Estimate Construction Cost (80% Confidence) ->	**$32,403,120**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**40.0 Months**
Schedule Contingency Duration ->	15.7 Months
Project Schedule Duration (80% Confidence) ->	**55.7 Months**

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

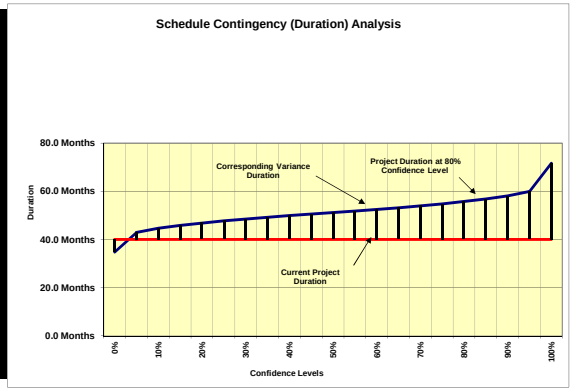
Baseline Cost Estimate	$26,344,000	
Confidence Level	**Value**	**Contingency**
0%	$26,870,880	2%
5%	$28,978,400	10%
10%	$29,241,840	11%
15%	$29,768,720	13%
20%	$30,032,160	14%
25%	$30,295,600	15%
30%	$30,295,600	15%
35%	$30,559,040	16%
40%	$30,822,480	17%
45%	$31,085,920	18%
50%	$31,085,920	18%
55%	$31,349,360	19%
60%	$31,612,800	20%
65%	$31,612,800	20%
70%	$31,876,240	21%
75%	$32,139,680	22%
80%	**$32,403,120**	**23%**
85%	$32,666,560	24%
90%	$32,930,000	25%
95%	$33,456,880	27%
100%	$35,827,840	36%



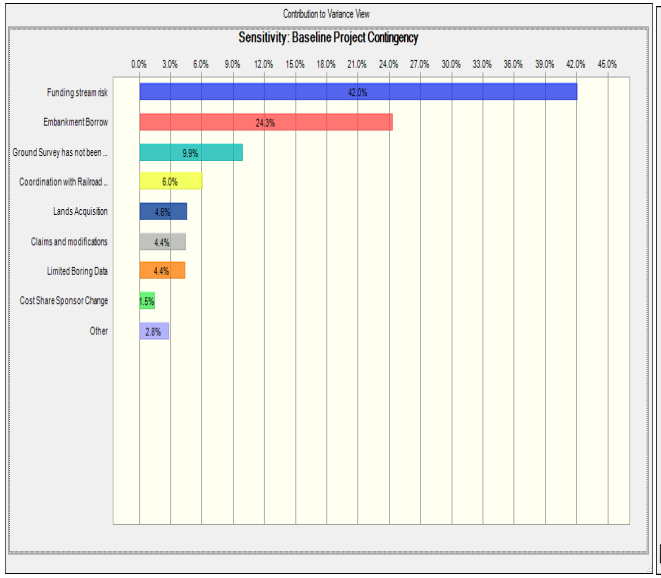
- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

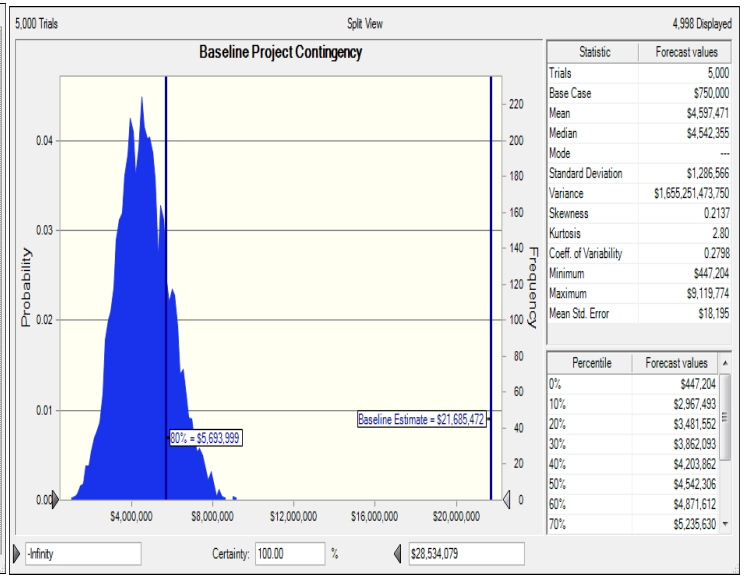
Contingency Analysis

Base Schedule Duration Cost Estimate	40.0 Months	
Confidence Level	**Value**	**Contingency**
0%	34.9 Months	-13%
5%	42.9 Months	7%
10%	44.7 Months	12%
15%	45.9 Months	15%
20%	46.9 Months	17%
25%	47.8 Months	19%
30%	48.5 Months	21%
35%	49.2 Months	23%
40%	49.9 Months	25%
45%	50.6 Months	26%
50%	51.2 Months	28%
55%	51.9 Months	30%
60%	52.6 Months	31%
65%	53.3 Months	33%
70%	54.0 Months	35%
75%	54.8 Months	37%
80%	**55.7 Months**	**39%**
85%	56.8 Months	42%
90%	58.1 Months	45%
95%	60.0 Months	50%
100%	71.7 Months	79%



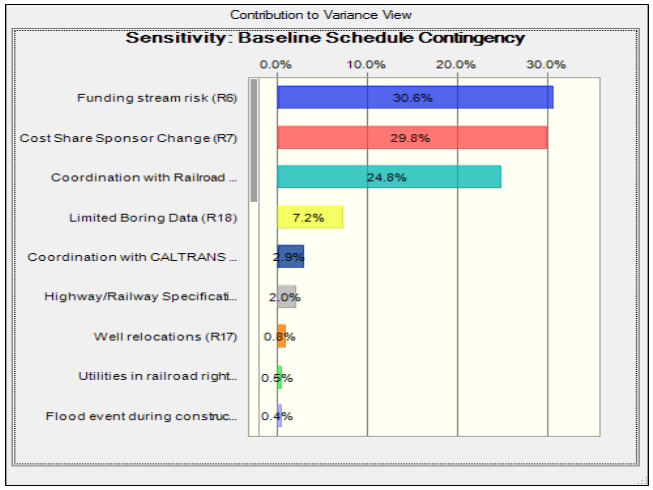
Boiler Plate - Cost Risk Analysis

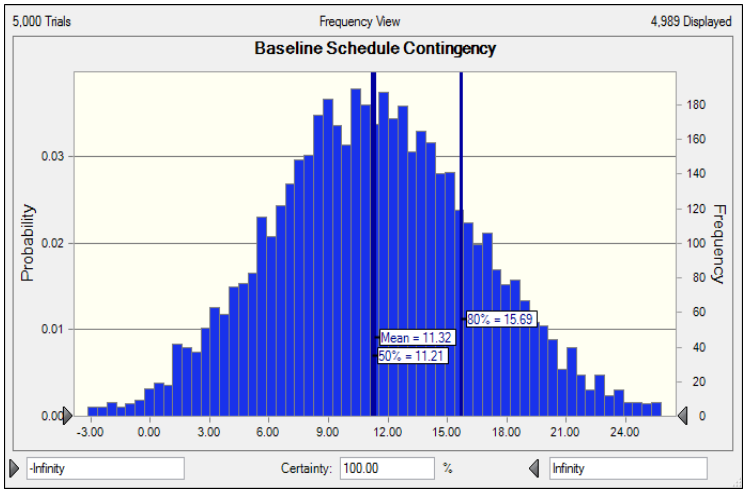




Statistic	Forecast values
Trials	5,000
Base Case	$750,000
Mean	$4,597,471
Median	$4,542,355
Mode	---
Standard Deviation	$1,286,566
Variance	$1,655,251,473,750
Skewness	0.2137
Kurtosis	2.80
Coeff. of Variability	0.2798
Minimum	$447,204
Maximum	$9,119,774
Mean Std. Error	$18,195

Percentile	Forecast values
0%	$447,204
10%	$2,967,493
20%	$3,481,552
30%	$3,862,093
40%	$4,203,862
50%	$4,542,306
60%	$4,871,612
70%	$5,235,630





Orestimba LPP CSRA Model

Risk No.	Risk/Opportunity Event	Shape	Probability	Project Cost: Likelihood*	Project Cost: Impact*	Project Cost: Risk Level*	Crystal Ball Simulation: Low	Crystal Ball Simulation: Most Likely	Crystal Ball Simulation: High	Cost Risk	Project Schedule: Likelihood*	Project Schedule: Impact*	Project Schedule: Risk Level*	Crystal Ball Simulation: Low	Crystal Ball Simulation: Most Likely	Crystal Ball Simulation: High	Schedule Risk
PROJECT & PROGRAM MGMT																	
PPM-1	Funding stream risk	Triangular	1	Likely	Marginal	MODERATE	$0	$0	$3,581,300	0	Likely	Critical	HIGH	0	0	12	0
PPM-3	Cost Share Sponsor Change	Triangular	1	Very Likely	Marginal	MODERATE	($716,260)	$0	$0	0	Very Unlikely	Marginal	LOW	-12	0	0	0
PPM-5	Coordination with Railroad for crossing	Triangular	1	Very Likely	Marginal	MODERATE	$0	$379,065	$1,424,390	0	Very Likely	Significant	HIGH	0	2	12	0
PPM-6	Coordination with CALTRANS	Triangular	1	Very Likely	Negligible	LOW	$0	$0	$358,130	0	Very Likely	Marginal	MODERATE	0	0	4	0
CONTRACT ACQUISITION RISKS																	
CA-3	Highway/Railway Specification/Jurisdiction issues	Triangular	1	Likely	Marginal	MODERATE	$0	$0	$268,598	0	Likely	Marginal	MODERATE	0	0	3	0
TECHNICAL RISKS																	
TL-2	Ground Survey has not been completed	Triangular	1	Very Likely	Marginal	MODERATE	($1,378,000)	$0	$1,378,000	0	Very Unlikely	Negligible	LOW	0	0	0	0
TL-3	Railroad crossing -seepage	Triangular	1	Very Likely	Marginal	MODERATE	$0	$200,000	$350,000	0	Very Likely	Negligible	LOW	0	0	0	0
TL-4	Highway 33 raise	Triangular	1	Very Likely	Marginal	MODERATE	$0	$0	$200,000	0	Very Likely	Negligible	LOW	0	0	1	0
TL-5	Stuhr Road Culvert	Triangular	1	Likely	Marginal	MODERATE	$0	$0	$115,000	0	Unlikely	Negligible	LOW	0	0	0	0
TL-6	Well relocations	Triangular	1	Very Likely	Marginal	MODERATE	($250,000)	$0	$50,000	0	Very Likely	Negligible	LOW	0	0	2	0
TL-8	Limited Boring Data	Triangular	1	Very likely	Marginal	MODERATE	$0	$0	$1,148,450	0	Very Likely	Marginal	MODERATE	0	0	6	0
LANDS AND DAMAGES RISKS																	
LD-1	Lands Acquisition	Triangular	1	Very Likely	Marginal	MODERATE	$0	$0	$1,250,000	0	Very Likely	Marginal	MODERATE	0	0	0	0
LD-3	Utilities in railroad right of way	Triangular	1	Very Likely	Significant	HIGH	$0	$0	$369,377	0	Very Likely	Marginal	MODERATE	0	0	2	0
CONSTRUCTION RISKS																	
CON-1	Flood event during construction	Triangular	1	Unlikely	Marginal	LOW	$0	$0	$200,000	0	Unlikely	Significant	MODERATE	0	0	1	0
~~CON-2~~	~~Claims and modifications~~	~~Triangular~~	~~1~~	~~Likely~~	~~Marginal~~	~~MODERATE~~	~~$0~~	~~$526,880~~	~~$1,317,200~~	~~0~~	~~Likely~~	~~Marginal~~	~~MODERATE~~	~~0~~	~~0~~	~~0~~	~~0~~
CON-3	Hazmat/HTRW	Triangular	1	Likely	Marginal	MODERATE	$0	$0	$159,888	0	Likely	Marginal	MODERATE	0	0	1	0
ESTIMATE AND SCHEDULE RISKS																	
EST-1	Irrigation	Triangular	1	Very Likely	Marginal	MODERATE	$0	$120,000	$240,000	0	Very Likely	Negligible	LOW				
EST-4	Embankment Borrow	yes/no	0.6	Very Likely	Critical	HIGH	$0	$0	$1,625,000	975000	Likely	Negligible	LOW				
EST-6	Stoplog Storage Area	Triangular	1	Very Likely	Marginal	MODERATE	$0	$100,000	$200,000	0	Very Likely	Negligible	LOW				
										$26,344,000						40	0
								$975,000									

Estimate	**$26,344,000**
Rom TPC	**$35,813,000**

PROJECT CONTINGENCY BASELINE COST ESTIMATE	Percentile	Baseline	Contingency	Baseline w/	Contingency %
	0%	$26,344,000	**$526,880**	**$26,870,880**	**2%**
	5%	$26,344,000	**$2,634,400**	**$28,978,400**	**10%**
	10%	$26,344,000	**$2,897,840**	**$29,241,840**	**11%**
	15%	$26,344,000	**$3,424,720**	**$29,768,720**	**13%**
	20%	$26,344,000	**$3,688,160**	**$30,032,160**	**14%**
	25%	$26,344,000	**$3,951,600**	**$30,295,600**	**15%**
	30%	$26,344,000	**$3,951,600**	**$30,295,600**	**15%**
	35%	$26,344,000	**$4,215,040**	**$30,559,040**	**16%**
	40%	$26,344,000	**$4,478,480**	**$30,822,480**	**17%**
	45%	$26,344,000	**$4,741,920**	**$31,085,920**	**18%**
	50%	$26,344,000	**$4,741,920**	**$31,085,920**	**18%**
	55%	$26,344,000	**$5,005,360**	**$31,349,360**	**19%**
	60%	$26,344,000	**$5,268,800**	**$31,612,800**	**20%**
	65%	$26,344,000	**$5,268,800**	**$31,612,800**	**20%**
	70%	$26,344,000	**$5,532,240**	**$31,876,240**	**21%**
	75%	$26,344,000	**$5,795,680**	**$32,139,680**	**22%**
	80%	$26,344,000	**$6,059,120**	**$32,403,120**	**23%**
	85%	$26,344,000	**$6,322,560**	**$32,666,560**	**24%**
	90%	$26,344,000	**$6,586,000**	**$32,930,000**	**25%**
	95%	$26,344,000	**$7,112,880**	**$33,456,880**	**27%**
	100%	$26,344,000	**$9,483,840**	**$35,827,840**	**36%**

PROJECT CONTINGENCY BASELINE SCHEDULE	Percentile	Baseline	Contingency	Baseline w/	Contingency
	0%	40.0 Months	**-5.1 Months**	**34.9 Months**	**-12.83%**
	5%	40.0 Months	**2.9 Months**	**42.9 Months**	**7.29%**
	10%	40.0 Months	**4.7 Months**	**44.7 Months**	**11.78%**
	15%	40.0 Months	**5.9 Months**	**45.9 Months**	**14.84%**
	20%	40.0 Months	**6.9 Months**	**46.9 Months**	**17.37%**
	25%	40.0 Months	**7.8 Months**	**47.8 Months**	**19.46%**
	30%	40.0 Months	**8.5 Months**	**48.5 Months**	**21.33%**
	35%	40.0 Months	**9.2 Months**	**49.2 Months**	**22.94%**
	40%	40.0 Months	**9.9 Months**	**49.9 Months**	**24.73%**
	45%	40.0 Months	**10.6 Months**	**50.6 Months**	**26.42%**
	50%	40.0 Months	**11.2 Months**	**51.2 Months**	**28.04%**
	55%	40.0 Months	**11.9 Months**	**51.9 Months**	**29.72%**
	60%	40.0 Months	**12.6 Months**	**52.6 Months**	**31.39%**
	65%	40.0 Months	**13.3 Months**	**53.3 Months**	**33.16%**
	70%	40.0 Months	**14.0 Months**	**54.0 Months**	**34.97%**
	75%	40.0 Months	**14.8 Months**	**54.8 Months**	**36.93%**
	80%	40.0 Months	**15.7 Months**	**55.7 Months**	**39.23%**
	85%	40.0 Months	**16.8 Months**	**56.8 Months**	**41.99%**
	90%	40.0 Months	**18.1 Months**	**58.1 Months**	**45.32%**
	95%	40.0 Months	**20.0 Months**	**60.0 Months**	**49.98%**
	100%	40.0 Months	**31.7 Months**	**71.7 Months**	**79.27%**

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
PPM-1	Funding stream risk	$0	$0	$3,581,300	0 mo	0 mo	12 mo

Notes: This item captures the risk that the funding stream will change. The funding stream could cause the project to be split up over two or more years and result in the project being split

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes the project is spread over 2 years and split into two contracts. Assume this would add 10% to the overall TPC.

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
PPM-3	Cost Share Sponsor Change	($716,260)	$0	$0	-12 mo	0 mo	0 mo
		[redacted]					

Notes: Most likely the cost share sponsor will change to be the state. This most likely would help the project as the state most likely is in a better position to fund the project.

Likely Likely assumes no change from the baseline estimate.

Low

Low- The state may be able to fund their portion sooner than the current sponsor advancing the project up to a year. Causing 1 year esc savings of approx 2%

High

High- No Changes to baseline estimate

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
PPM-5	Coordination with Railroad	$0	$379,065	$1,424,390	0 mo	2 mo	12 mo

Notes: This item captures the risk that coordination with the railroad could cause a delay. Coordination usually takes 12-18 months minimum. Usually the railroad does not like to

Likely Likely assumes that there will be 2 months additional time added to the critical path due to coordination with the railroad, as well as 200k in changes to the design

Low Low- No change to critical path of schedule due to coordination

High High assumes the delay could be as high as 12 months and the design could increase 350k

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
PPM-6	Coordination with CALTRANS	$0	$0	$358,130	0 mo	0 mo	4 mo

Notes: This item models the risk that coordination will CALTRANS will cause a delay to the project.

Likely Likely assumes no change from the baseline estimate.

Low

Low- No change to the estiamte or schedule.

High

High- Assumes no significant design changes but a 4 month delay to the project for coordination.

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
CA-3	Highway/Railway work	$0	$0	$268,598	0 mo	0 mo	3 mo

Notes: This item captures the risk that due to the project involving multiple agencies having different requirements that there may be additional reviews and coordination required prior

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes a 90 day delay for additional coordination and review

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-2	Ground Survey has not been completed	($1,378,000)	$0	$1,378,000	0 mo	0 mo	0 mo

Notes: This item captures the risk that since the quantities are based off of LIDAR vs. an actual survey that they could be 4-5 inches in error.

Likely Likely assumes no change from the baseline estimate.

Low

Low- If the area is higher than the survey approx 40000lcy could be reduced from the fill quantities saving approx 800k

High

If the area is low an extra 30000 lcy would be required or approx 800k

26.5 per yard
52000 approx qty
1378000 rom cost

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-3	Railroad crossing under seepage.		$200,000	$350,000	0 mo	0 mo	0 mo

Notes:

Inspection trench is added to estimate still need 200k or so for seepage issues

Likely Most likely some sort of additional work will be requried to address seepage under the

Low

Costs in estimate are adequate to cover seepage issues at railroad crossing.

High

$350k will be required to fix railroad crossing seepage issues

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-4	Highway 33 raise	$0	$0	$200,000	0 mo	0 mo	1 mo

Notes: This item captures the risk that there may be additional costs in raising the highway either through changed specifications and or unknown utilities in the area

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes that there could be up to 200k in additonal costs due to unknown utilities and or additional fill requirements. Up to a 1 month schedule delay could occur

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-5	Stuhr Road Culvert	$0	$0	$115,000	0 mo	0 mo	

Notes: This item captures the risk that the estimators assumed culvert size may not be adequate to pass the required flow

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes that the 115k currently in the estimate for the culvert is not adequate and could double in cost. No schedule impact assumed.

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-6	Well relocations	($250,000)	$0	$50,000	0 mo	0 mo	2 mo
		[redacted]					

Notes: This item captures the risk that the 10 wells along the alignment may need work to be waterproofed and or moved. There are costs for replacing motors etc..

Likely Likely assumes estimate is adequate to cover the cost

Low

Low- assumes 50% less than estimated due to not replacing well pumps.

High

High assumes estimate wells need to be relocated at 50k plus estimate cost

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
TL-8	Limited Borings done at feasibility	$0	$0	$1,148,450	0 mo	0 mo	6 mo

Notes: This item captures the risk that adequate borings may not have been completed and that the geotechnical conditions may be different.

Likely Likely assumes no change from the baseline estimate.

Low

Low assumes no change.

High

High assumes that the construction cost could increase up to 3% due to additional measures due to geotechnical conditions. This also could cause 6 mo delay for redesign.

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
LD-1	Lands Acquisition	$0	$0	$1,250,000	0 mo	0 mo	0 mo

Notes: This is combined with RE-1 This assumes that either additional land for right of way may need to be procured and or additional lands need to be purchased to offset

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes an additional 50acers at 25000/acre may need to be purchased to offset the loss of farmland. This is not assumed to impact the critical path.

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
LD-3/4	Unknown utilities	$0	$0	$369,377	0 mo	0 mo	2 mo

Notes: This captures the risk that there are unknown utilities in the railroad right of way and or in the roadway.

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes that there are additional utilities that could require relocation costing up to 250k and 2 months delay

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
CON-1	Flood event during construction	$0	$0	$200,000	0 mo	0 mo	1 mo

Notes:

This item captures the risk that there could be a flood event during construction

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes that the contractor may have to demobilize, remobilize and perform some limited repairs. Assume 200k and 1 month delay

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
CON-2	Claims and modifications	$0	$526,880	$1,317,200	0 mo	0 mo	0 mo

Notes: This item captures the risk that claims and modifications can typically add 3-5% to a contract

Likely Likely assumes 2% of contract in claims

Low

Low- same as likely

High

High assumes 5% in claims

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
Con-3	HTRW	$0	$0	$159,688	0 mo	0 mo	1 mo

Notes: This item captures the risk that there may be HTRW encountered. Either small abandoned dumpsites or even leakage from the oil pipeline

Likely Likely assumes no change from the baseline estimate.

Low

Low- same as likely

High

High assumes that 100k is required to clean up HTRW encountered. 1 month delay assumed plus delay cost.

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
EST-1	Irrigation	$0	$120,000	$240,000	0 mo	0 mo	0 mo

Notes: Sand filters and temporary irrigation at major intersections are added into estimate. Small culverts may need temporary pumping. There are approximatly 24 small culverts that may

Likely Likely 12 of the culverts will need puping

Low

Low- no need pumping.

High

All 24 need pumping

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
EST-4	Embankment Borrow	$0	$0	$1,625,000	0 mo	0 mo	0 mo

Notes: There are two potential borrow sources available however it is not a guarantee that they will be able to supply all of the 325000 yards

Likely Borrow can be had from existing sources with no additional cost

Low

Borrow can be had from existing sources at no additional costs

High Worst case is that only half of the material can be obtained from the two potential sources and that it will cost $5/yard over what is in the estimate to do the makeup. No schedule delay assumed

325000

Orestimba LPP CSRA Model

		COST			Schedule		
Risk Refer No.	Risk Event	Low	Most Likely	High	Low	Most Likely	High
EST-6	Stoplog Storage Area	$0	$100,000	$200,000	0 mo	0 mo	0 mo

Notes:

There is currently no provision for stoplog storage in the design

Likely Assume 100k for stoplog storage provision

Low

Sponsor will stow logs in some existing area at no cost

High

Assume 200k for stoplog storage

WALLA WALLA COST ENGINEERING TECHNICAL CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For

SPK - Orestimba Creek Feasibility Study

The Orestimba Creek Feasibility as presented by Sacramento District has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Technical Center of Expertise (Cost TCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of April 23, 2012, the Cost TCX certifies the estimated total project cost:

NED Plan
FY 2014 Price Level: $36,499,000
Fully Funded Amount: $37,265,000

LPP Plan
FY 2014 Price Level: $45,658,000
Fully Funded Amount: $47,329,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management throughout the life of the project.

Kim C. Callan, PE, CCE, PM1
Chief, Cost Engineering
Walla Walla District

US Army Corps of Engineers®

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: Orestimba Creek NED PLAN
LOCATION: West Stanislaus County, CA

DISTRICT: Sacramento
POC: CHIEF, COST ENGINEERING,

PREPARED: 4/20/2012

This Estimate reflects the scope and schedule in report; Orestimba Creek Feasibility Study

Program Year (Budget EC): 2014
Effective Price Level Date: 1 OCT 13

WBS NUMBER	Civil Works Feature & Sub-Feature Description	ESTIMATED COST COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	PROJECT FIRST COST ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	TOTAL PROJECT COST (FULLY FUNDED) Spent Thru: 1-Oct-11 ($K)		COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*
02	RELOCATIONS	$3,968	$952	24%	$4,920	3.5%	$4,105	$985	**$5,091**			$4,251	$1,020	$5,272
11	LEVEES & FLOODWALLS	$16,580	$3,979	24%	$20,559	3.5%	$17,154	$4,117	**$21,271**			$17,763	$4,263	$22,027
	CONSTRUCTION ESTIMATE TOTALS:	$20,548	$4,932		**$25,480**	3.5%	$21,259	$5,102	**$26,361**			$22,015	$5,284	$27,298
01	LANDS AND DAMAGES	$2,180	$501	23%	$2,681	3.5%	$2,255	$519	**$2,774**			$2,294	$528	$2,822
18	CULTURAL RESCOURCES	$225	$56	25%	$281	3.5%	$233	$58	**$291**			$241	$60	$301
30	PLANNING, ENGINEERING & DESIGN	$3,698	$888	24%	$4,586	4.4%	$3,859	$926	**$4,786**			$3,728	$895	$4,622
31	CONSTRUCTION MANAGEMENT	$1,767	$424	24%	$2,191	4.4%	$1,844	$443	**$2,287**			$1,792	$430	$2,222
	PROJECT COST TOTALS:	$28,418	$6,801	24%	**$35,219**	3.6%	$29,451	$7,048	**$36,499**			$30,069	$7,196	$37,265

ESTIMATED FEDERAL COST:	65%	**$24,222**
ESTIMATED NON-FEDERAL COST:	35%	**$13,043**
ESTIMATED TOTAL PROJECT COST:		**$37,265**

_____ CHIEF, COST ENGINEERING,

_____ PROJECT MANAGER,

_____ CHIEF, REAL ESTATE,

_____ CHIEF, PLANNING,

_____ CHIEF, ENGINEERING,

_____ CHIEF, OPERATIONS,

_____ CHIEF, CONSTRUCTION,

_____ CHIEF, CONTRACTING,

_____ CHIEF, PM-PB,

_____ CHIEF, DPM,

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Orestimba Creek NED PLAN
LOCATION: West Stanislaus County, CA
This Estimate reflects the scope and schedule in report; Orestimba Creek Feasibility Study

DISTRICT: Sacramento
POC: CHIEF, COST ENGINEERING,
PREPARED: 4/20/2012

Estimate Prepared: 18-Apr-12
Effective Price Level: 1-Oct-11

Program Year (Budget EC): 2014
Effective Price Level Date: 1 OCT 13

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1													
02	RELOCATIONS	$3,968	$952	24%	$4,920	3.5%	$4,105	$985	$5,091	2016Q1	3.6%	$4,251	$1,020	$5,272
11	LEVEES & FLOODWALLS	$16,580	$3,979	24%	$20,559	3.5%	$17,154	$4,117	$21,271	2016Q1	3.6%	$17,763	$4,263	$22,027
	CONSTRUCTION ESTIMATE TOTALS:	$20,548	$4,932	24%	**$25,480**		$21,259	$5,102	$26,361			$22,015	$5,284	$27,298
01	LANDS AND DAMAGES	$2,180	$501	23%	$2,681	3.5%	$2,255	$519	$2,774	2015Q1	1.7%	$2,294	$528	$2,822
18	CULTURAL RESCOURCES	$225	$56	25%	$281	3.5%	$233	$58	$291	2016Q1	3.6%	$241	$60	$301
30	PLANNING, ENGINEERING & DESIGN													
1.9%	Project Management	$390	$94	24%	$484	4.4%	$407	$98	$505	2012Q3	-3.6%	$393	$94	$487
1.5%	Planning & Environmental Compliance	$308	$74	24%	$382	4.4%	$321	$77	$399	2012Q3	-3.6%	$310	$74	$384
6.3%	Engineering & Design	$1,295	$311	24%	$1,606	4.4%	$1,352	$324	$1,676	2012Q3	-3.6%	$1,303	$313	$1,616
1.5%	Engineering Tech Review ITR & VE	$308	$74	24%	$382	4.4%	$321	$77	$399	2012Q3	-3.6%	$310	$74	$384
1.5%	Contracting & Reprographics	$308	$74	24%	$382	4.4%	$321	$77	$399	2012Q3	-3.6%	$310	$74	$384
2.3%	Engineering During Construction	$473	$114	24%	$587	4.4%	$494	$118	$612	2013Q1	-2.9%	$480	$115	$595
1.5%	Planning During Construction	$308	$74	24%	$382	4.4%	$321	$77	$399	2013Q1	-2.9%	$312	$75	$387
1.5%	Project Operations	$308	$74	24%	$382	4.4%	$321	$77	$399	2012Q3	-3.6%	$310	$74	$384
31	CONSTRUCTION MANAGEMENT													
6.0%	Construction Management	$1,233	$296	24%	$1,529	4.4%	$1,287	$309	$1,596	2013Q1	-2.9%	$1,250	$300	$1,550
1.1%	Project Operation:	$226	$54	24%	$280	4.4%	$236	$57	$292	2013Q1	-2.9%	$229	$55	$284
1.5%	Project Management	$308	$74	24%	$382	4.4%	$321	$77	$399	2013Q1	-2.9%	$312	$75	$387
	CONTRACT COST TOTALS:	$28,418	$6,801		**$35,219**		$29,451	$7,048	$36,499			$30,069	$7,196	**$37,265**

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: Orestimba Creek LPP PLAN
LOCATION: West Stanislaus County, CA

DISTRICT: Sacramento
POC: CHIEF, COST ENGINEERING,

PREPARED: 4/20/2012

This Estimate reflects the scope and schedule in report; Orestimba Creek Feasibility Study

Program Year (Budget EC): 2014
Effective Price Level Date: 1 OCT 13

WBS NUMBER	Civil Works Feature & Sub-Feature Description	ESTIMATED COST COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	PROJECT FIRST COST ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	TOTAL PROJECT COST (FULLY FUNDED) Spent Thru: 1-Oct-11 ($K)		COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
02	RELOCATIONS	$4,821	$1,109	23%	$5,930	3.5%	$4,988	$1,147	**$6,135**			$5,165	$1,188	$6,353
11	LEVEES & FLOODWALLS	$21,523	$4,950	23%	$26,473	3.5%	$22,268	$5,122	**$27,389**			$23,059	$5,304	$28,363
	CONSTRUCTION ESTIMATE TOTALS:	$26,344	$6,059		**$32,403**	3.5%	$27,256	$6,269	**$33,524**			$28,224	$6,492	$34,716
01	LANDS AND DAMAGES	$2,180	$501	23%	$2,681	3.5%	$2,255	$519	**$2,774**			$2,294	$528	$2,822
18	CULTURAL RESCOURCES	$282	$71	25%	$353	3.5%	$292	$73	**$365**			$302	$76	$378
30	PLANNING, ENGINEERING & DESIGN	$4,742	$1,091	23%	$5,833	4.4%	$4,949	$1,138	**$6,087**			$5,103	$1,174	$6,276
31	CONSTRUCTION MANAGEMENT	$2,265	$521	23%	$2,786	4.4%	$2,364	$544	**$2,908**			$2,550	$587	$3,137
	PROJECT COST TOTALS:	$35,813	$8,243	23%	**$44,056**	3.6%	$37,116	$8,542	**$45,658**			$38,474	$8,855	$47,329

ESTIMATED FEDERAL COST:	65%	**$30,764**
ESTIMATED NON-FEDERAL COST:	35%	**$16,565**
ESTIMATED TOTAL PROJECT COST:		**$47,329**

_____ CHIEF, COST ENGINEERING,

_____ PROJECT MANAGER,

_____ CHIEF, REAL ESTATE, xxx

_____ CHIEF, PLANNING,

_____ CHIEF, ENGINEERING,

_____ CHIEF, OPERATIONS,

_____ CHIEF, CONSTRUCTION,

_____ CHIEF, CONTRACTING,

_____ CHIEF, PM-PB, xxxx

_____ CHIEF, DPM,

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Orestimba Creek LPP PLAN
LOCATION: West Stanislaus County, CA
This Estimate reflects the scope and schedule in report; Orestimba Creek Feasibility Study

DISTRICT: Sacramento
POC: CHIEF, COST ENGINEERING,

PREPARED: 4/20/2012

Estimate Prepared: 18-Apr-12
Effective Price Level: 1-Oct-11

Program Year (Budget EC): 2014
Effective Price Level Date: 1 OCT 13

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A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	PHASE 1													
02	RELOCATIONS	$4,821	$1,109	23%	$5,930	3.5%	$4,988	$1,147	$6,135	2016Q1	3.6%	$5,165	$1,188	$6,353
11	LEVEES & FLOODWALLS	$21,523	$4,950	23%	$26,473	3.5%	$22,268	$5,122	$27,389	2016Q1	3.6%	$23,059	$5,304	$28,363
	CONSTRUCTION ESTIMATE TOTALS:	$26,344	$6,059	23%	**$32,403**		$27,256	$6,269	$33,524			$28,224	$6,492	$34,716
01	LANDS AND DAMAGES	$2,180	$501	23%	$2,681	3.5%	$2,255	$519	$2,774	2015Q1	1.7%	$2,294	$528	$2,822
18	CULTURAL RESCOURCES	$282	$71	25%	$353	3.5%	$292	$73	$365	2016Q1	3.6%	$302	$76	$378
30	PLANNING, ENGINEERING & DESIGN													
1.9%	Project Management	$501	$115	23%	$616	4.4%	$523	$120	$643	2014Q3	1.8%	$532	$122	$655
1.5%	Planning & Environmental Compliance	$395	$91	23%	$486	4.4%	$412	$95	$507	2014Q3	1.8%	$420	$97	$516
6.3%	Engineering & Design	$1,660	$382	23%	$2,042	4.4%	$1,732	$398	$2,131	2014Q3	1.8%	$1,764	$406	$2,170
1.5%	Engineering Tech Review ITR & VE	$395	$91	23%	$486	4.4%	$412	$95	$507	2014Q3	1.8%	$420	$97	$516
1.5%	Contracting & Reprographics	$395	$91	23%	$486	4.4%	$412	$95	$507	2014Q3	1.8%	$420	$97	$516
2.3%	Engineering During Construction	$606	$139	23%	$745	4.4%	$632	$145	$778	2016Q1	7.9%	$682	$157	$839
1.5%	Planning During Construction	$395	$91	23%	$486	4.4%	$412	$95	$507	2016Q1	7.9%	$445	$102	$547
1.5%	Project Operations	$395	$91	23%	$486	4.4%	$412	$95	$507	2014Q3	1.8%	$420	$97	$516
31	CONSTRUCTION MANAGEMENT													
5.9%	Construction Management	$1,554	$357	23%	$1,911	4.4%	$1,622	$373	$1,995	2016Q1	7.9%	$1,750	$402	$2,152
1.2%	Project Operation:	$316	$73	23%	$389	4.4%	$330	$76	$406	2016Q1	7.9%	$356	$82	$438
1.5%	Project Management	$395	$91	23%	$486	4.4%	$412	$95	$507	2016Q1	7.9%	$445	$102	$547
	CONTRACT COST TOTALS:	$35,813	$8,243		**$44,056**		$37,116	$8,542	$45,658			$38,474	$8,855	**$47,329**

US Army Corps
of Engineers
Sacramento District

ORESTIMBA CREEK FEASIBILITY STUDY
AFB (F4A)-ATTACHMENT A

STANISLAUS COUNTY
CALIFORNIA

FY_2012

NOT FOR CONSTRUCTION

This project was designed by the Sacramento District of the U. S. Army Corps of Engineers. The initials or signatures and registration designations of individuals appear on these project documents within the scope of their employment as required by ER 1110-1-8152

Approved
Chief, Engineering Division Date:
Prepared Under the Direction of
Col., Corps of Engineers, District Engineer

Drawing Code:
Designed by
Drawn by
Spec No.
Design File No:

Approved Functional Adequacy
Chief, Design Br Date:
Prepared by
SACRAMENTO DISTRICT
DESIGN BRANCH
Chief, Civil Engr Des Sec B Date:

STANISLAUS COUNTY CALIFORNIA
ORESTIMBA CREEK FEASIBILITY STUDY
WITHOUT CHANNEL MODIFICATION
COVER SHEET

Sheet reference number:
G-001

PLATE LIST

PLATE NO.	DESCRIPTION
	GENERAL
G-001	COVER SHEET
G-002	SHEET LIST
PLATE 01	LPP OVERALL PLAN
PLATE 02	NED OVERALL PLAN
PLATE 03	KEYMAP
PLATE 04	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 05	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 06	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 07	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 08	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 09	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 10	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 11	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 12	LPP LEVEE, HWY 33 & RAILROAD PROTECTION PLAN VIEW
PLATE 13	RAILROAD EROSION PROCTION PLAN
PLATE 14	RAILROAD EROSION PROCTION PLAN
PLATE 15	RAILROAD EROSION PROCTION PLAN
PLATE 16	RAILROAD EROSION PROCTION PLAN
PLATE 17	ORESTIMBA LPP LEVEE PROFILE
PLATE 18	ORESTIMBA NED LEVEE PROFILE
PLATE 19	LEVEE TYPICAL CROSS SECTIONS
PLATE 20	STOP LOG STRUCTURE
PLATE 21	SWING GATE STRUCTURE
PLATE 22	LPP LEVEE CROSS SECTIONS
PLATE 23	LPP LEVEE CROSS SECTIONS
PLATE 24	LPP LEVEE CROSS SECTIONS
PLATE 25	LPP LEVEE CROSS SECTIONS

SURVEY DATA:
HORIZONTAL DATUM NAD83, MAP PROJECTION C.C. S.
ZONE III, VERTICAL DATUM NAVD 88.

TOPOGRAPHIC CONTOURS OBTAINED FROM TIN OF PHASE 1
LIDAR TOPOGRAPHY FROM CENTRAL VALLEY FLOOD
EVALUATION AND DELINEATION CALIFORNIA DEPARTMENT OF
WATER RESOURCES FLOWN 30 APRIL 2008.

LIDAR NOMINAL POST SPACING IS 1-METER. HORIZONTAL ACCURACY
+/- 3.5 FT @ 95% CONFIDENCE LEVEL. VERTCAL ACCURACY
+/- 1.2 FT @ 95% CONFIDENCY LEVEL.

IMAGERY DATE IS JUNE 16, 2011. IMAGERY IS FROM GOOGLE EARTH.

NOT FOR CONSTRUCTION

US Army Corps of Engineers
Sacramento District

Symbol	Description	Date	Approved

Designed by: | Dwn by: | Reviewed by: | Submitted by: | CHIEF, CIV ENGR DES SEC A
Spec No.: | Drawing Code:
Date: | Design file no: | File name: | Plot date: | Plot scale:
Rev.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 'J' STREET
SACRAMENTO, CA 95814-2922

STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

PLATE LIST

Sheet reference number:
G-002

IMAGERY DATE IS JUNE 16, 2011.

2000' 1000' 0 2000'

1"=2000'

N

PROJECT BEGIN

EASTIN ROAD

SHULTS ROAD

INSTALL 18" DIAMETER PIPE UNDER ROADWAY

NEW STOPLOG (SEE PLATE 20 FOR DETAIL)

CCID

TURNOUT

CANAL

DRAPER ROAD

HALDORSEN ROAD

NEW STOPLOG (SEE PLATE 20 FOR DETAIL)

SEEPAGE BERM

ORESTIMBA CREEK

INSTALL 18" DIAMETER PIPE UNDER ROADWAY

NEW STOPLOG (SEE PLATE 20 FOR DETAIL)

INSTALL 18" DIAMETER PIPE UNDER ROADWAY

SEEPAGE BERM BEGIN

STAGING AREA 3

TURNOUT

NEW STOPLOG (SEE PLATE 20 FOR DETAIL)

SEEPAGE BERM END

INSTALL 18" DIAMETER PIPE UNDER ROADWAY

HALE ROAD

TOWN OF NEWMAN

TURNOUT

LPP LEVEE

STUART ROAD

NEWMAN ROAD

MAIN CANAL

STAGING AREA 2

RAISE HW33

HWY 33

RAILROAD

247+44

RAILROAD EMBANKMENT EROSION PROTECTION

SWING GATE (SEE PLATE 21 FOR DETAIL)

VILLA MANICHA RD

FLOW

ORESTIMBA CREEK

CCID CANAL

SOUTHERN

STAGING AREA 1

PROJECT END

L. ROSIN ROAD

NOT FOR CONSTRUCTION

US Army Corps of Engineers®
Sacramento District

Symbol	Description	Date	Approved

Designed by:		Dates:	Rev.
Dwn by:	Spec No.:	Design file no:	
Reviewed by:		Drawing Code:	
Submitted by:		File name: Plot date: Plot scale:	
CHIEF, CIV ENGR DES SEC. A			

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 'J' STREET
SACRAMENTO, CA 95814-2922

STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

LPP OVERALL PLAN

Sheet reference number:

PLATE 01

8.1.2

PLOT DATE: $$$$date$$$$ PLOT TIME: $$$$time$$$$ DGNSPEC

IMAGERY DATE IS JUNE 16, 2011.

2000' 1000' 0 2000'

1"=2000'

N

PROJECT BEGIN

10+00

20+00

30+00

40+00

50+00

60+00

70+00

80+00

90+00

100+00

110+00

120+00

130+00

140+00

150+00

160+00

170+00

180+00

190+00

200+00

210+00

220+00

230+00

240+00

247+44

INSTALL 18" DIAMETER PIPE UNDER ROADWAY

NEW STOPLOG

TURNOUT

CCID CANAL

SEEPAGE BERM

SEEPAGE BERM BEGIN

STAGING AREA 3

SEEPAGE BERM END

NED LEVEE

NEWMAN, CA

STAGING AREA 2

RAISE HW33

HWY 33

RAILROAD

RAILROAD EMBANKMENT EROSION PROTECTION

SWING GATE

WATER FLOW

ORESTIMBA CREEK

STAGING AREA 1

PROJECT END

EASTIN ROAD

SHELLS ROAD

DRAPER ROAD

HALLOWELL ROAD

HOYER ROAD

STUHR ROAD

HALE ROAD

MAIN CANAL

ANDERSON ROAD

LINDY ROAD

VILLA MANUCHA RD

CROW ROAD

NOT FOR CONSTRUCTION

US Army Corps of Engineers®
Sacramento District

Symbol	Description	Date	Approved

Designed by:
Dwn by:
Spec No.:
Reviewed by:
Submitted by:
CHIEF, CIV ENGR DES SEC 4
Date:
Rev.
Design file no:
Drawing Code:
File name:
Plot date:
Plot scale:

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 "J" STREET
SACRAMENTO, CA 95814-2922

STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

NED OVERALL PLAN

Sheet reference number:
PLATE 02

8.1.2

PLOT DATE: $$$$date$$$$ PLOT TIME: $$$$time$$$$ DGNSPEC

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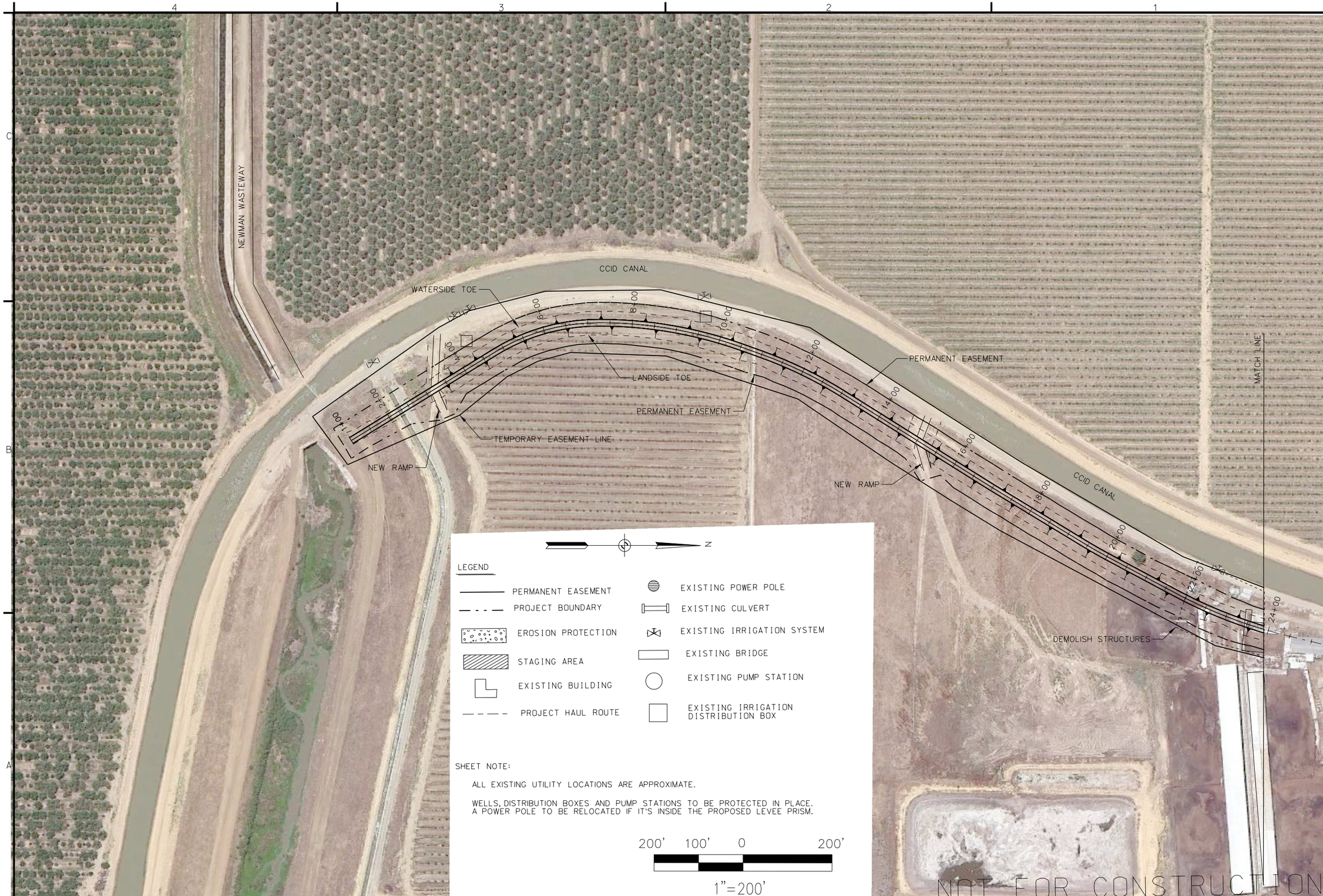
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

KEY MAP
LPP OVERALL PLAN

Sheet reference number:
PLATE 03

NOT FOR CONSTRUCTION

8.1.2 | PLOT DATE: $$$$date$$$$ | PLOT TIME: $$$$time$$$$ | DGNSPEC



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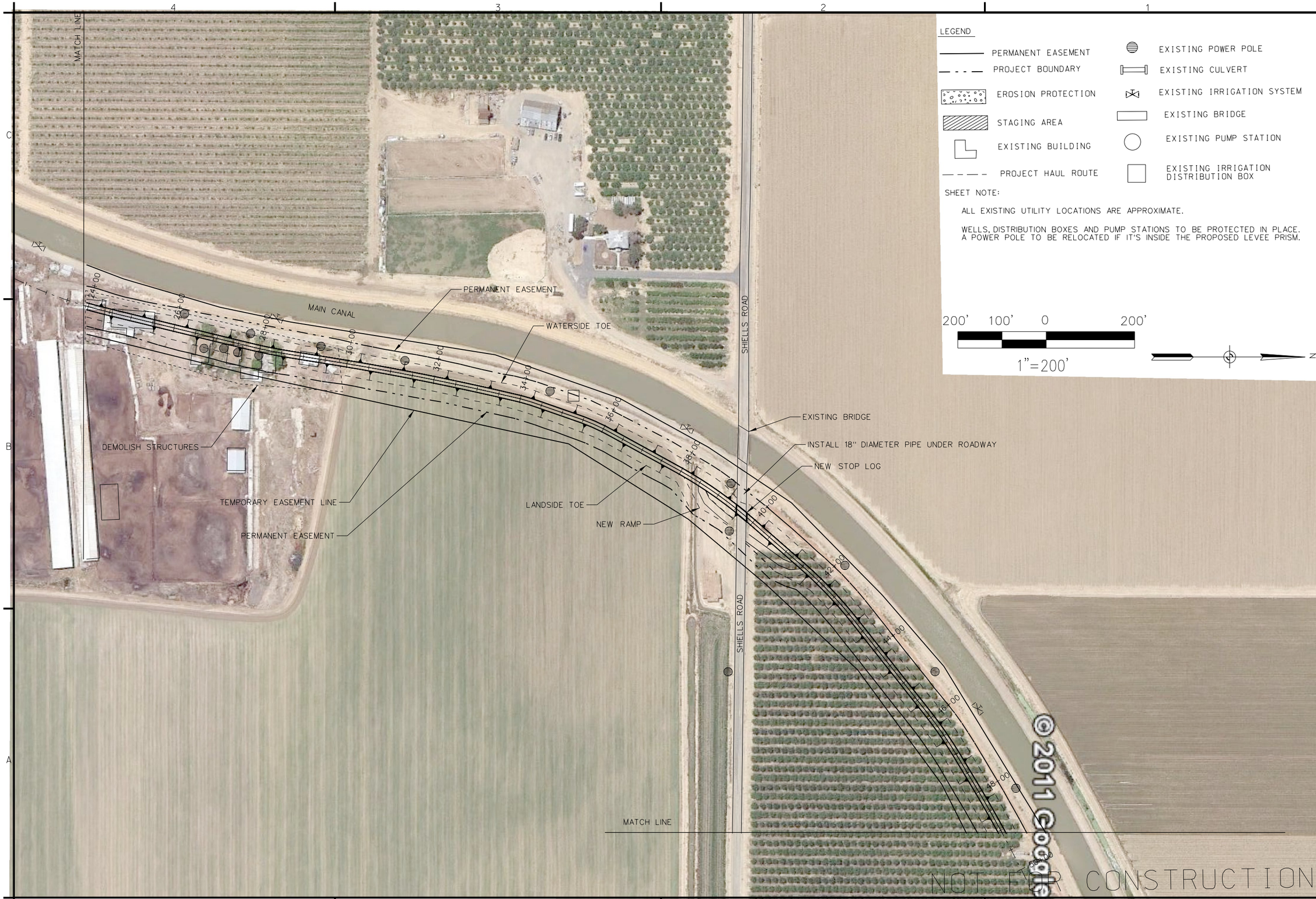
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:
PLATE 04

8.1.2 PLOT DATE: $$$$date$$$$ PLOT TIME: $$$$time$$$$ DGNSPEC



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- EXISTING BRIDGE
- EXISTING PUMP STATION
- EXISTING IRRIGATION DISTRIBUTION BOX

SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

WELLS, DISTRIBUTION BOXES AND PUMP STATIONS TO BE PROTECTED IN PLACE. A POWER POLE TO BE RELOCATED IF IT'S INSIDE THE PROPOSED LEVEE PRISM.

200' 100' 0 200'

1"=200'

N

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STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 05

8.1.2 PLOT DATE: $$$$date$$$$ PLOT TIME: $$$$time$$$$ DGNSPEC

LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
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- EXISTING IRRIGATION DISTRIBUTION BOX

SHEET NOTE:

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200' 100' 0 200'

1"=200'

N

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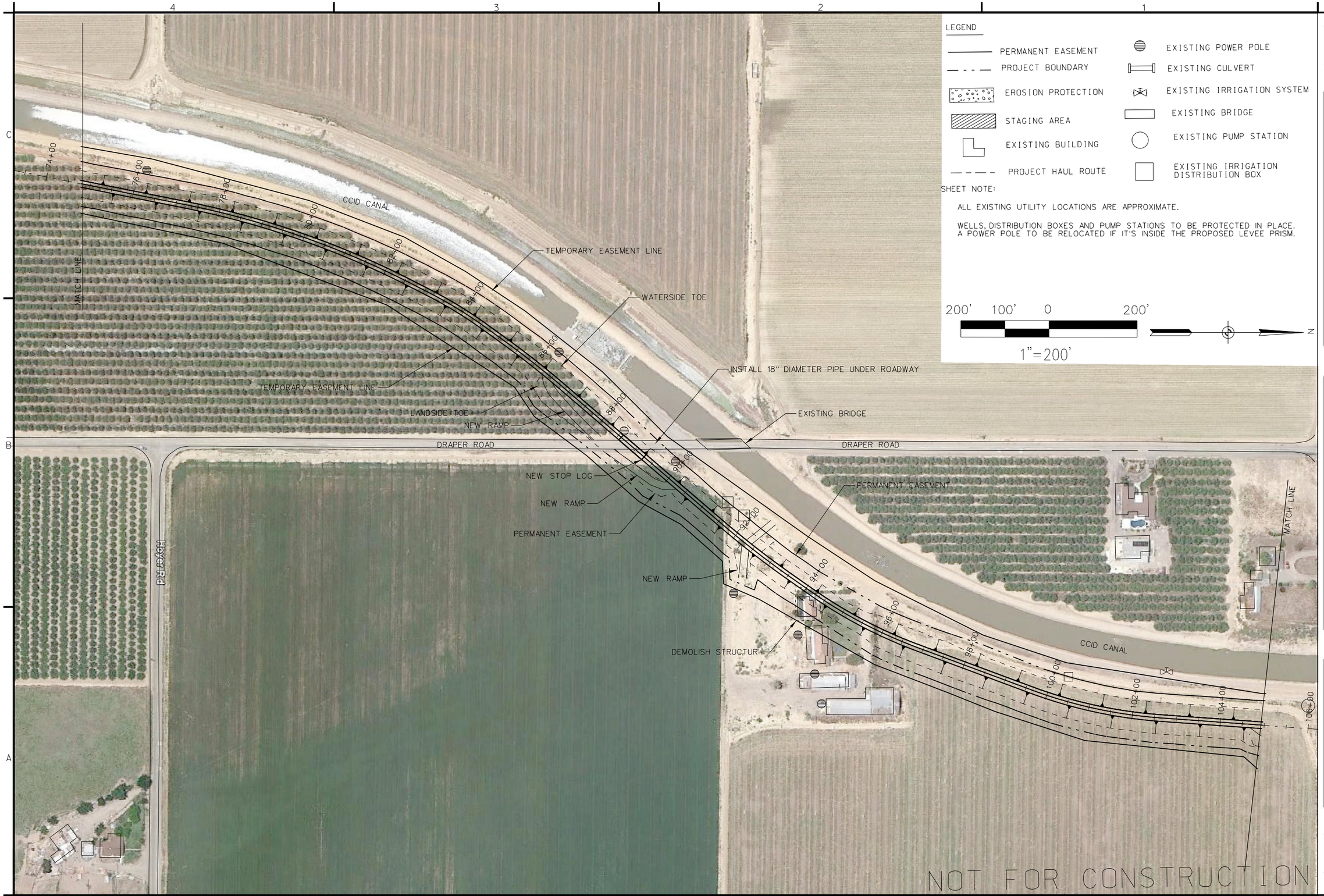
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 06



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- EXISTING BRIDGE
- EXISTING PUMP STATION
- EXISTING IRRIGATION DISTRIBUTION BOX

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200' 100' 0 200'

1"=200'

N

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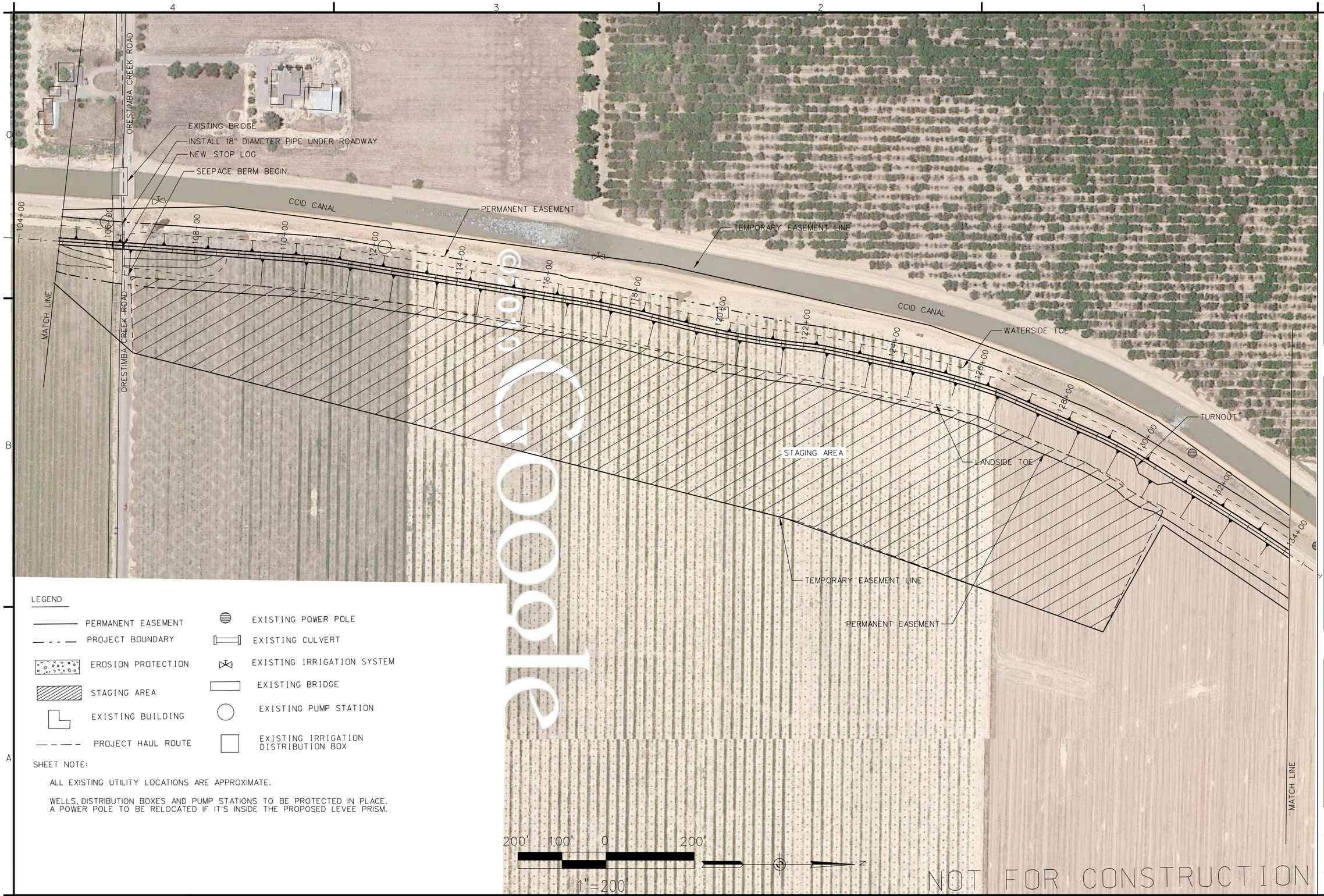
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 07

8.1.2 PLOT DATE: $$$$date$$$$ PLOT TIME: $$$$time$$$$ DGNSPEC



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
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- EXISTING IRRIGATION DISTRIBUTION BOX

SHEET NOTE:

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WELLS, DISTRIBUTION BOXES AND PUMP STATIONS TO BE PROTECTED IN PLACE. A POWER POLE TO BE RELOCATED IF IT'S INSIDE THE PROPOSED LEVEE PRISM.

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Date:
Rev.
Design file no:
Drawing Code:
File name:
Plot date:
Plot scale:

STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 08

LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- EXISTING BRIDGE
- EXISTING PUMP STATION
- EXISTING IRRIGATION DISTRIBUTION BOX

SHEET NOTE:

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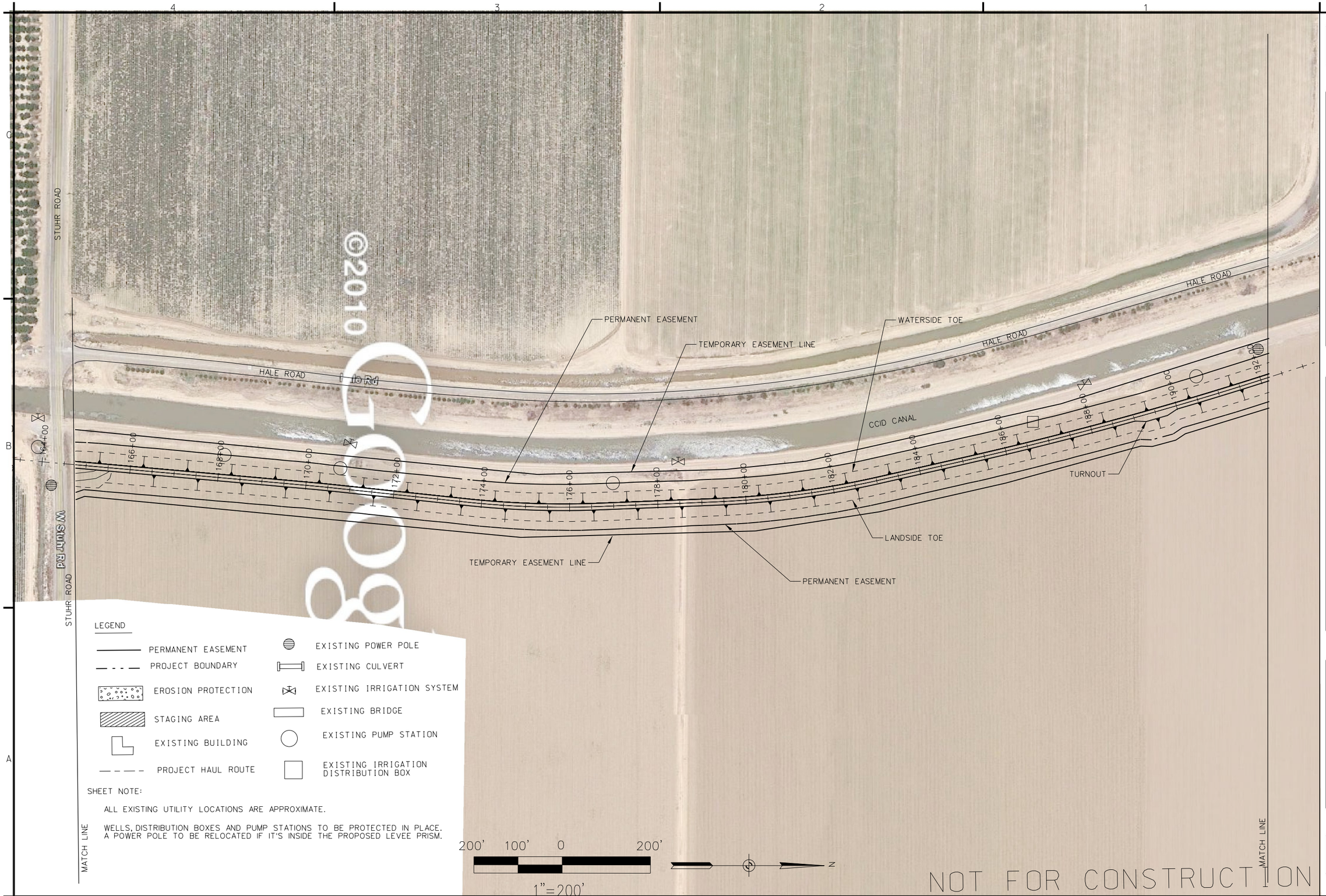
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 09



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
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- EXISTING IRRIGATION DISTRIBUTION BOX

SHEET NOTE:

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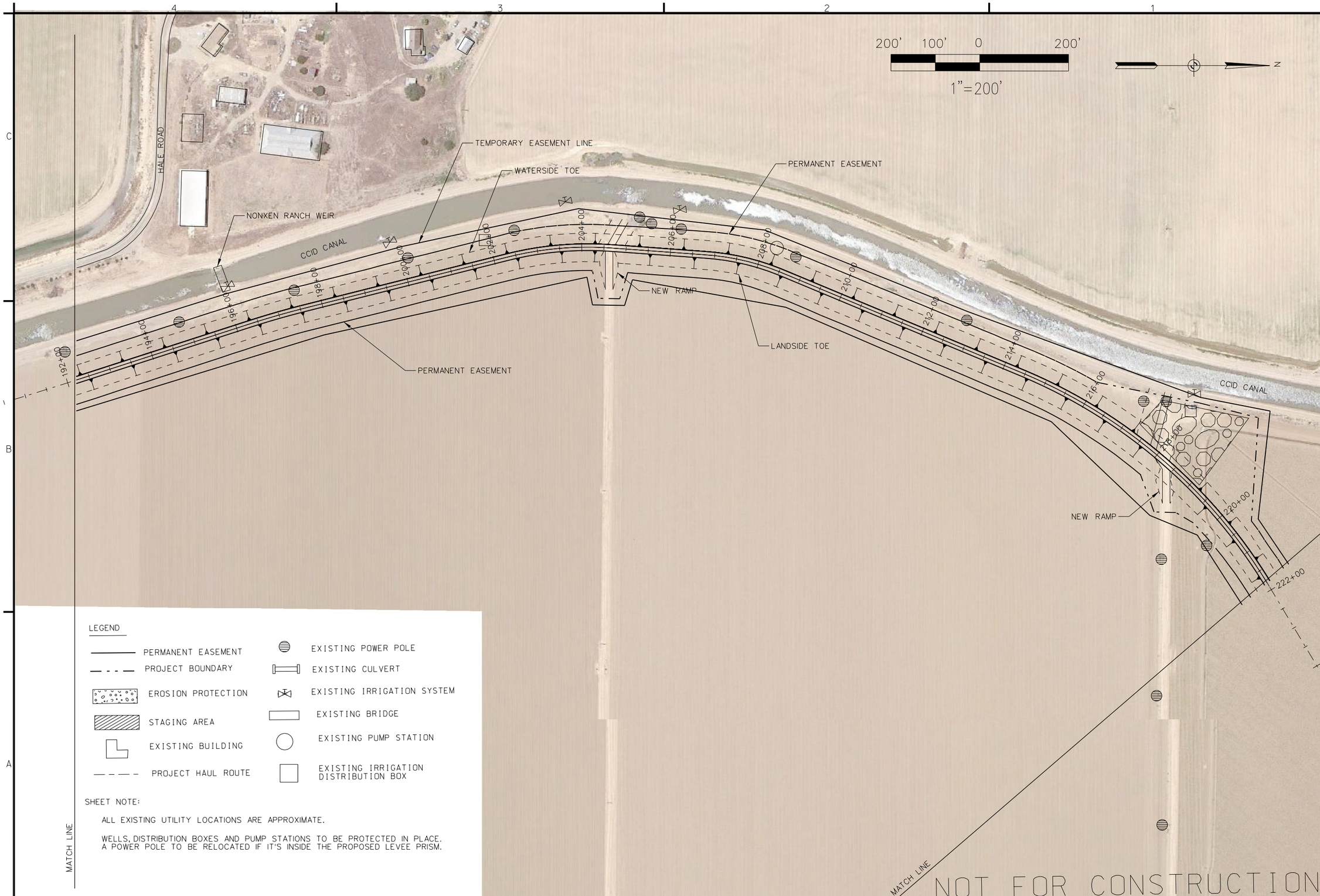
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 10



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
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- EXISTING IRRIGATION DISTRIBUTION BOX

SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

WELLS, DISTRIBUTION BOXES AND PUMP STATIONS TO BE PROTECTED IN PLACE. A POWER POLE TO BE RELOCATED IF IT'S INSIDE THE PROPOSED LEVEE PRISM.

MATCH LINE

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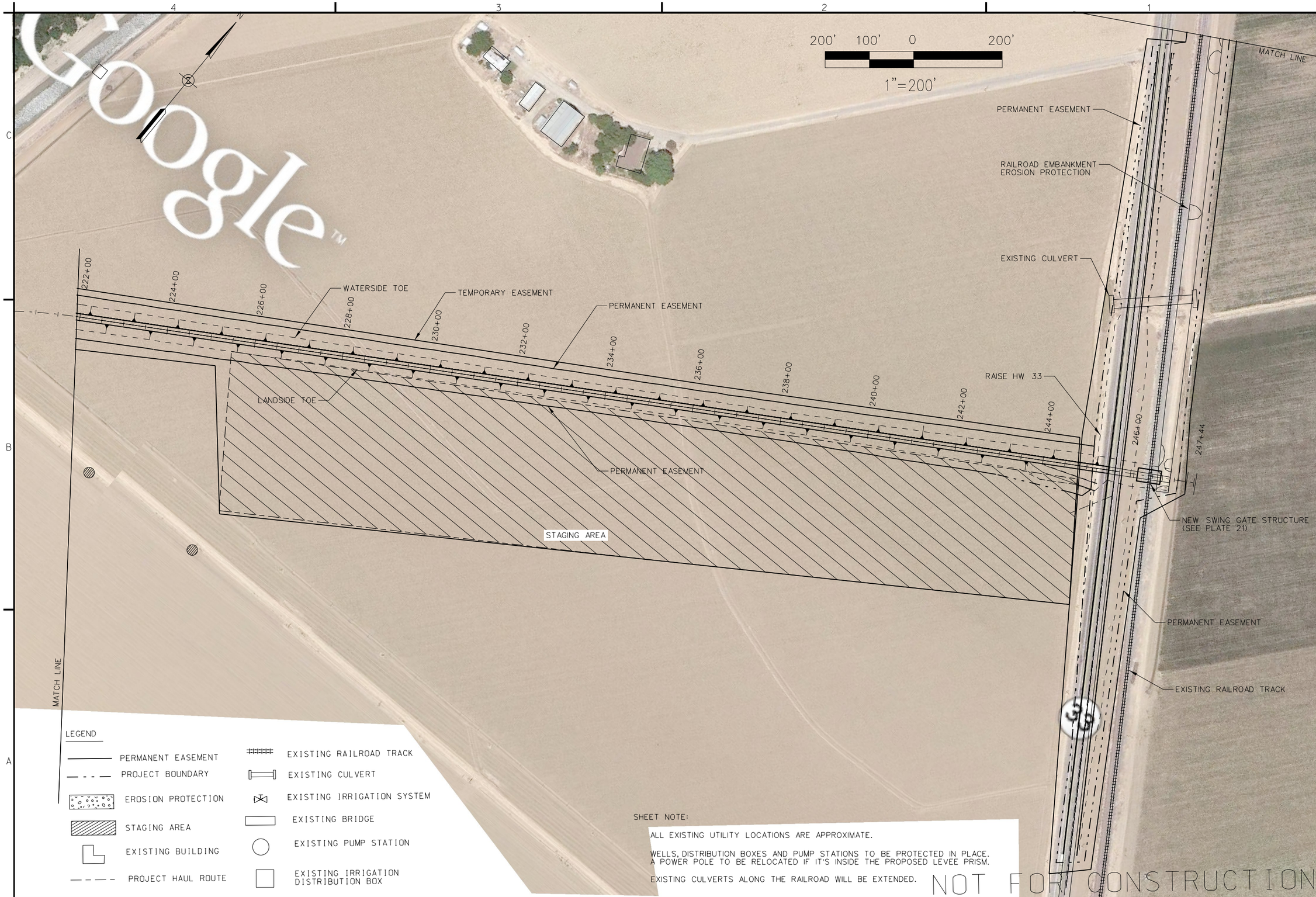
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 11



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File name:
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STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE-HIGHWAY 33
AND RAILROAD PROTECTION PLAN VIEW

Sheet reference number:
PLATE 12

8.1.2 PLOT DATE: $$$$date$$$$ PLOT TIME: $$$$time$$$$ DGNSPEC

LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING RAILROAD TRACK
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- EXISTING BRIDGE
- EXISTING PUMP STATION
- EXISTING IRRIGATION DISTRIBUTION BOX

200' 100' 0 200'

1"=200'

SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

EXISTING CULVERTS ALONG THE RAILROAD WILL BE EXTENDED.

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File name:
Plot date:
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STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

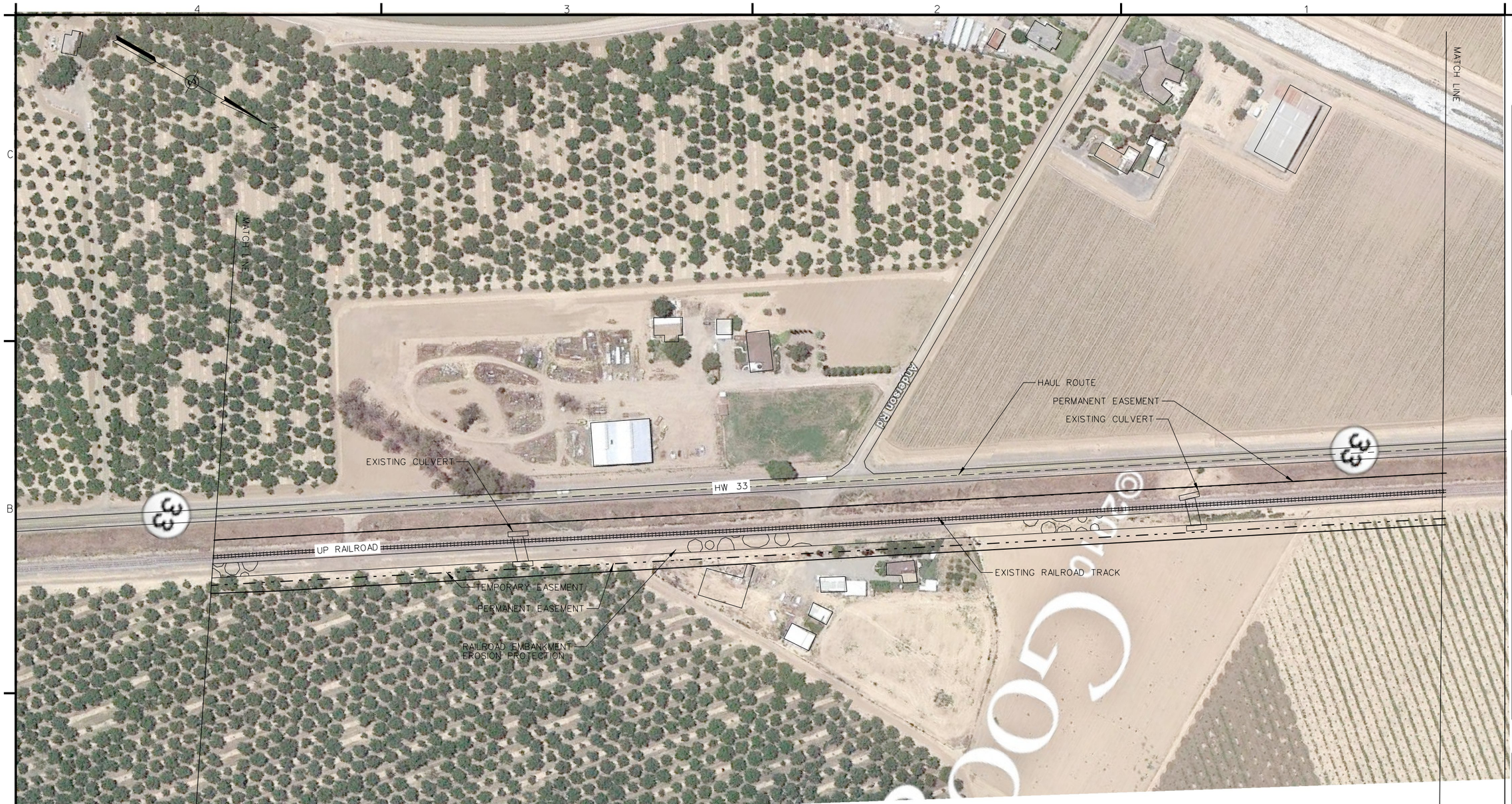
RAILROAD EMBANKMENT
EROSION PROTECTION PLAN VIEW

Sheet reference number:

PLATE 13

8.1.2

PLOT DATE: $$$$date$$$$ PLOT TIME: $$$$time$$$$ DGNSPEC



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING RAILROAD TRACK
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- EXISTING BRIDGE
- EXISTING PUMP STATION
- EXISTING IRRIGATION DISTRIBUTION BOX

200' 100' 0 200'

1"=200'

SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

EXISTING CULVERTS ALONG THE RAILROAD WILL BE EXTENDED.

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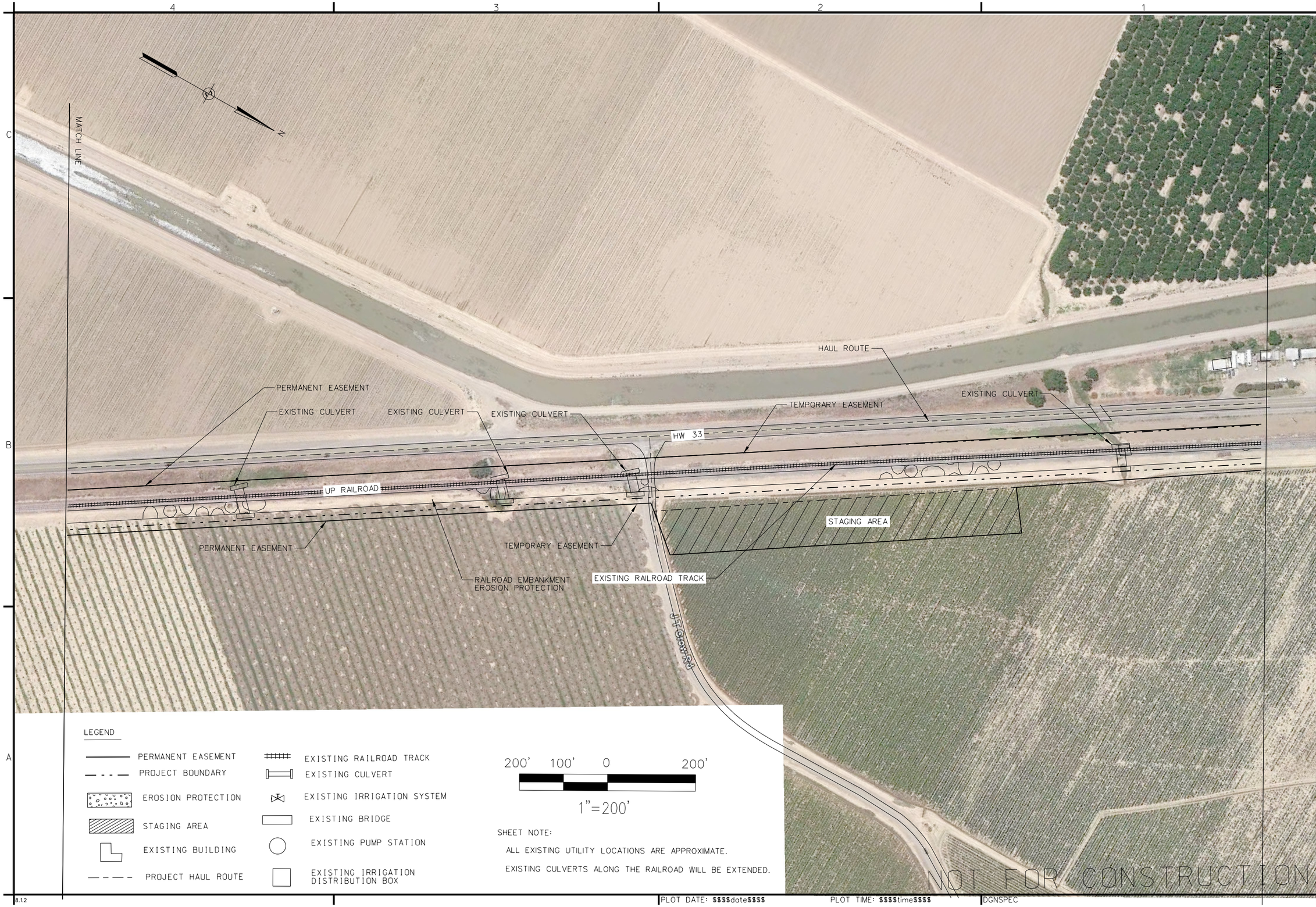
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

RAILROAD EMBANKMENT
EROSION PROTECTION PLAN VIEW

Sheet reference number:

PLATE 14

8.1.2 | PLOT DATE: $$$$date$$$$ | PLOT TIME: $$$$time$$$$ | DGNSPEC



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STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

RAILROAD EMBANKMENT
EROSION PROTECTION PLAN VIEW

Sheet reference number:
PLATE 15

LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING RAILROAD TRACK
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- EXISTING BRIDGE
- EXISTING PUMP STATION
- EXISTING IRRIGATION DISTRIBUTION BOX

200' 100' 0 200'

1"=200'

SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

EXISTING CULVERTS ALONG THE RAILROAD WILL BE EXTENDED.

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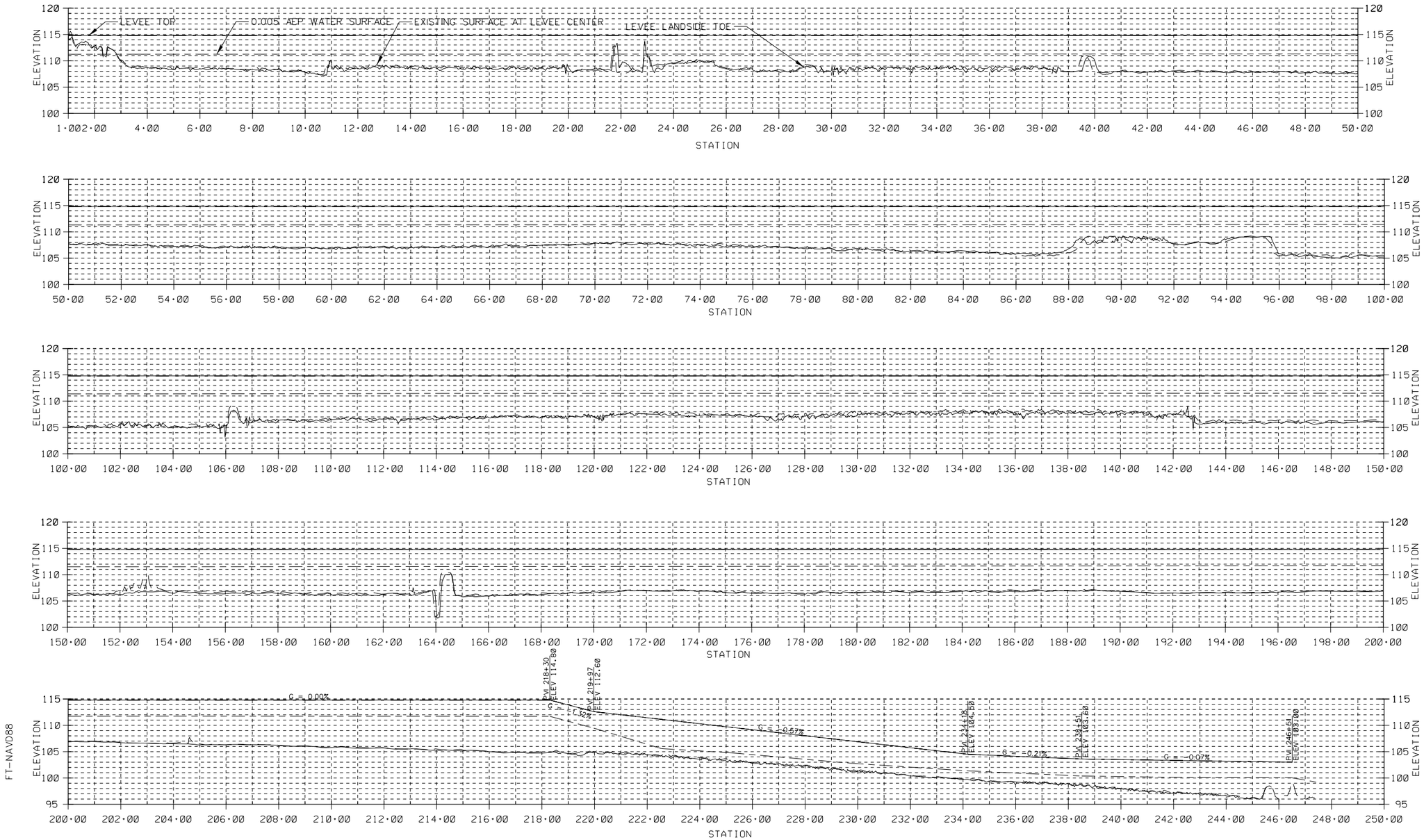
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

RAILROAD EMBANKMENT
EROSION PROTECTION PLAN VIEW

Sheet reference number:

PLATE 16

8.1.2 | PLOT DATE: $$$$date$$$$ | PLOT TIME: $$$$time$$$$ | DGNSPEC



ORESTIMBA LPP LEVEE PROFILE

400' 200' 0 400'

H: 1"=400'

20' 10' 0 20'

V: 1"=20'

NOT FOR CONSTRUCTION

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Sacramento District

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SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
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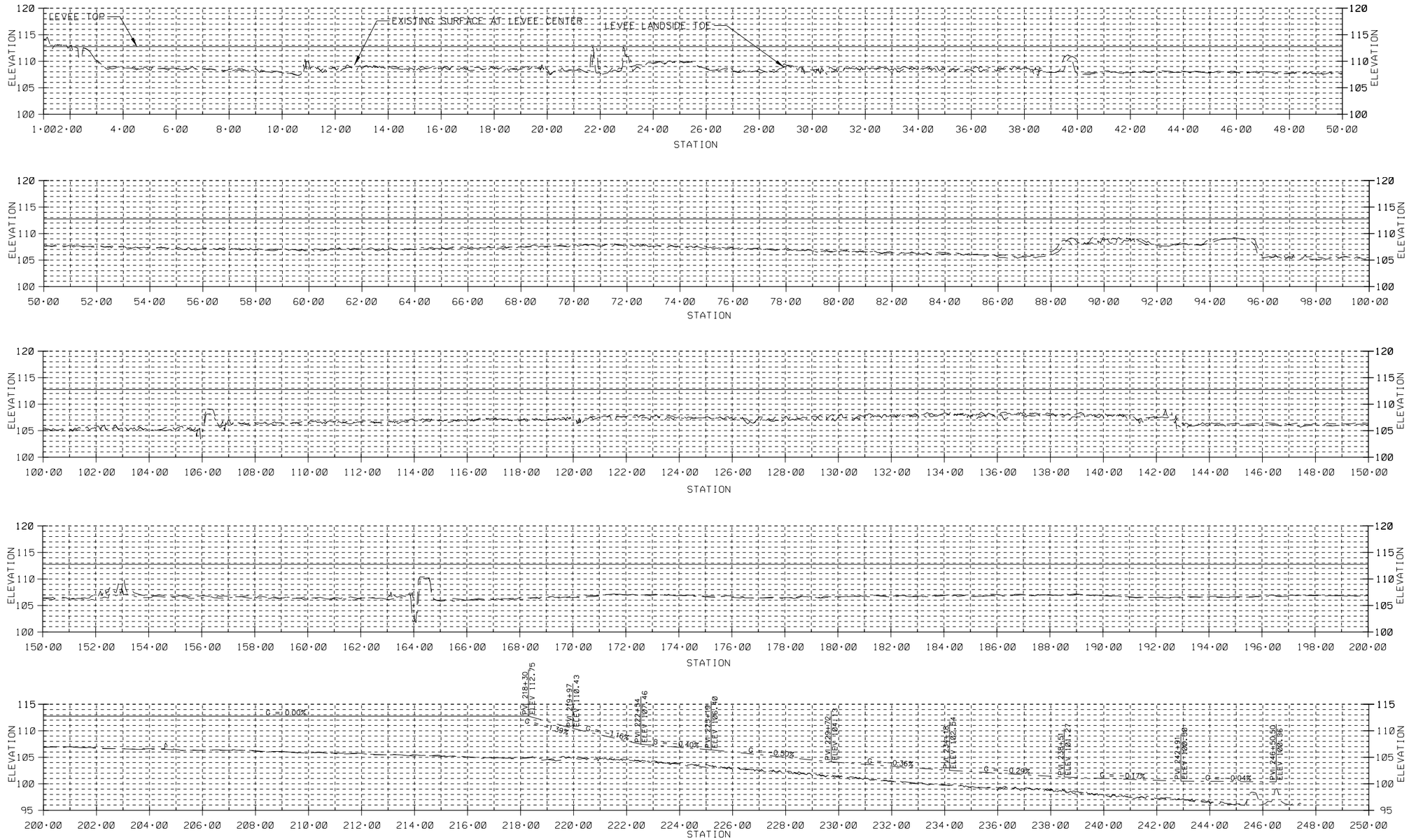
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PROFILE

Sheet reference number:

PLATE 17



ORESTIMBA NED LEVEE PROFILE

400' 200' 0 400'

H: 1"=400'

20' 10' 0 20'

V: 1"=20'

NOT FOR CONSTRUCTION

US Army Corps of Engineers
Sacramento District

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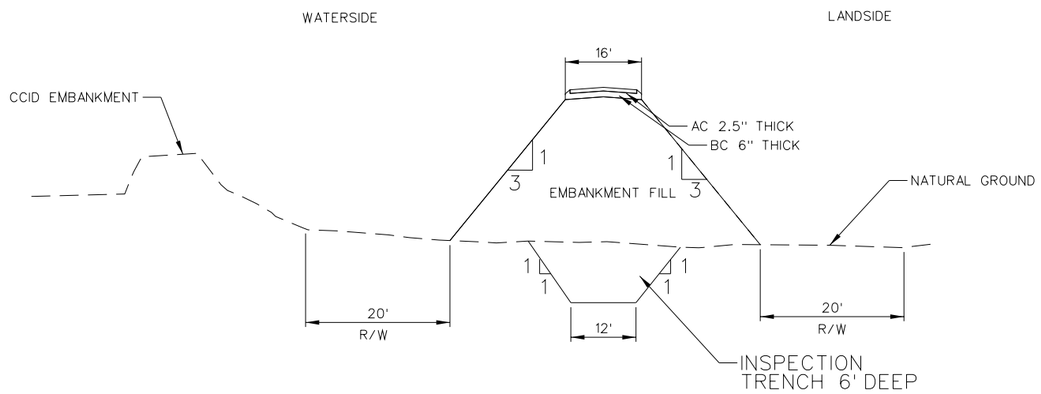
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA NED LEVEE PROFILE

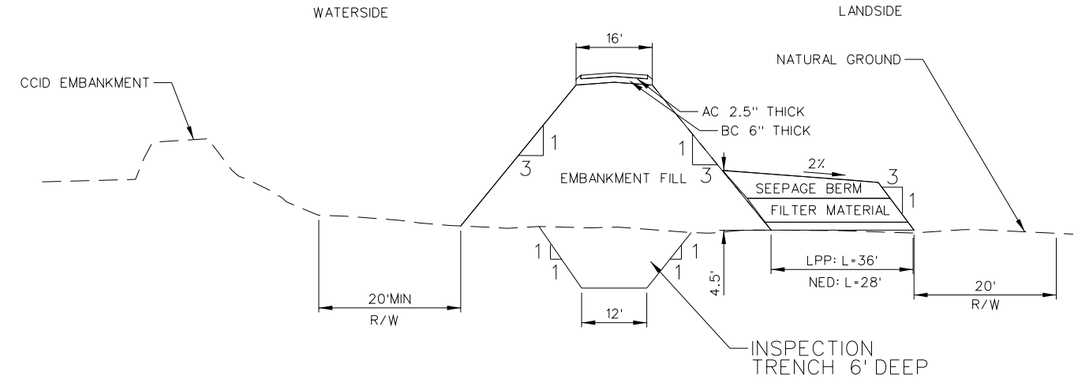
Sheet reference number:

PLATE 18



(A) CHERVON LEVEE TYPICAL CROSS SECTION

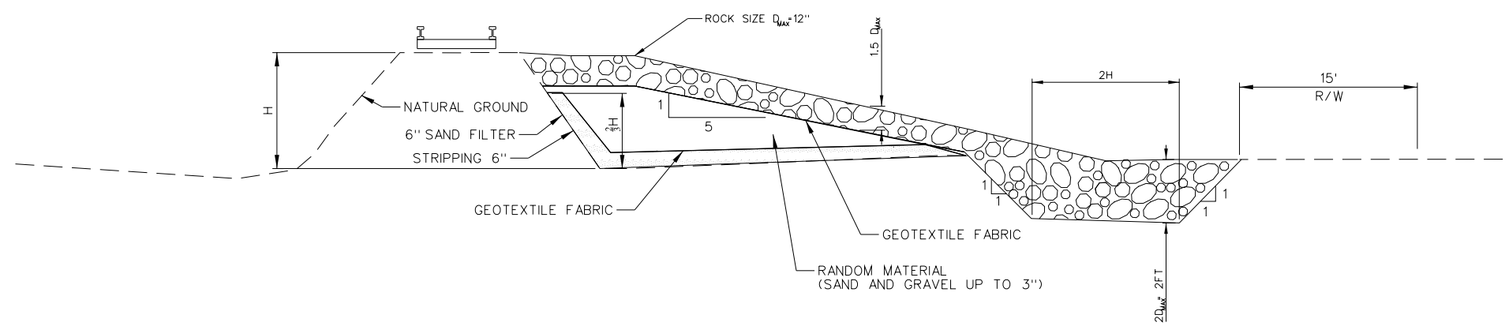
NOT TO SCALE FROM STA. 1+00 TO 106+70
FROM STA. 164+25 TO 245+00



(B) CHERVON LEVEE SEEPAGE TYPICAL CROSS SECTION

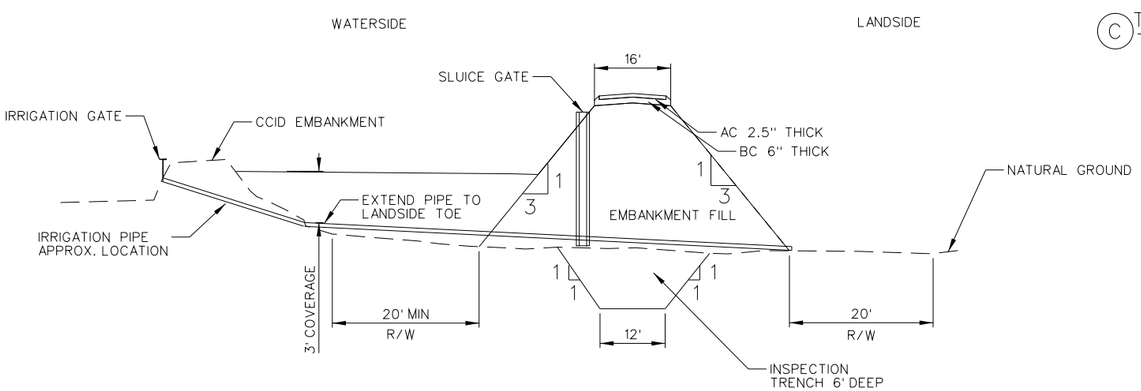
NOT TO SCALE FROM STA. 106+70 TO 164+25

SHEET NOTE:
LPP LEVEE HAS 2.5"AC AND 6"BC ON THE TOP OF LEVEE,
BUT NED LEVEE HAS ONLY 6" GRAVEL ON THE TOP OF LEVEE.
LPP SEEPAGE BERM L =28' AND NED SEEPAGE BERM L =26'.



(C) TYPICAL SECTION FOR RAILROAD EMBANKMENT PROTECTION

NOT TO SCALE TYPICAL SECTION



(D) CHERVON LEVEE TYPICAL CROSS SECTION

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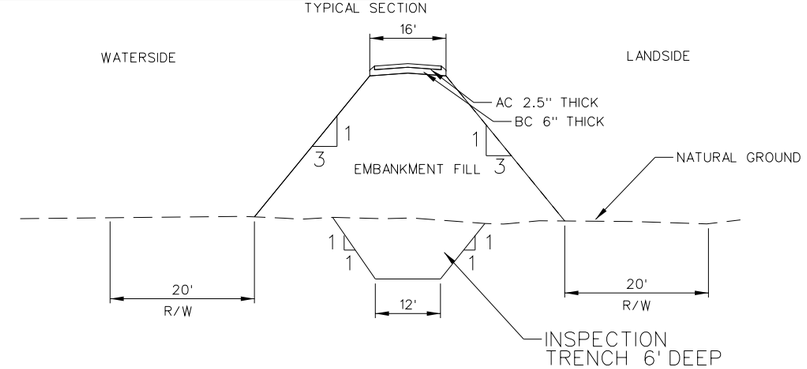

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STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

LEVEE TYPICAL CROSS SECTIONS

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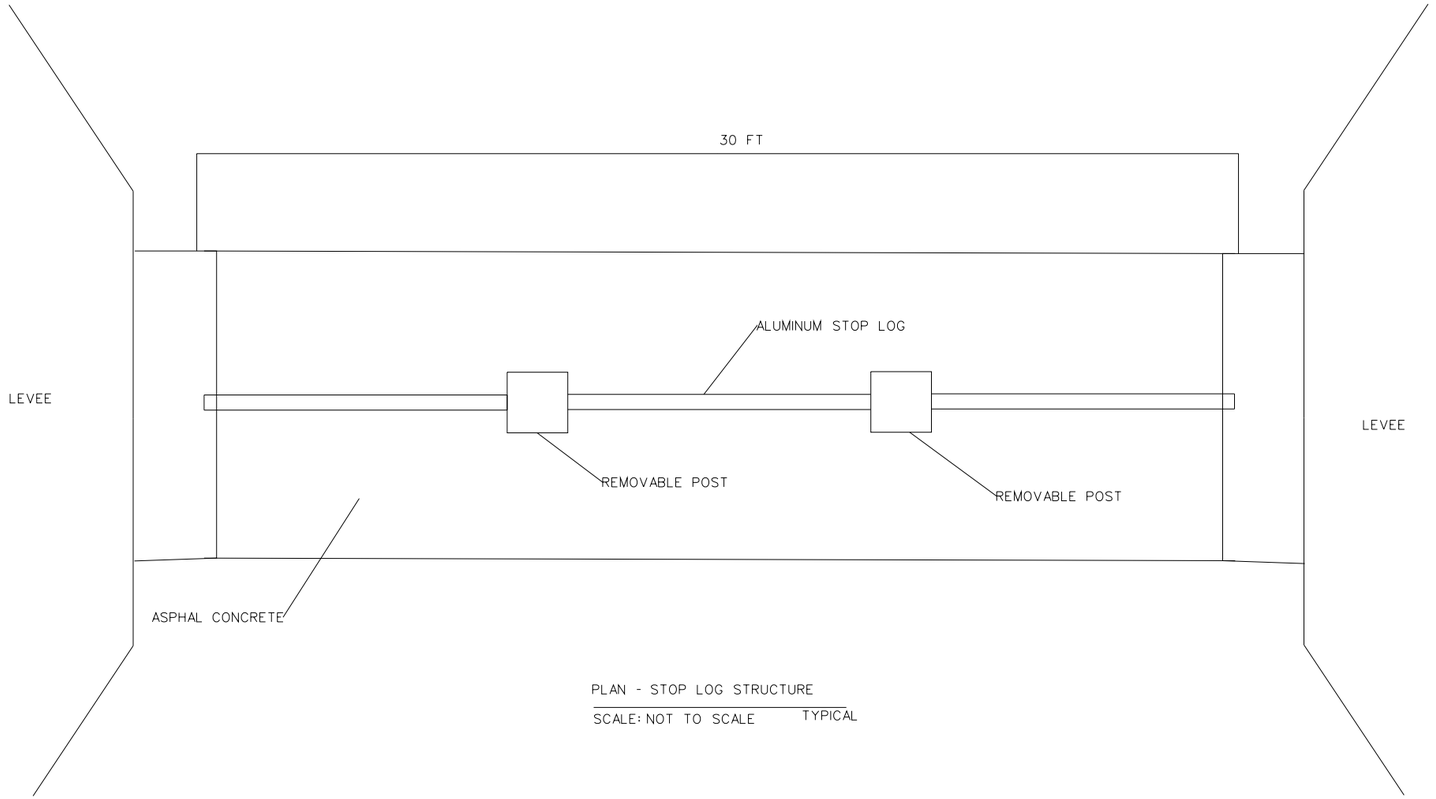
PLATE 19



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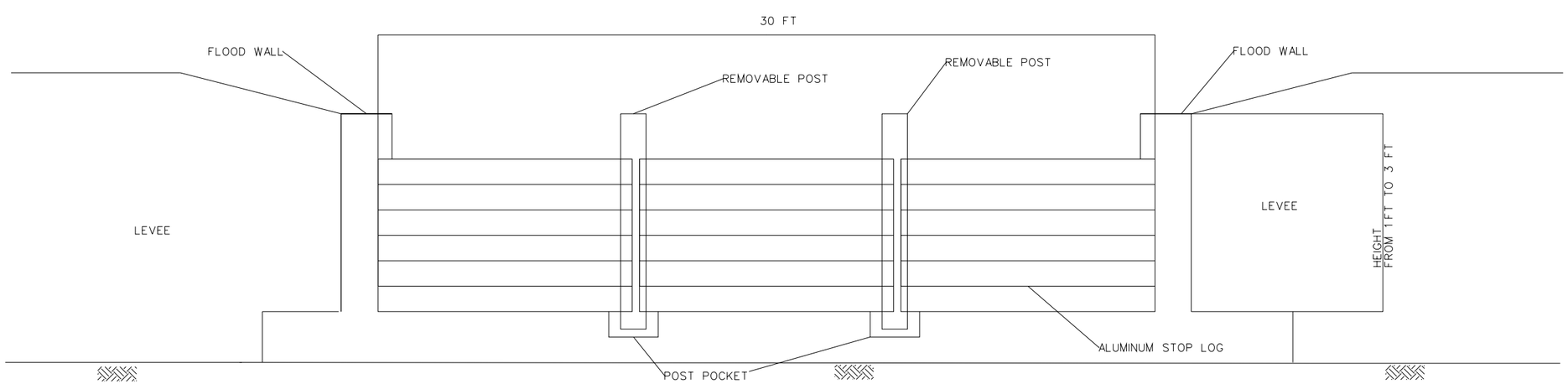

ELEVATION - STOP LOG STRUCTURE

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STOP LOG STRUCTURE

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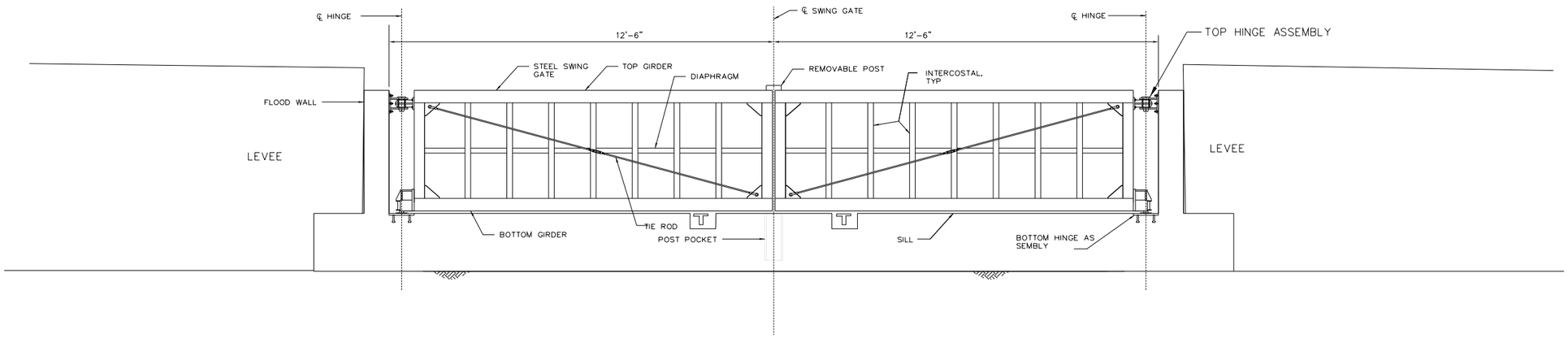
PLATE 20

AM-XX



ELEVATON – SWING GATE STRUCTURE

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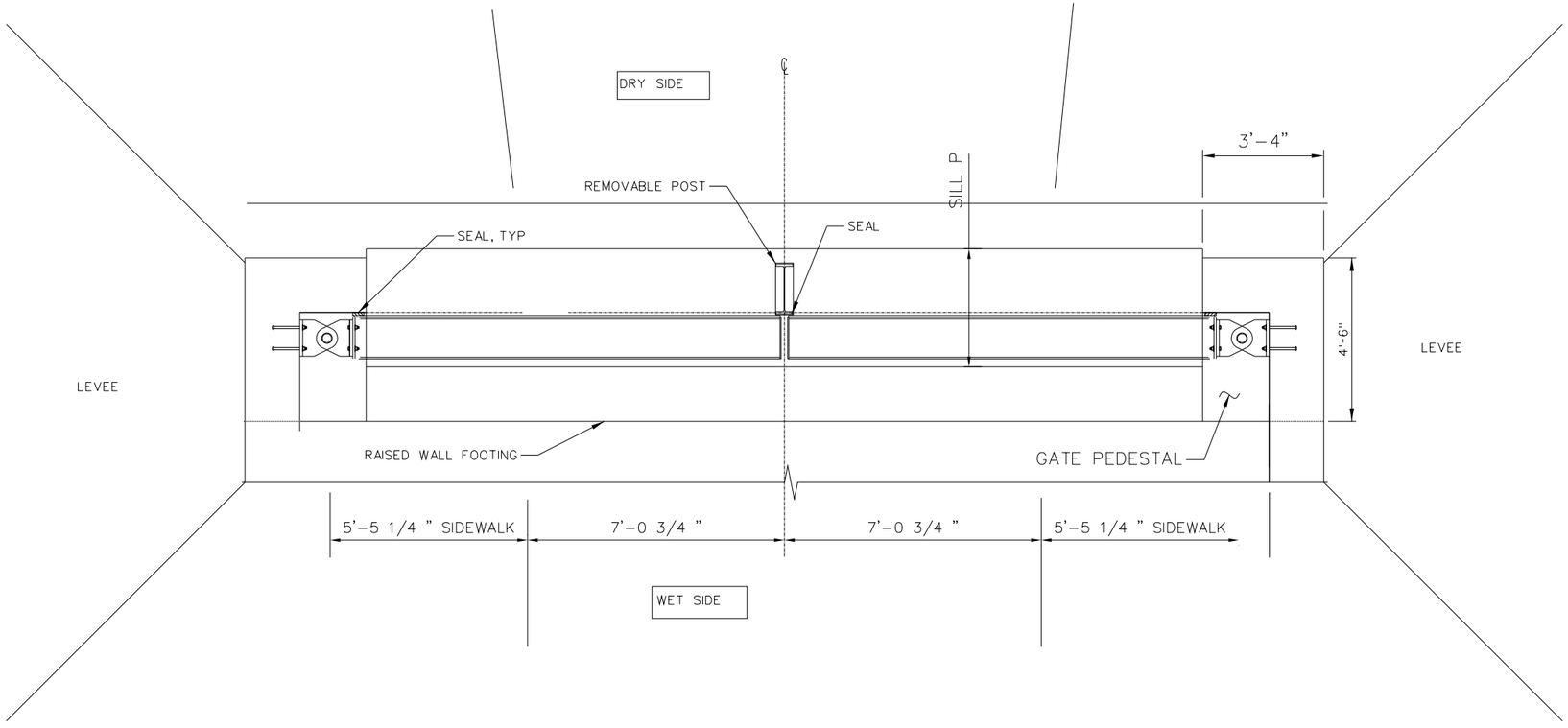

PLAN – SWING GATE STRUCTURE

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LEVEE TYPICAL CROSS SECTIONS

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PLATE 21

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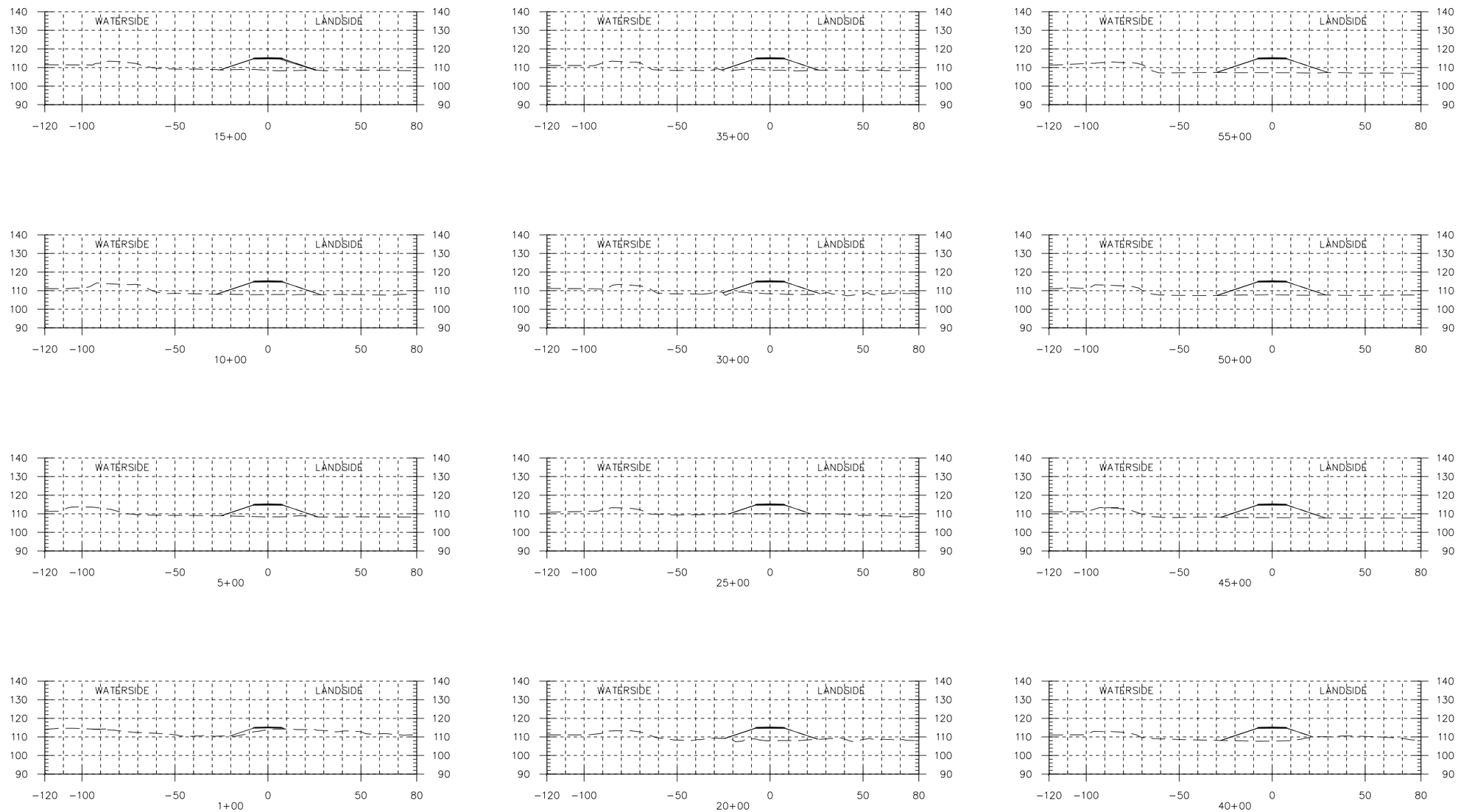

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ORESTIMBA CREEK FEASIBILITY STUDY

LPP LEVEE CROSS SECTIONS
STA. 1+00 TO STA.55+00

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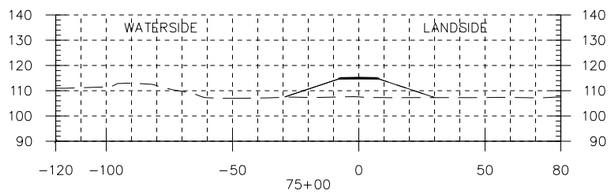
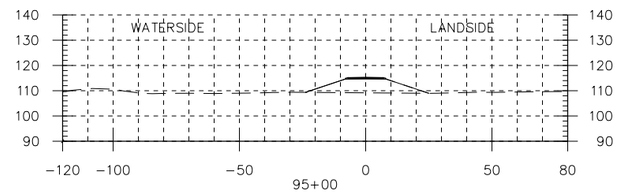
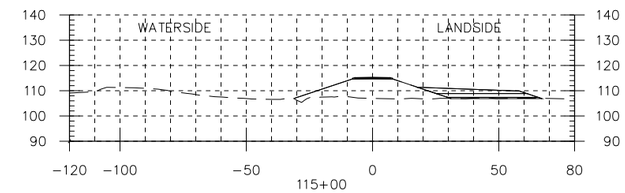
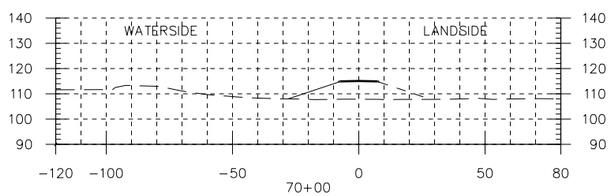
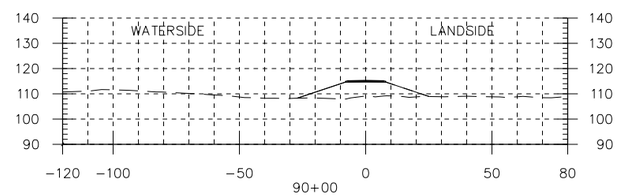
PLATE 22

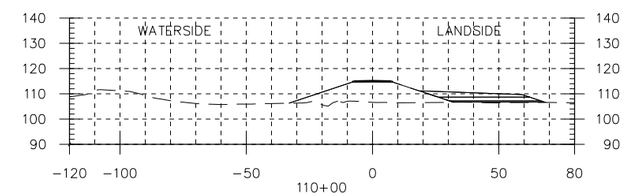


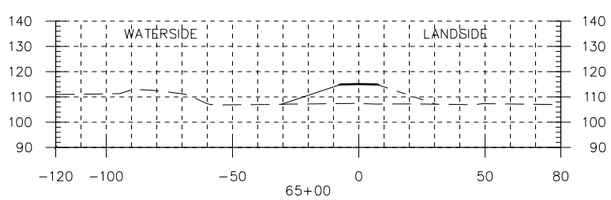


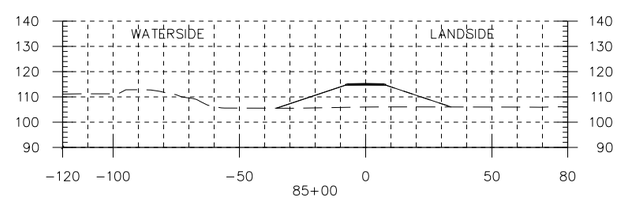


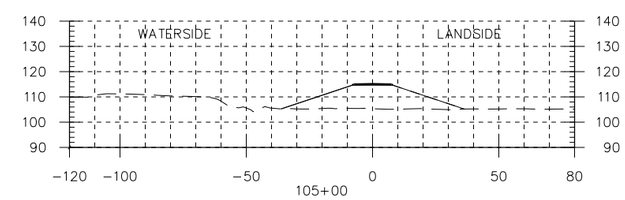


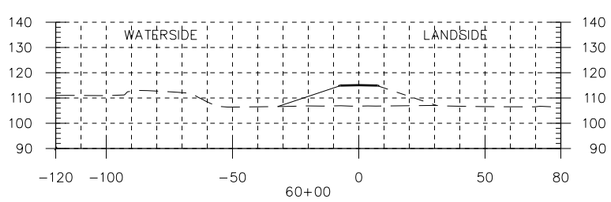


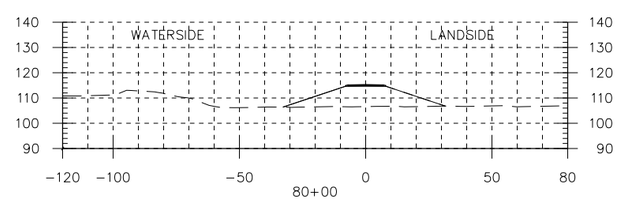


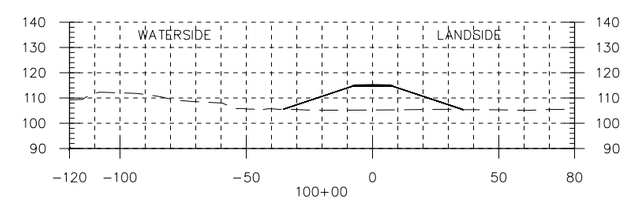












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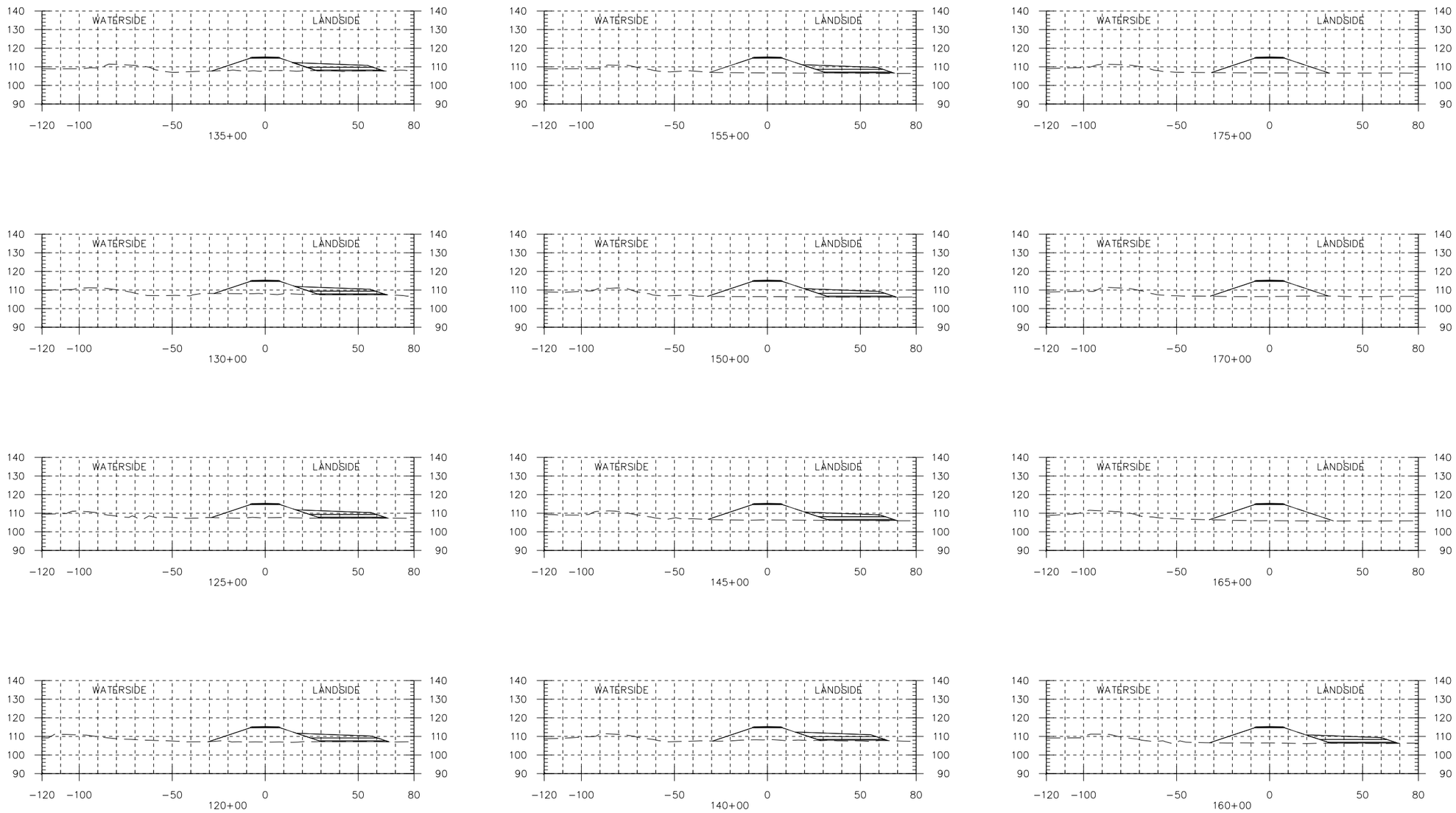
ORESTIMBA CREEK FEASIBILITY STUDY

LPP LEVEE CROSS SECTIONS
STA. 60+00 TO STA.115+00

Sheet reference number:
PLATE 23



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ORESTIMBA CREEK FEASIBILITY STUDY

LPP LEVEE CROSS SECTIONS
STA. 120+00 TO STA.175+00

Sheet reference number:
PLATE 24

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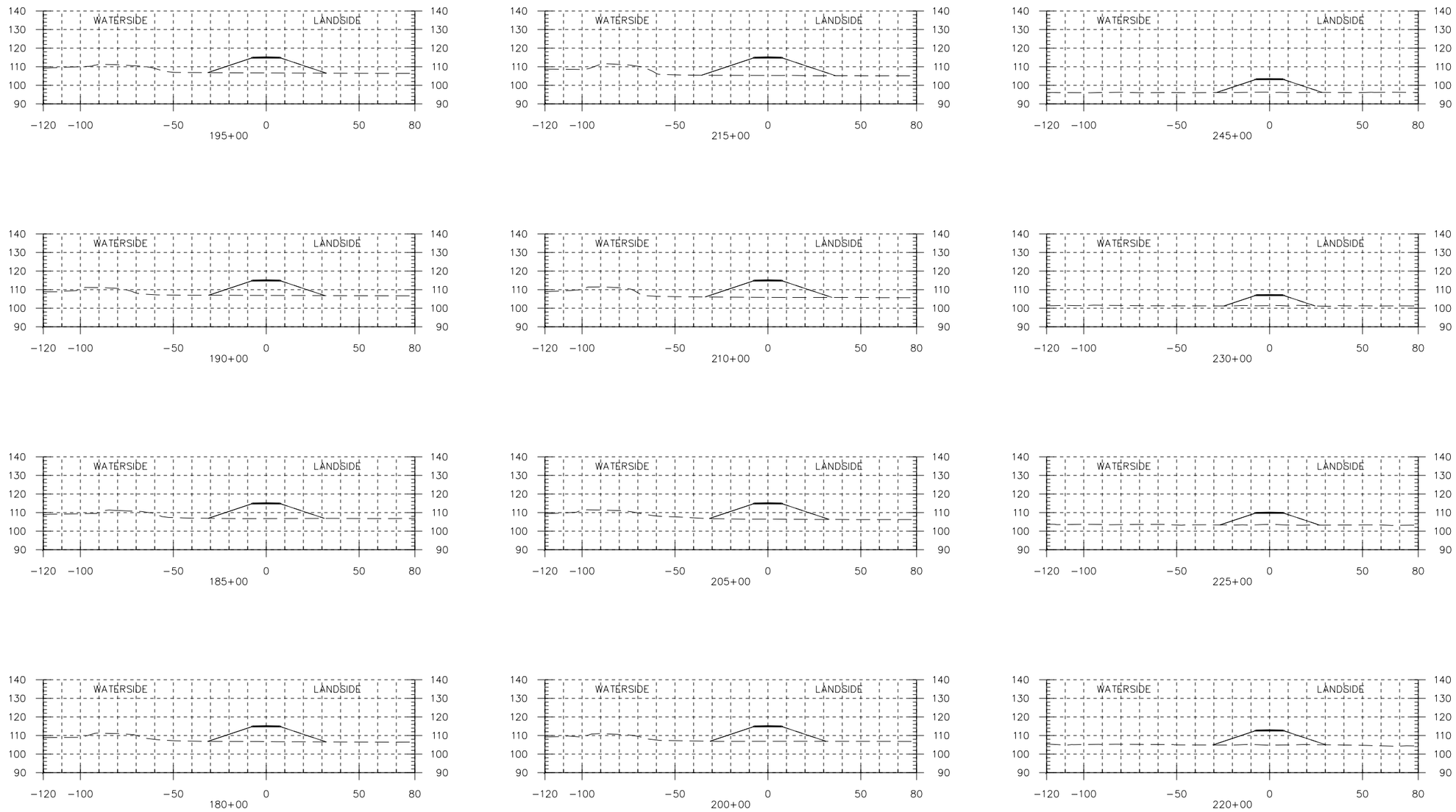

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ORESTIMBA CREEK FEASIBILITY STUDY

LPP LEVEE CROSS SECTIONS

STA. 180+00 TO STA.245+00

Sheet reference number:

PLATE 25

8.1.2

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Appendix C6.

CIVIL DESIGN

Orestimba Creek Flood Risk Management Feasibility Study

Civil Design
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Orestimba Creek Flood Risk Management Feasibility Study
Appendix C6 - Civil Design

I. Introduction

A. Site Location

The project site is located on the west side of the San Joaquin River in Stanislaus County, California. Orestimba Creek is traversed by US Interstate Highway 5, the California Aqueduct, the Delta-Mendota Canal, State Highway 33, the Northern California Railroad (NCRR), and the Central California Irrigation District (CCID) Main Canal. For the location of Orestimba Creek, see Figure C6-1.

B. Study Area Description

The study area includes the City of Newman and the surrounding rural area. The city of Newman is the largest community in the study area and is located along State Highway 33. The population of Newman City was estimated by the Census Bureau to be 7,093 residents as of 2000.[1] Newman is home to the world's first school bus company and its surrounding area are home to some of California's most efficient and important agricultural industries. Tomato and vegetable processing, cheese manufacturing, and turkey hatching are examples of some of the important agricultural industries located in the area. The area is acknowledged for crop diversity and productivity, which can be accredited to a combination of exceptional factors such as soil quality, air quality, climate and water supply.

Newman has experienced 13 floods in the past 41 years (1954, 1955, 1957, 1958, 1959, 1963, 1968, 1978, 1980, 1983, 1986, and 1995) due to flood overflows from Orestimba creek. Although the town is situated some distance from the channel, flood overflows are diverted along road and railroad embankments and other features into town.

In 1995, Newman experienced the worst flood in its 107-year history. On March 10, 1995, 12,000 cfs was recorded at the USGS gage on Orestimba Creek near the California Aqueduct. The floodwater overwhelmed the channel and flowed overland across agricultural fields, backing up against a railroad embankment and inundating the Newman.

II. Site Selection

A. Design Alternative

Ch3 –Alternative Plans discusses the selection of the project site and evaluates alternatives layouts, alignments and components. This Appendix provides civil design details for features used during plan formulation and development of the LPP and NED plans. In the F4 appendix, both the LPP plan and NED plan consisted of two primary design features, 1) modification of Orestimba Creek's Channel and 2) construction of a chevron levee along the city of Newman's northwestern perimeter. The PDT planned in more details on the two primary design features after F4. Hydraulic design team ran the

hydraulic model again and added more features on the channel modification plan and chevron levee plan.

The channel modifications could prevent agricultural damages, but it could not provide a high level of flood protection to Newman, and the resulting B/C ratio is less than 1. Due to the fact that the Chevron levee would provide protection to the urban area of Newman and has a high B/C ratio, the channel modification in both the LPP and NED plans will be removed. Both the new LPP plan and NED plan have only one primary design feature, the chevron levee.

B. The New Locally Preferred Plan (LPP)

Chevron levee would be constructed and paralleled to the east bank of the CCID Main Canal about four miles from the Newman Wasteway, and the levee alignment would be continued diagonally constructing another 0.7 miles to tie in to the railroad embankment near an existing culvert to reduce the frequency and duration of floodwater ponding on the north side of the levee. The levee would also extend an additional 35 feet east of the CNRR embankment to insure that floodwaters do not flank the proposed levee. The levee would be about 4.7 miles in total length. The proposed levee is higher than roadway elevations at four crossing locations, and a gap in the top portion of the levee is required to meet highway vertical curve safety standards. A slotted abutment would be constructed in the levee on each side of these roadways. During a flood event, stop logs would be placed into the slotted abutments, across the roadways. When installed, the stop log structure (see Plate 20 in attachment A for detail) would be approximately 1-3 feet (0.5-2 feet for NED plan) high and will prevent floodwaters from flowing through the gap. This will not interfere with traffic because the roadway to the west of the structure would be flooded when the stop logs were in place. The stop-log closure structures would be at the following locations:

- Shells Road
- Draper Road
- Orestimba Creek Road
- Stuhr Road

Another gate closure would be constructed where the levee crosses the CNRR railroad embankment. The proposed levee is higher than the railway and a gap in the top portion of the levee is required to prevent interference with the levee grade. The levee grade can not be changed because the height of the levee segment is dependent on floodwaters overtopping this grade. An abutment would be constructed in the levee on each side of the railway. During a flood event, floodgates hinged on the abutment would be closed across the railway. When installed, the swing gate structure (see Plate 21 in attachment A for detail) would be approximately 2-3 feet high and will prevent floodwaters from flowing through the gap. This will not interfere with railway traffic because the railway north of the levee would be flooded when the swing gate structure was in place.

Where the levee crosses state Highway 33, the highway will be raised to meet levee design elevations (see Plate 12 Attachment A for detail). Highway 33 would be raised

over an additional 2000 foot length to account for longer vertical curves necessary to go over the higher levee.

Another component of the levee is a seepage berm. Geotechnical analysis shows a thin clay blanket with high exit gradient from station 106+00 to 164+00. Levee seepage could threaten levee stability in this area. A seepage berm needs to be constructed along the landside levee toe from station 106+00 to 164+00 (See Plate 8, 9, and 19 in Attachment A).

This LPP would also include railroad embankment protection plan (see Plate 12,13,14,15 and 19). During small flood events and localized rainfall events, Orestimba creek floodwater or local runoff would be conveyed to the east side of the railroad embankment through existing drainage culverts. However, the railroad would be overtopped during a big flood event. To mitigate for this condition, the east side of the railroad embankment will need sand filter and be lined with rock revetment to prevent erosion. Approximately 10 culverts under the CNRR embankment will be extended to accommodate the seepage embankment and erosion protection. New upstream and downstream headwalls will be constructed at each culvert. The railroad embankment protection plan begins where the proposed levee crosses the railroad and ends where the railroad crosses Orestimba Creek. The distance is approximately 2 miles.

The LPP levee includes three feet of freeboard above the mean 0.5% water surface elevation. This freeboard was requested by the local sponsor in order to meet FEMA certification requirements.

C. The Tentative National Economic Development Plan (NED)

The tentative NED Plan includes the same elements as the LPP plan but different dimensions. The NED levee would have the same alignment as the LPP levee (See Plate 2, Attachment A). The NED levee would be about three feet lower than LPP levee (See Plate 18 for Profile in Attachment A). Since seepage berm size depends on levee height, the size of the NED seepage berm would be smaller than the size of LPP seepage berm.

D. Borrow Site and Disposal Area

The Fink landfill has been designated as a preliminary borrow source for the proposed levee alignment. In the event that this source is not available at the time of levee construction, levee embankment requirements are described in Geotech Appedix. The Disposal area would be also in Fink Landfill. The total distance to the construction site from Fink Land fill is about 12 miles.

E. Staging Area

The contractor's staging areas will be located at existing open agricultural areas. Three main temporary construction staging areas are proposed. Staging area 1 is approximately 1.9 acres and is located along the railroad embankment between JT Crow Road and the end of the project area. It would be used for construction of the railroad embankment protection. Staging area 2 is approximately 10.6 acres and would begin at an unnamed farm road (west of Lundy Road) and extend to where the levee ties into Highway 33. It would be used for the Highway 33 construction project and the levee construction

project. Staging area 3 is approximately 11.7 acres. It would be used for the levee construction project. Staging areas are shown on Plate 01 and Plate 02. Each proposed staging area has temporary easements, included in the real estate estimate.

F. Access Roads & Haul Routes

In Plates 01 and Plate 02 also show haul routes. The existing Fink Road, Highway 33, J T Crow Road, Lundy road, Stuhr Road, Drape Road and Orestimba Creek Road would be used during construction. Most roads are paved and ready to use. There are no new roads to be constructed to allow access to the project sites. Adequate temporary work area easements are accounted for to allow for contractor access to all sites during construction.

A 16-foot width patrol road would be constructed on the top of the proposed levee. The patrol road would be used for maintenance and emergency operations. The proposed NED levee plan would have six inches gravel on the top of the new levee, and the proposed LPP levee plan would have six inches gravel and 2.5 inches asphalt concrete on the new levee. The pavement width for LPP would be14 feet. New ramps would be built, so the patrol road could be accessed through existing public roads, such as Newman Waste Way, Shiells Road, and Stuhr Road.

G. Interior Drainage

Construction of the levee will create about 41 acres of isolated drainage area between the CCID berm and the proposed levee toe. This area would have no upstream contributing drainage area and rainfall would infiltrate naturally without drainage pumps or culverts. In the case of a breach or overtopping of the CCID canal berm, this area would be inundated by floodwaters. Culverts would be installed under the roadways and earthen embankments, so most of the floodwaters would drain by gravity following the flood event. However, it is anticipated that some floodwaters would be trapped in low isolated areas. Since this would only occur during a rare event and may vary by event, portable pumps are recommended to drain the isolated areas. It is anticipated that this minor volume of floodwater would be pumped into the CCID canal where it would be drained back to Orestimba Creek through CCID's outlet structure and would occur once hydrologic/hydraulic conditions permit.

III. General Design Considerations

Design considerations information included levee construction guidance, seepage mitigation measures, and relocation requirements. The project layout and features of the flood damage reduction alternatives LPP and NED for the Orestimba Creek Feasibility Study are described in Attachment A.

A. Datum

All elevations provided herein are relative to the NAVD88 vertical datum and NAD83 horizontal datum. Horizontal coordinates are projected to the California State Plane Zone III coordinate system.

B. Source of Data

Topographic contours are obtained from TIN of phase 1 LIDAR topography, Central Valley Flood Evaluation, and Delineation California Department of Water Resource Flown on 30 April 2008. Aerial photography is from Google Earth updated in 2010 or 2011. LIDAR nominal post spacing is 1-meter horizontal accuracy +/- 3.5ft at 95% confidence levee and vertical accuracy +/- 1.2 ft at 95% confidence level.

C. General Levee Inspection Trench and Levee Design

The base width of the levee and inspection trench is determined by the required height, the center width, and slopes. The allowable landside and waterside levee slopes are determined by the strength of the underlying soils, the levee fill material, and the width of the levee crown. Table 2-4 provides general levee design criteria and inspection trench criteria provided by Soils Design Section for this feasibility study. See the Plate 22 and 23 in Attachment A for typical sections of levees and inspection trenches.

Table 6-1: Levee and Inspection Trench Design Criteria

Components	Landside Slope (horizontal to vertical)	Waterside Slope (horizontal to vertical)	Levee Crown Width/ Trench Bottom width (feet)
Levee	3:1	3:1	16
Inspection Trench	1:1	1:1	12

IV. Real Estate

The general real estate requirements for the Orestimba Creek Feasibility Study project are the acquisition of temporary work area easements (TWAE), flood protection levee easements (FPLE), Staging area, railroad embankment improvement easements and the easements for the raised portion of Highway 33(see Plate 01 and Plate 02 in Attachment A). Typical real estate footprint requirements for improvement levees are shown in typical cross section detail on Plate 19 in Attachment A. Refinement of these footprints will be provided in final design prior to levee construction.

<u>Levees</u>

The water side toe of the levee would be approximately 20 feet from the toe of CCID canal berm. The levees will have a permanent FPLE, which will provide space for the levee, landside seepage remediation, and a 20-foot operations and maintenance right-of-ways on the landside of the seepage remediation feature and waterside toe. Levees will require TWAE on both the waterside and landside. Approximately 35 feet landward of all the new levees and/or berm toes will be needed temporarily for staging of equipment and materials necessary for construction. TWAE on waterside of the new levee would be required to extend to the waterside hinge point of CCID berm in order to install irrigation system.

<u>Staging Area</u>

There would be total three staging areas, all TWAE. The staging area 1 would be used for railroad embankment protection construction. The staging area 2 would be used for Highway construction project and levee construction project. And staging area 3 would be used for levee construction project. Locations of staging area show on Plate 01 and plate 02. The Table 6-2 below shows surface area of staging area.

Table 6-2: Staging Area

ALTERNATIVE	STAGING AREA 1 (ACRES)	STAGING AREA 2 (ACRES)	STAGING AREA 3 (ACRES)
NED PLAN	1.9	10.6	11.7
LPP PLAN	1.9	14.6	15.7

Highway 33

Highway 33 would be raised approximately 4 feet to equal the top of levee elevation where it crosses the proposed LPP levee, and it would be raised about 1.5 feet where it crosses the proposed NED levee. The raised segment of roadway would be designed to meet standard Caltrans specifications. Both sides of the Highway 33 would have 4H:1V slope if raising the highway. The highway would be affected about 1080 feet for NED plan and about 1850 ft for LPP plan. And the easement would be 20 ft from the toe, and TWAE would have 30ft from the toe.

Railroad Embankment

Railroad Embankment would be flattened its downstream slope to 5H:1V, and it is shown as detail C on Plate 19. Its easement would be 15 ft from toe and its TWAE would be 25 ft from the toe. The required easements show on Plate 12, 13, 14, 15 and 16 in Attachment A.

V. Relocations

In general, actual relocations of existing utilities and other facility features with the selected plans are minimal. Most of the lands are currently designated agriculture. The utilities along the proposed levee alignment are irrigation gates, pipes, power poles, pump stations, distribution boxes and a ditch. There are also about 10 culverts under railroad track. Those pipes would be extended to the railroad downstream toe. The Table C6-3 describes the quantity of utilities of each alternative. Those utility items were assumed 30% contingency over construction contract costs.

Several existing groundwater wells are located between the levee waterside toe and CCID berm. These wells will be flood proofed to an elevation greater than top of levee.

Irrigation gates, pump stations and distribution boxes would be outside the proposed levee prism and would be protected in place during construction. Construction of the levee segment would interfere with 24 CCID gravity diversion pipes that discharge CCID irrigation water to the eastern side of the canal. Irrigation diversions would be maintained as gravity systems by extending the pipes through the levee embankment and providing positive closure gates on the water side (west side) of the levee. Irrigation pumps, sand filter, piping, etc. impacted by the project will be modified to accommodate

the changes. Since all irrigation pipes are gravity pipes, they could be extended to landside toe of the proposed levee. Those metal pipes might be replaced with concrete pipes or enclosed with concrete for the future. Each irrigation pipe or ditch going through the levee will require a positive closure structure, such as sluice gate (See detail D on Plate 19, Attachment A). Power poles along the proposed levee alignment may be impacted and relocated.

An existing ditch between Shells Road and Orestimba Creek Road would be relocated. Its width is about 7 ft and about 3.5 ft deep. The new ditch would be located away a minimum of 20 ft and a minimum distance of 10 times its depth from the levee toe.

Building structures are located inside the proposed levee footprint would be moved out. There are about 7 building structures that would be bought out and demolished. The locations of building structures are shown on the Plate 01 Attachment A.

Table C6-3 Relocations and Cost Schedule:

Utility/Facility Feature	Quantities on NED Plan	Quantities on LPP Plan	Cost on NED Plan ($)	Cost on LPP Plan ($)
Extend Irrigation Systems/Pipes	24	24	1,724,000	1,814,000
Power Poles	55	55	1,316,000	1,316,000
Demolish Building Structures	7	7	275,000	275,000
Ditch along CCID canal	1	1	10,000	10,000
Ditches cross the Proposed Levee	2	3	236,000	724,000
Culverts along UPP Railroad	10	10	237,000	237,000
HW33	Elevate 1.5 ft	Elevate 4 ft	816,000	1,542,000
Well Relocation	10	10	622,000	622,000
Railroad Removal & Replacement for Inspection Trench	44	44	81,000	81,000
Total Cost			5,317,000	6,621,000

VI. Operation and Maintenance

It is assumed that standard USACE and State of California requirements for levee operations and maintenance would be followed. The local sponsor shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. The Table C6-4 includes maintenance items. If the life span of the project

is taken to be 50 years, the estimated present worth for each O&M item is listed on the Table C-6-4. The interest rate was token i=4.13%. The annual cost on O&M for local sponsors would be $97,267 for LPP and $89,522 for NED. Additional O&M requirements and assumptions are described below.

1) Caltrans will take full responsibility to repair flood water caused erosion of the highway 33 embankment on Highway 33.

2) The existing culverts under Highway 33 and railroad track would continue to operate, and the government will not be responsible for any culverts maintenance cost.

3) CCID will allow residual floodwaters to be discharged into their canal following any overtopping or failure of the canal. Sponsor will be required to maintain and use portable pumps for this purpose.

4) After construction, CCID will obtain section 408 approvals for any modification to the project including any modification necessary to meet their irrigation delivery objectives.

5) Sponsor will insure stop log structures and flood gates are tested and are fully operational.

6) CCID and CNRR will maintain their embankment height to be no higher than existing conditions from the north end of the proposed levee for a distance of two miles in northern direction.

Table C6-4 Operation and Maintenance Items

Items	Life Cycle	Present Value for O&M Item on NED ($)		Present Value for O&M Item on LPP ($)	
		Federal Cost	Non Federal Cost	Federal Cost	Non Federal Cost
Emergency Supplies and equipment	50	0	156,148	0	234,233
Flood Preparedness and Training	50	0	62,459	0	62,459
Levee embankment Maintenance	50	0	517,863	0	679,787
Patrol road	50	0	428,235	0	438,837
Ground Repair	50	0	395,092	0	424,450
Vegetation Management	50	0	342,012	0	380,202
Riprap Revetments Restoration	50	0	50,965	0	50,965
Closure Structures Inspection & Maintenance	50	0	146,264	0	146,264
Pipe Gate Maintenance	50	0	63,266	0	63,266
Interior Drainage System Maintenance	50	0	4,222	0	4,222
Irrigation System Inspection & Maintenance	50	0	29,253	0	29,253
Irrigation System Detailed Inspection	50	0	60,168	0	60,168
Dewatering Between CCID Levee & New Levee	50	0	35,312	0	35,312
Bi- Yearly Inspection	50	0	181,805	0	181,805
Bi-Yearly Mowing	50	0	118,694	0	138,483
Corps Inspection	50	309,843	0	309,843	0
Quarterly Levee Patrol	50	0	117,011	0	117,011
Railroad Embankment Maintenance	50	0	119,675	0	119,675
Engineering & Surveying Services	50	0	312,296	0	312,296
Total		309,843	3,140,739	309,843	3,478,687

VII. Recommended Plan

The tentatively selected plan is the LPP. This plan is justified. This plan allows the local community to meet both FEMA certification requirements and the State of California's criteria for funding of flood management projects.

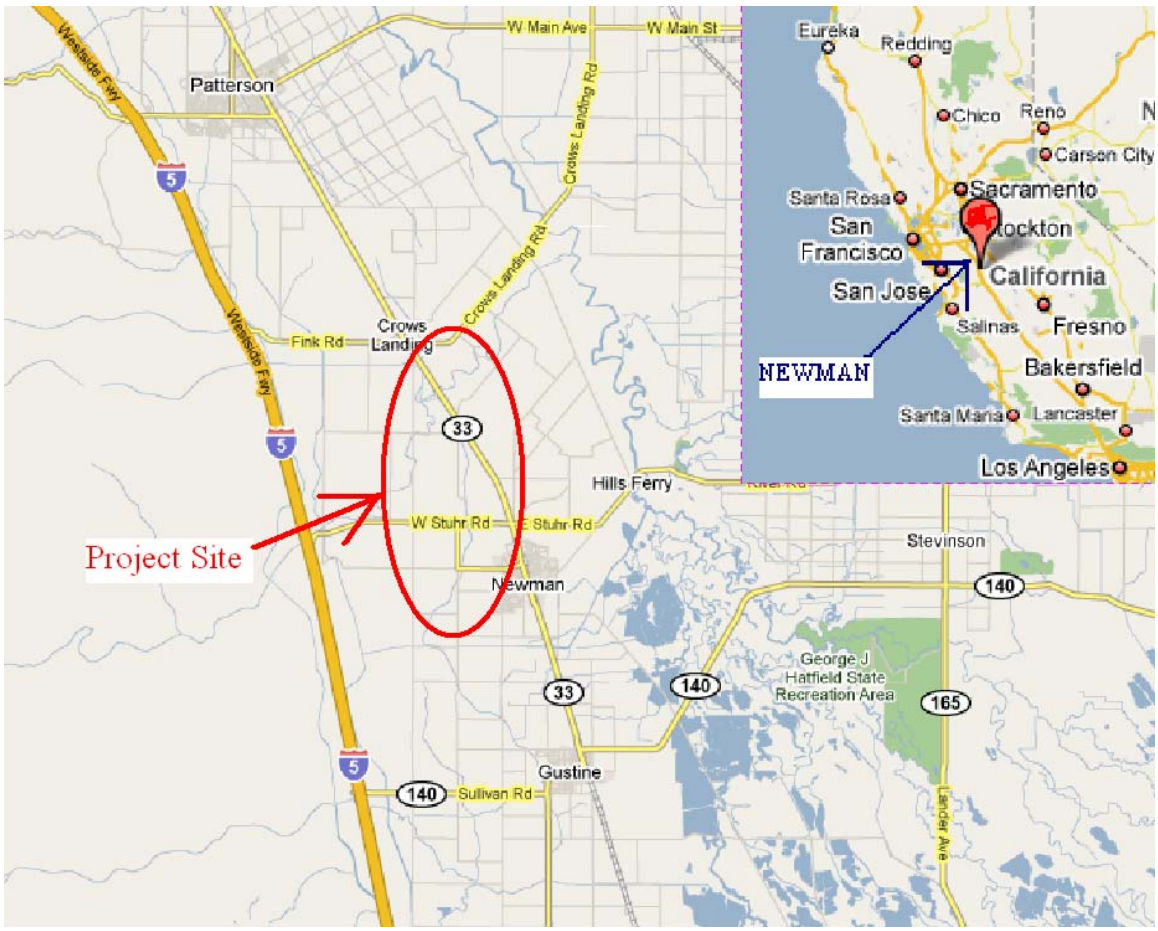

Figure C6-1

1. U.S. Census Bureau, (2000), http://www.census.gov

US Army Corps
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ORESTIMBA CREEK FEASIBILITY STUDY
ATTACHMENT A

STANISLAUS COUNTY
CALIFORNIA

FY_2012

CHEVRON LEVEE WITH CHANNEL MODFICATION.

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This project was designed by the Sacramento District of the U. S. Army Corps of Engineers. The initials or signatures and registration designations of individuals appear on these project documents within the scope of their employment as required by ER 1110-1-8152

Approved
Chief, Engineering Division XX/XX/XX Date:
Prepared Under the Direction of
Col., Corps of Engineers District Engineer

Drawing Code:
Designed by
Drawn by
Spec No.
Design File No:
FILE

Approved Functional Adequacy
Chief, Design Br XX/XX/11 Date:
Prepared by
SACRAMENTO DISTRICT
DESIGN BRANCH
Chief, Civil Engr Des Sec B XX/XX/11 Date:

STANISLAUS COUNTY CALIFORNIA
ORESTIMBA CREEK FEASIBILITY STUDY
WITH CHANNEL MODIFICATION
COVER SHEET

Sheet reference number:
G-001

PLATE LIST

PLATE NO.	DESCRIPTION
	GENERAL
G-001	COVER SHEET
G-002	SHEET LIST
PLATE 01	OVERALL PLAN
PLATE 02	LPP LEVEE OVERALL PLAN
PLATE 03	NED LEVEE OVERALL PLAN
PLATE 04	CHANNEL MOD OVERALL PLAN
PLATE 05	KEYMAP
PLATE 06	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 07	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 08	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 09	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 10	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 11	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 12	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 13	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 14	RAILROAD EROSION PROCTION PLAN
PLATE 15	RAILROAD EROSION PROCTION PLAN

PLATE NO.	DESCRIPTION
PLATE 16	ORESTIMBA CHANNEL MOD PLAN VIEW
PLATE 17	ORESTIMBA CHANNEL MOD PLAN VIEW
PLATE 18	ORESTIMBA LPP LEVEE PROFILE
PLATE 19	ORESTIMBA NED LEVEE PROFILE
PLATE 20	ORESTIMBA CREEK PROFILE
PLATE 21	ORESTIMBA CREEK PROFILE
PLATE 22	EROSION PROTECTION CROSS SECTIONS
PLATE 23	LEVEE TYPICAL CROSS SECTIONS
PLATE 24	RAILROAD BRIDGE CROSS SECTION
PLATE 25	LPP LEVEE CROSS SECTIONS
PLATE 26	LPP LEVEE CROSS SECTIONS
PLATE 27	LPP LEVEE CROSS SECTIONS
PLATE 28	LPP LEVEE CROSS SECTIONS
PLATE 29	CHANNEL MOD CROSS SECTIONS
PLATE 30	CHANNEL MOD CROSS SECTIONS
PLATE 31	CHANNEL MOD CROSS SECTIONS
PLATE 32	CHANNEL MOD CROSS SECTIONS

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ORESTIMBA CREEK FEASIBILITY STUDY

PLATE LIST

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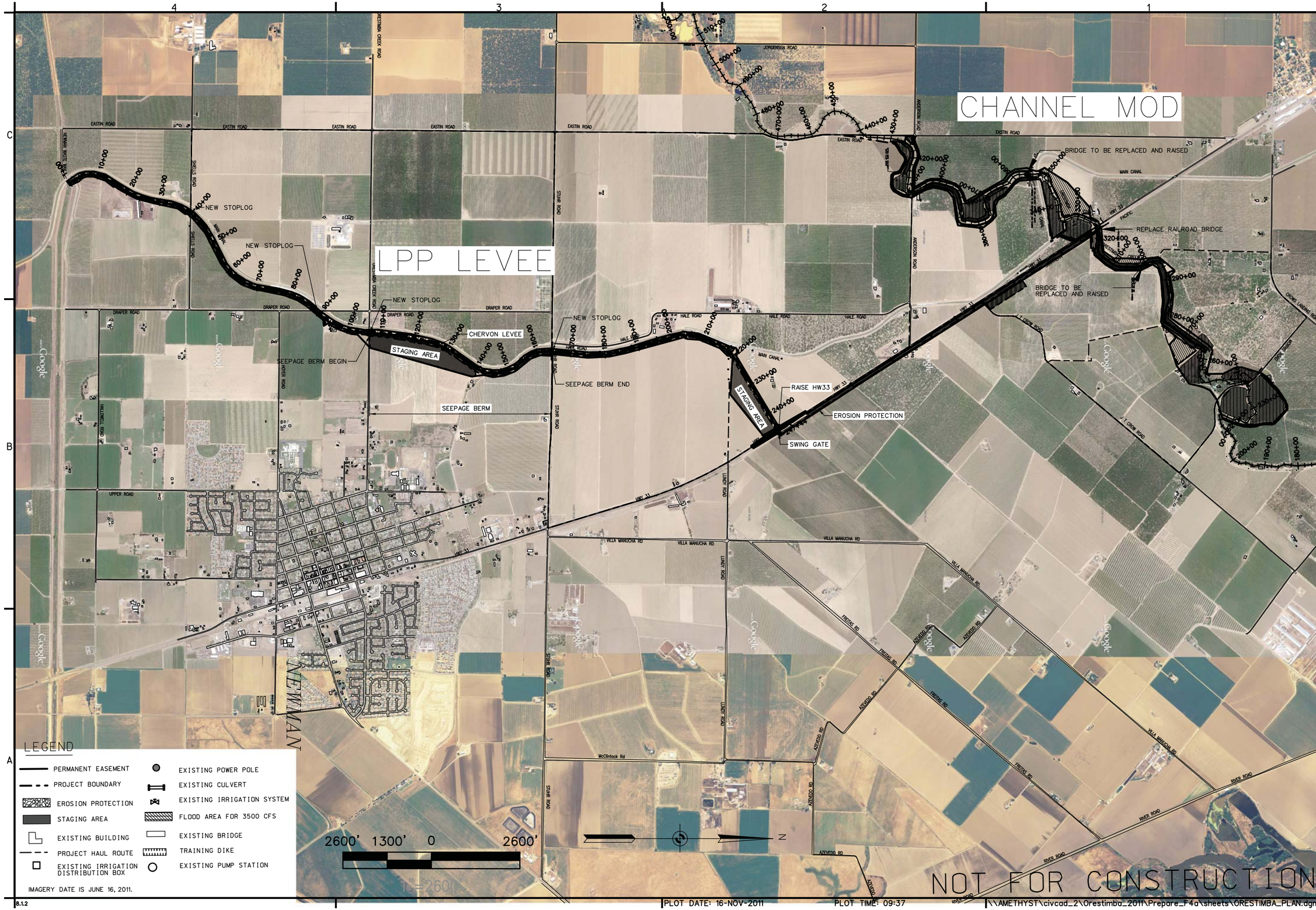

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OVERALL PLAN

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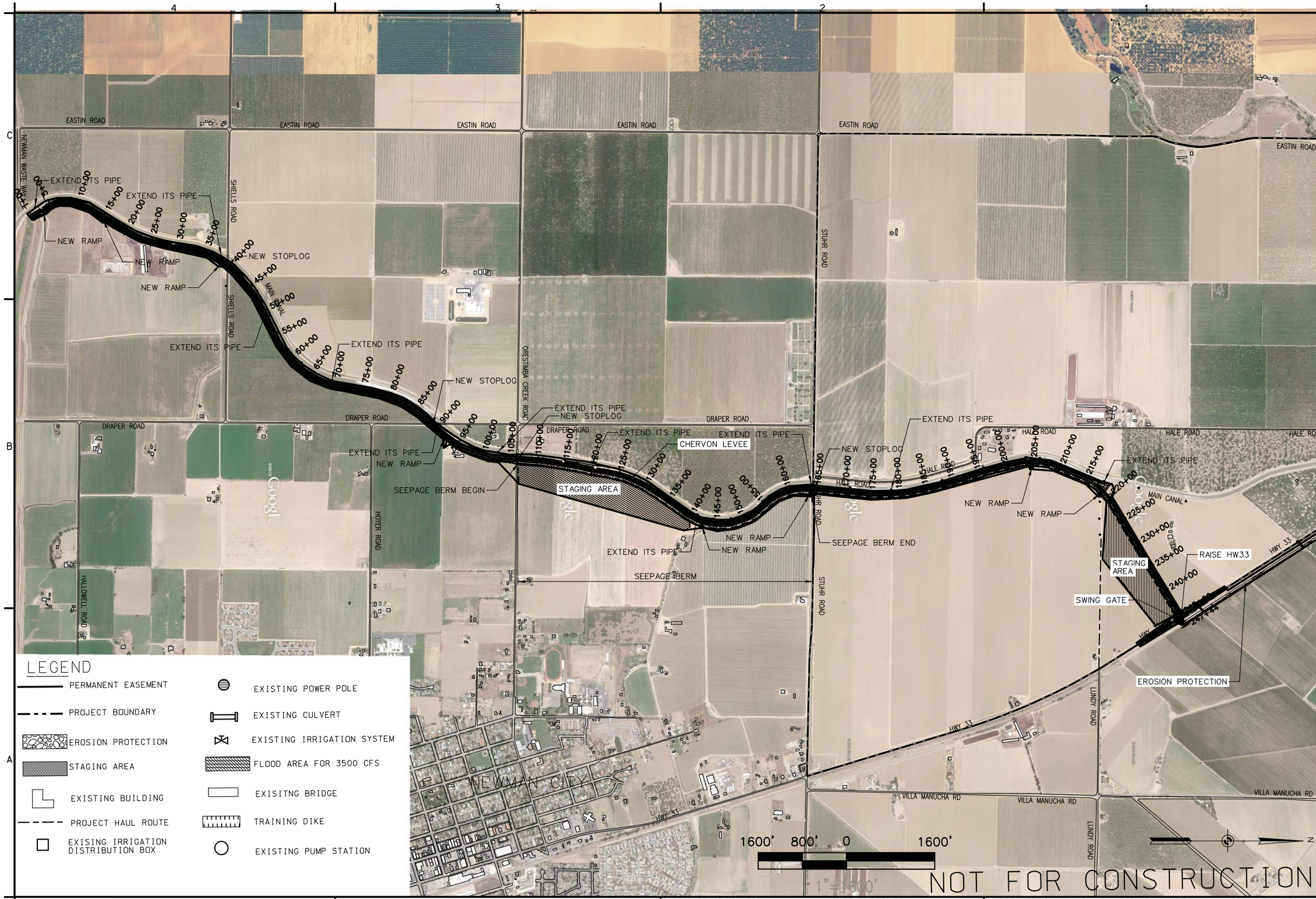

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LPP LEVEE OVERALLL PLAN

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PLATE 02

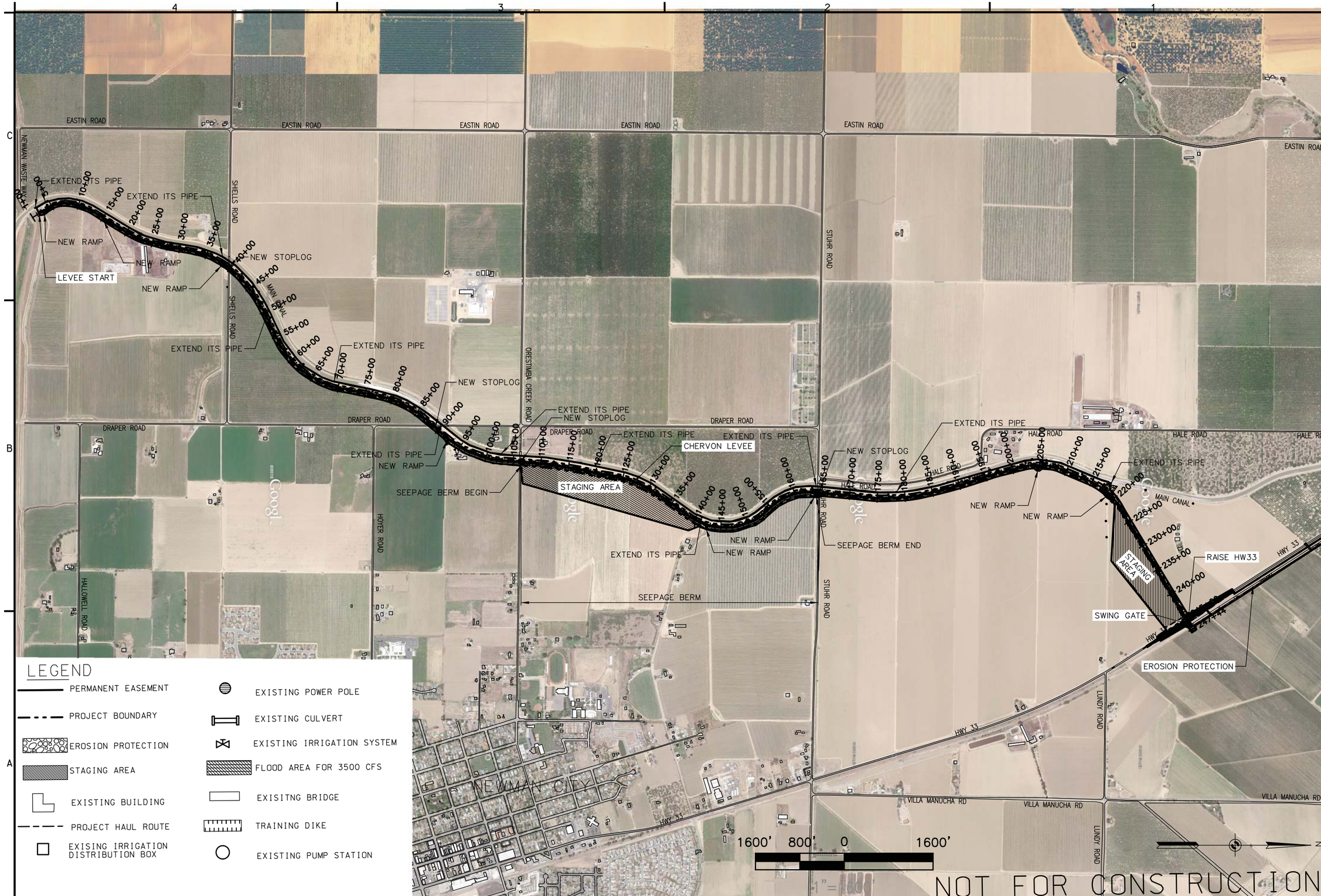

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PLATE 03

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ORESTIMBA CREEK FEASIBILITY STUDY

CHANNEL MOD OVERALL PLAN

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PLATE 04

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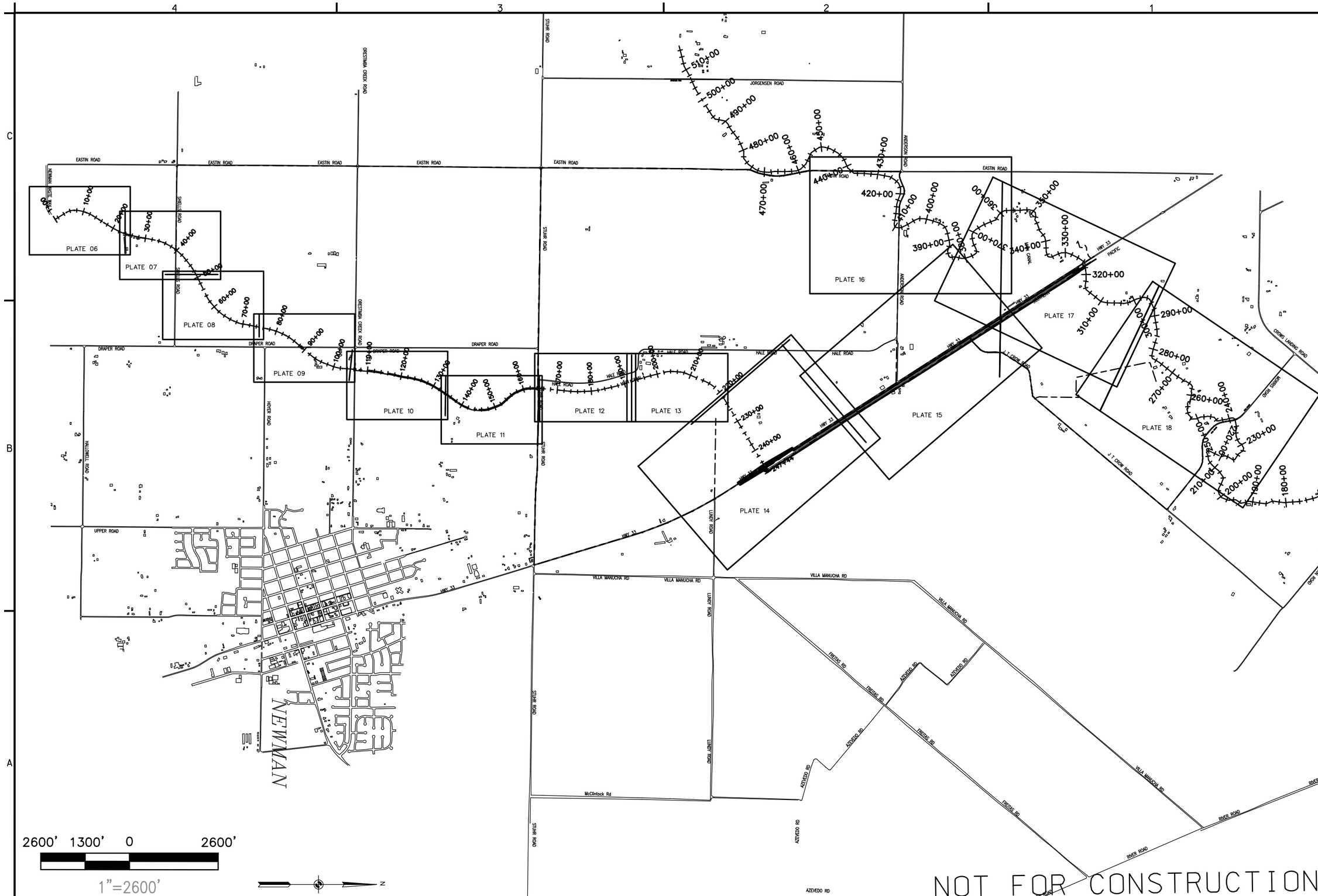

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KEYMAP

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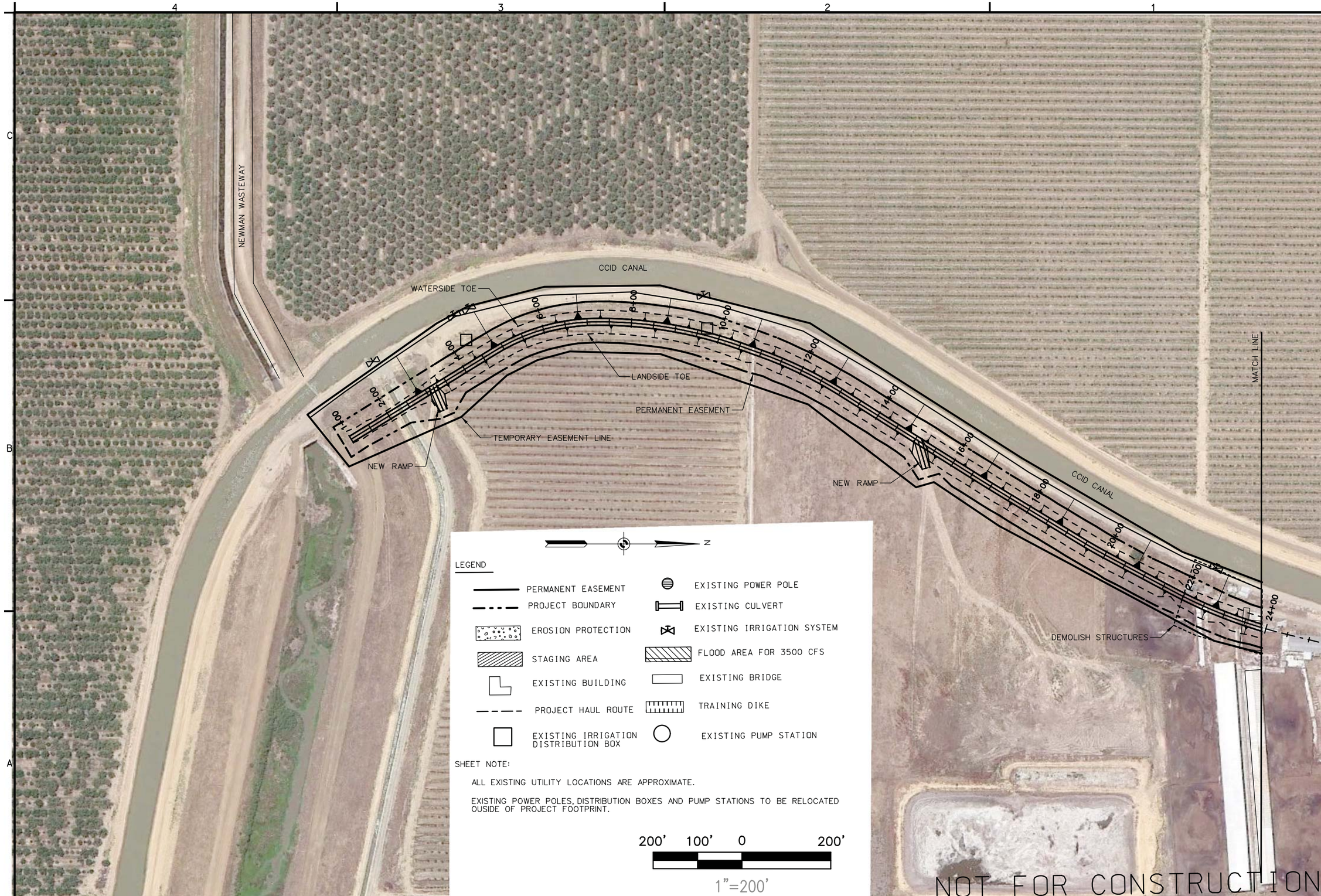

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ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

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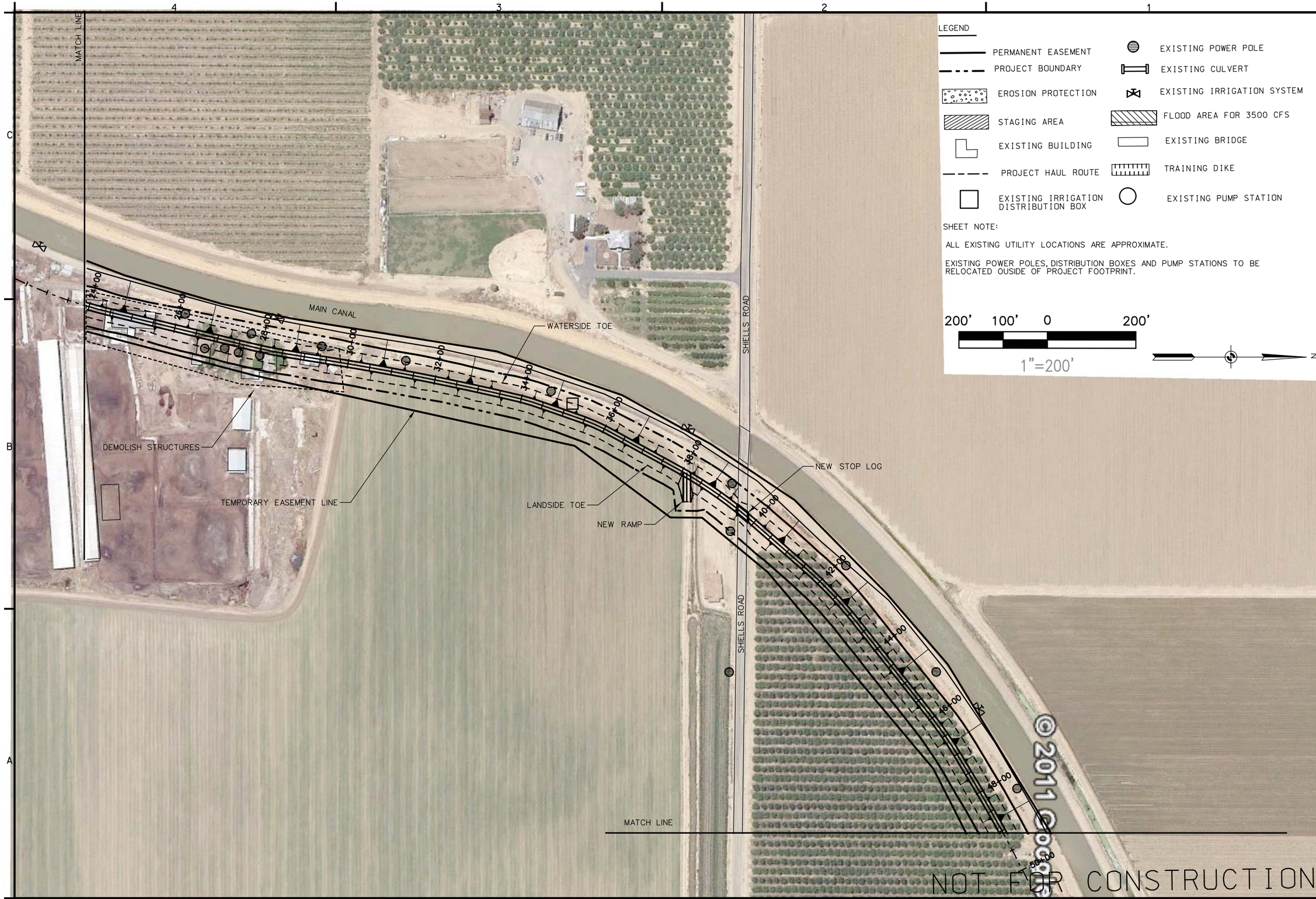

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- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING IRRIGATION DISTRIBUTION BOX
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- FLOOD AREA FOR 3500 CFS
- EXISTING BRIDGE
- TRAINING DIKE
- EXISTING PUMP STATION

SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

EXISTING POWER POLES, DISTRIBUTION BOXES AND PUMP STATIONS TO BE RELOCATED OUSIDE OF PROJECT FOOTPRINT.

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1"=200'

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PLATE 07

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ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

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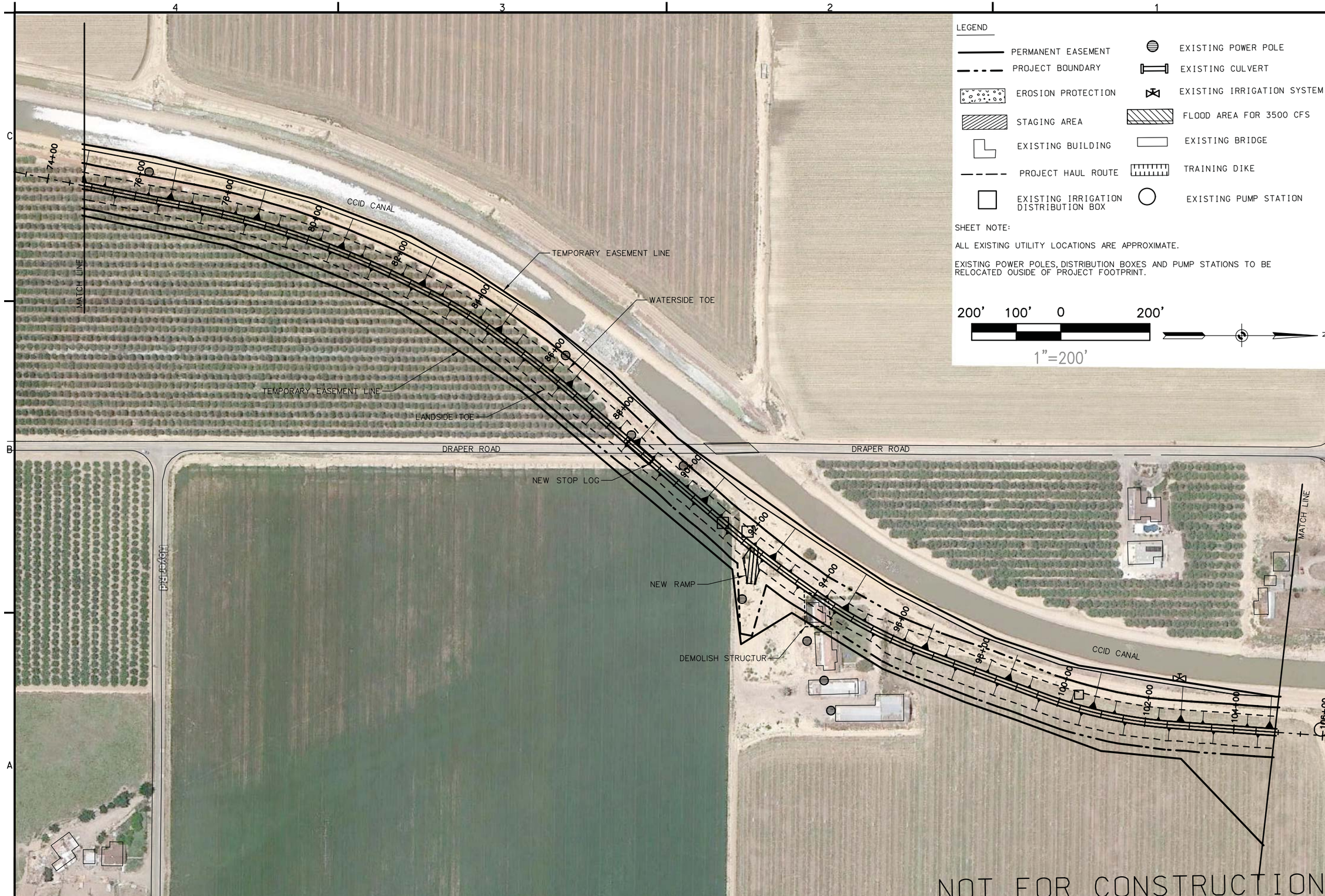

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SHEET NOTE:

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EXISTING POWER POLES, DISTRIBUTION BOXES AND PUMP STATIONS TO BE RELOCATED OUSIDE OF PROJECT FOOTPRINT.

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1"=200'

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ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 09

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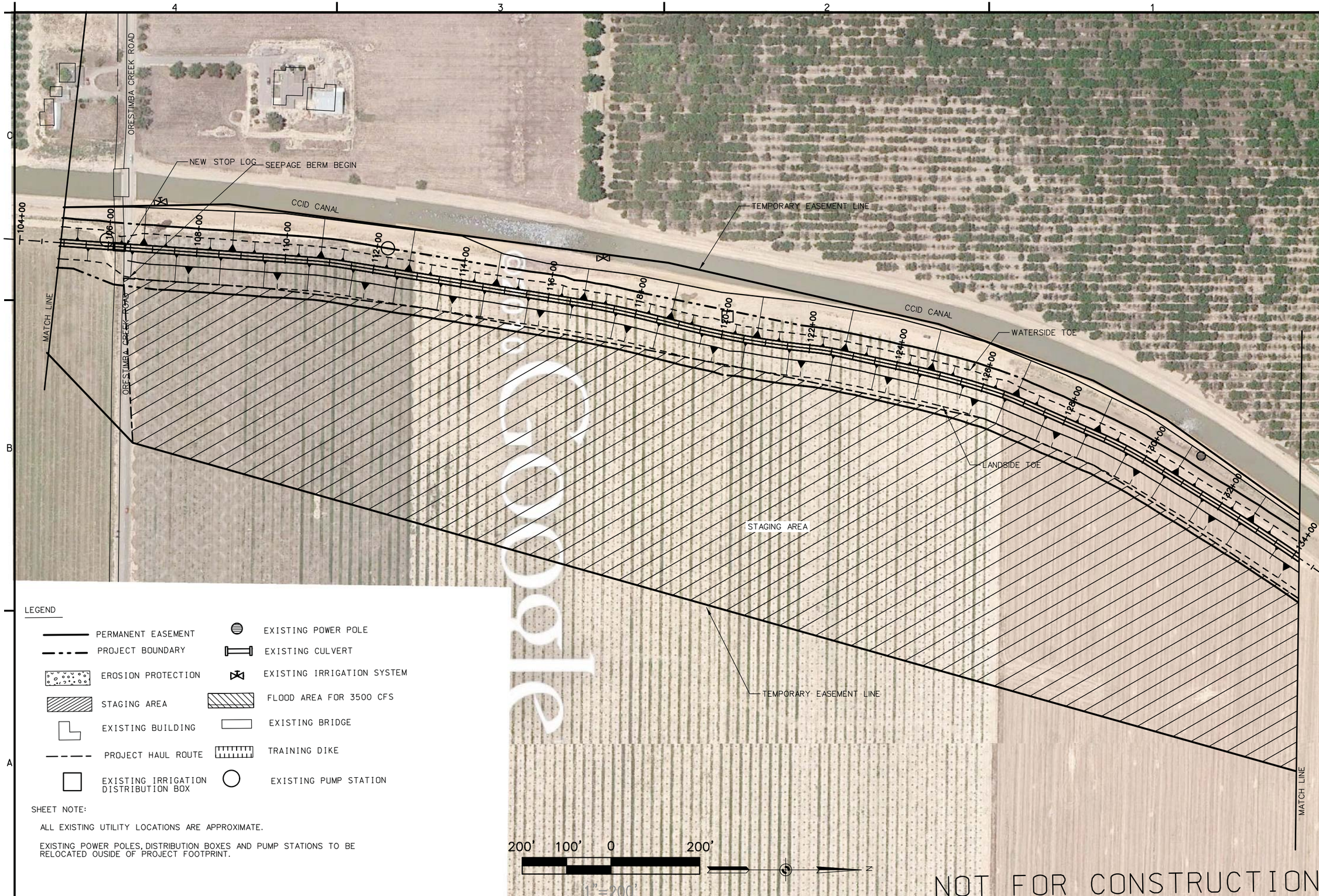

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- STAGING AREA
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- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- FLOOD AREA FOR 3500 CFS
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- EXISTING PUMP STATION

SHEET NOTE:

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ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

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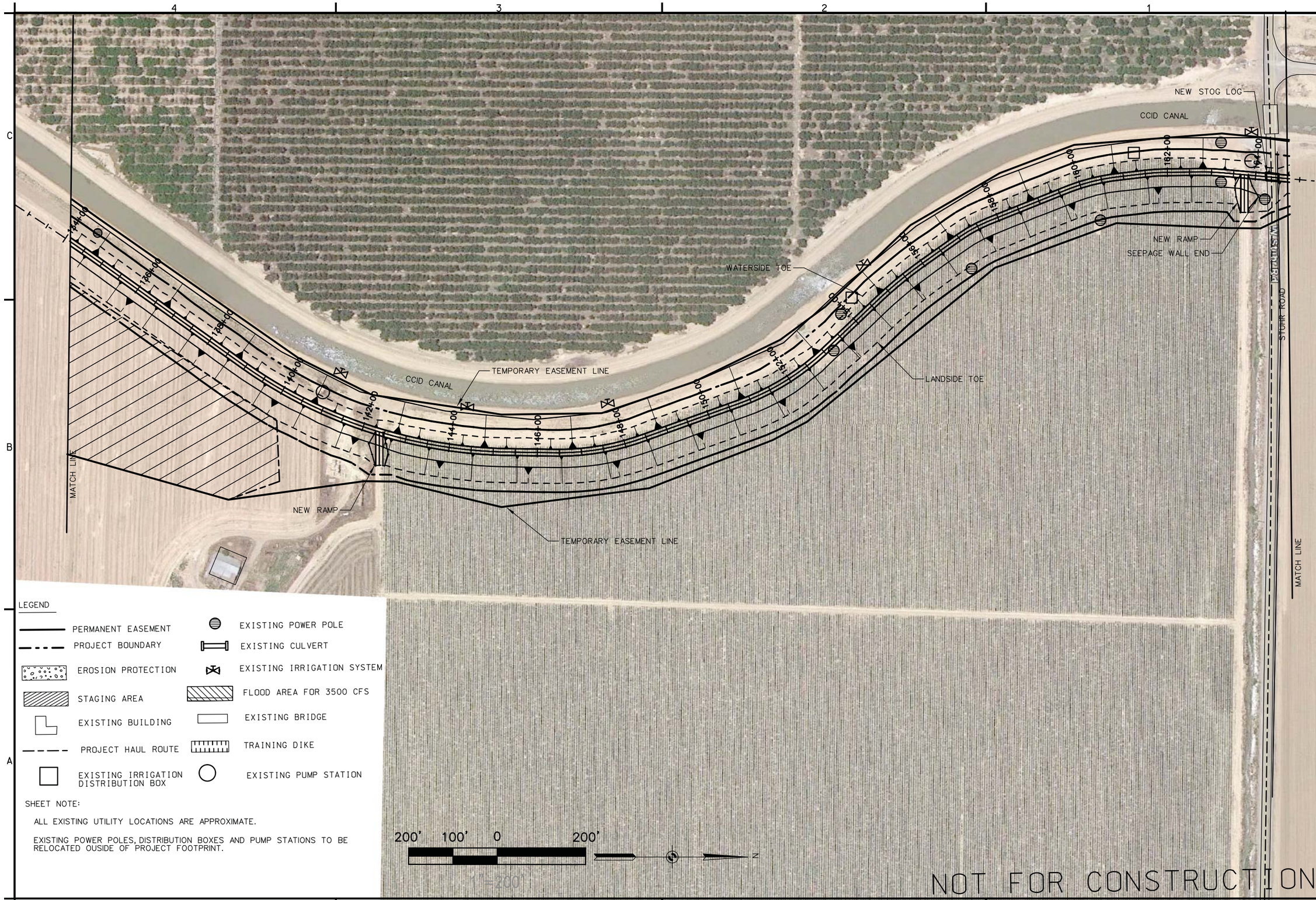

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US Army Corps of Engineers
Sacramento District

Symbol	Description	Date	Approved

Date: DATE_APPROVED
Rev:
Design File No: FILE_NO
Drawing Code: CODE
File name:
Plot date: 16-NOV-2011
Plot scale:

Designed by: B. LIANG
Dwn by: B. LIANG
Spec No.:
Reviewed by:
Submitted by:
CHIEF, CIV ENGR DES SEC A

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

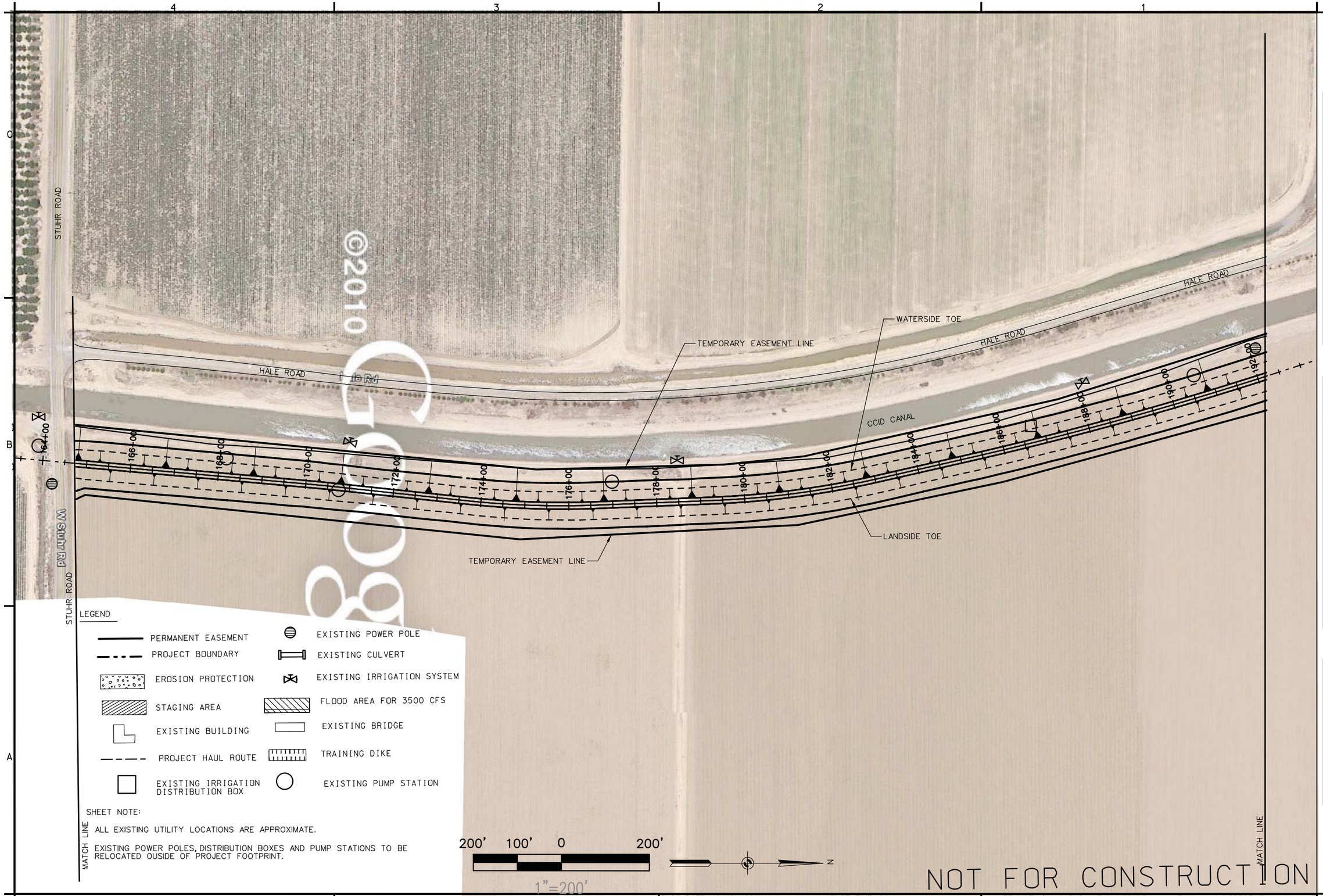
SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 "J" STREET
SACRAMENTO, CA 95814-2922

STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 11



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING IRRIGATION DISTRIBUTION BOX
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- FLOOD AREA FOR 3500 CFS
- EXISTING BRIDGE
- TRAINING DIKE
- EXISTING PUMP STATION

SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

EXISTING POWER POLES, DISTRIBUTION BOXES AND PUMP STATIONS TO BE RELOCATED OUSIDE OF PROJECT FOOTPRINT.

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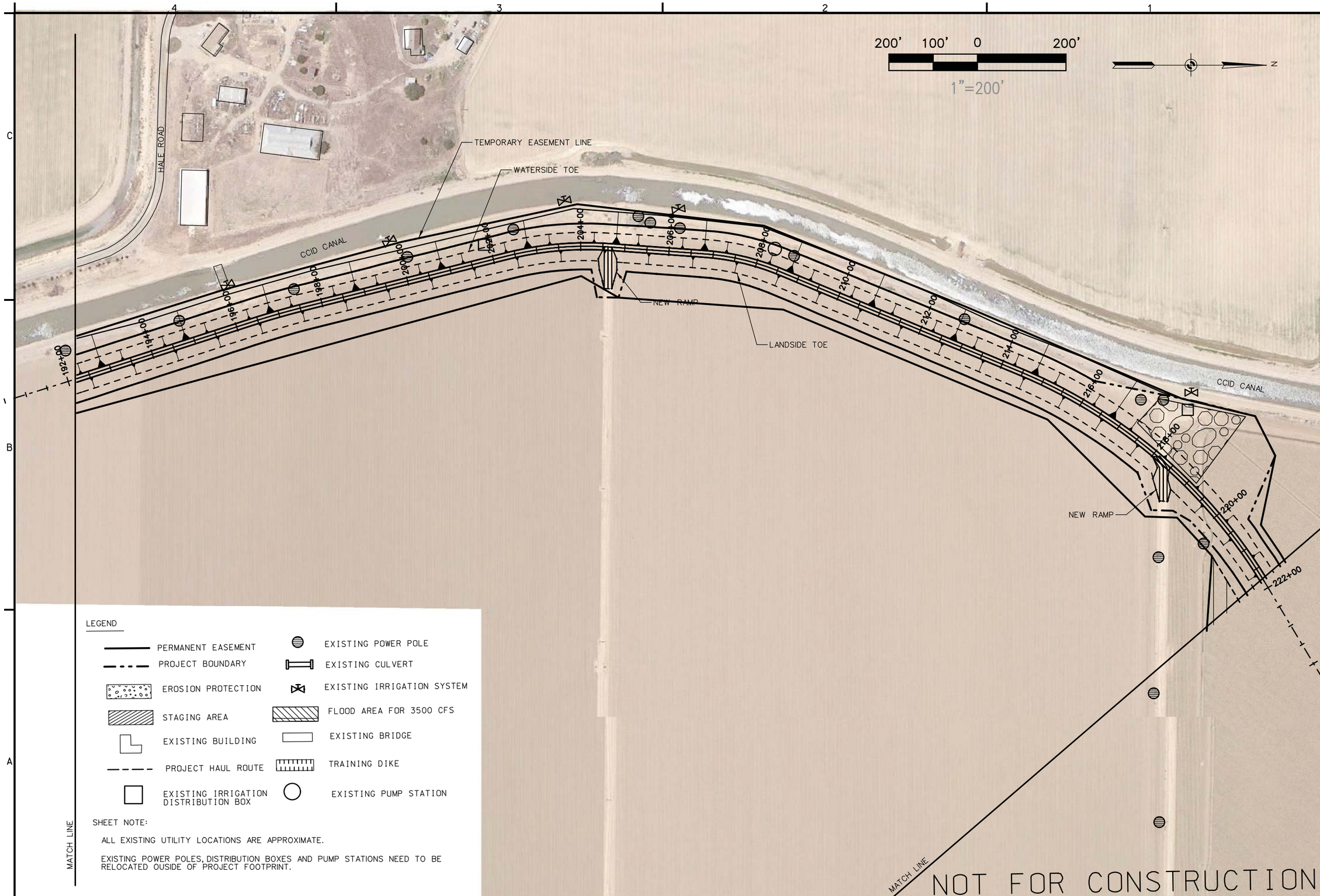
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 12



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING IRRIGATION DISTRIBUTION BOX
- EXISTING POWER POLE
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STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:
PLATE 13

KEY NOTE:

1. INSTALL A 12" DIA NEW CULVERT WITH FLAP GATE
2. EXCAVATION AREA
3. FLOOD AREA FOR 3500 CFS
4. FULL REVETMENT @ BRIDGE 100' U/S TO 100 D/S
5. CULVERTS ALONG THE RAILRAOD WILL BE EXTENDED.

LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- BUILDING
- PROJECT HAUL ROUTE
- POWER POLE
- CULVERT
- IRRIGATION SYSTEM
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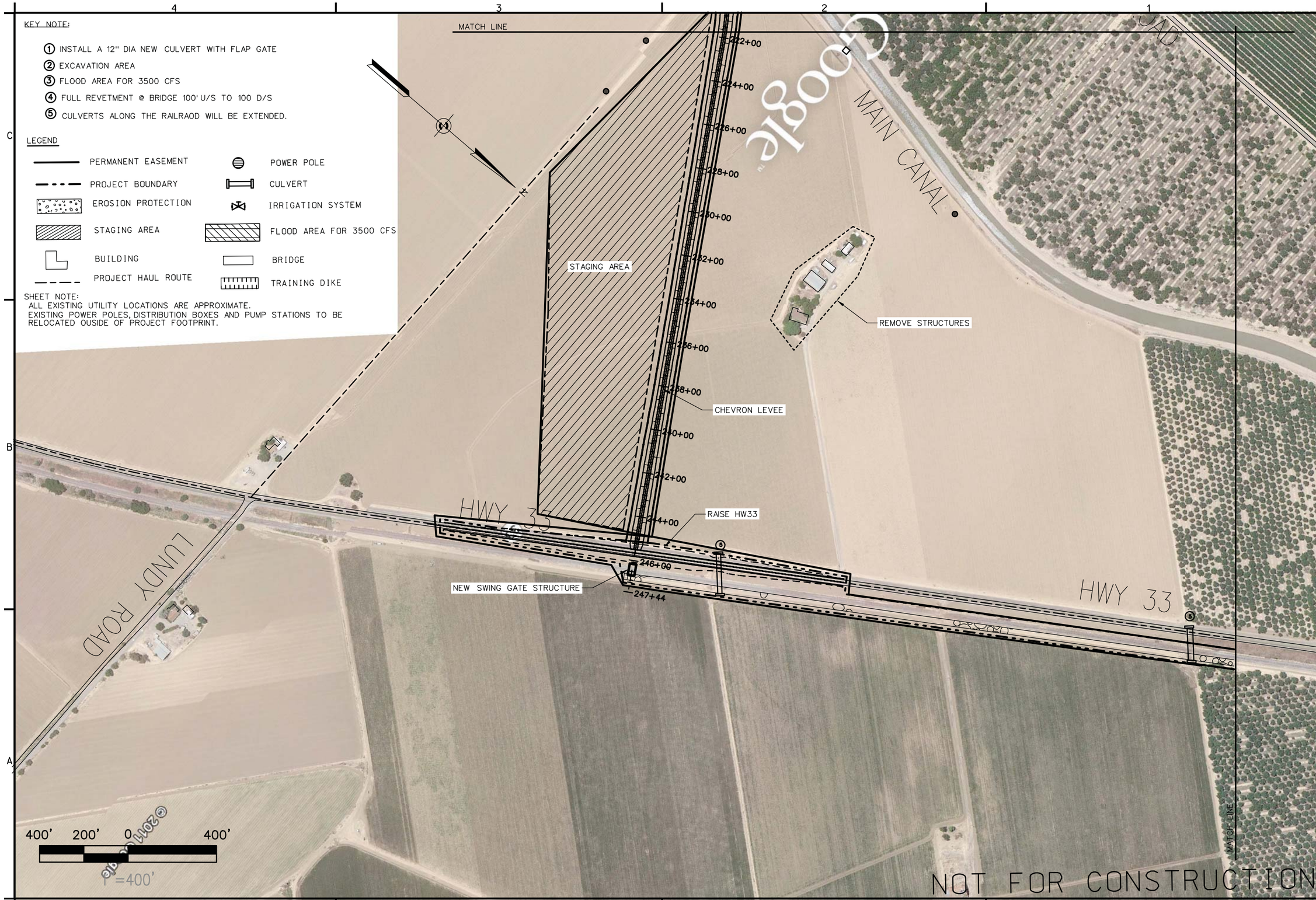

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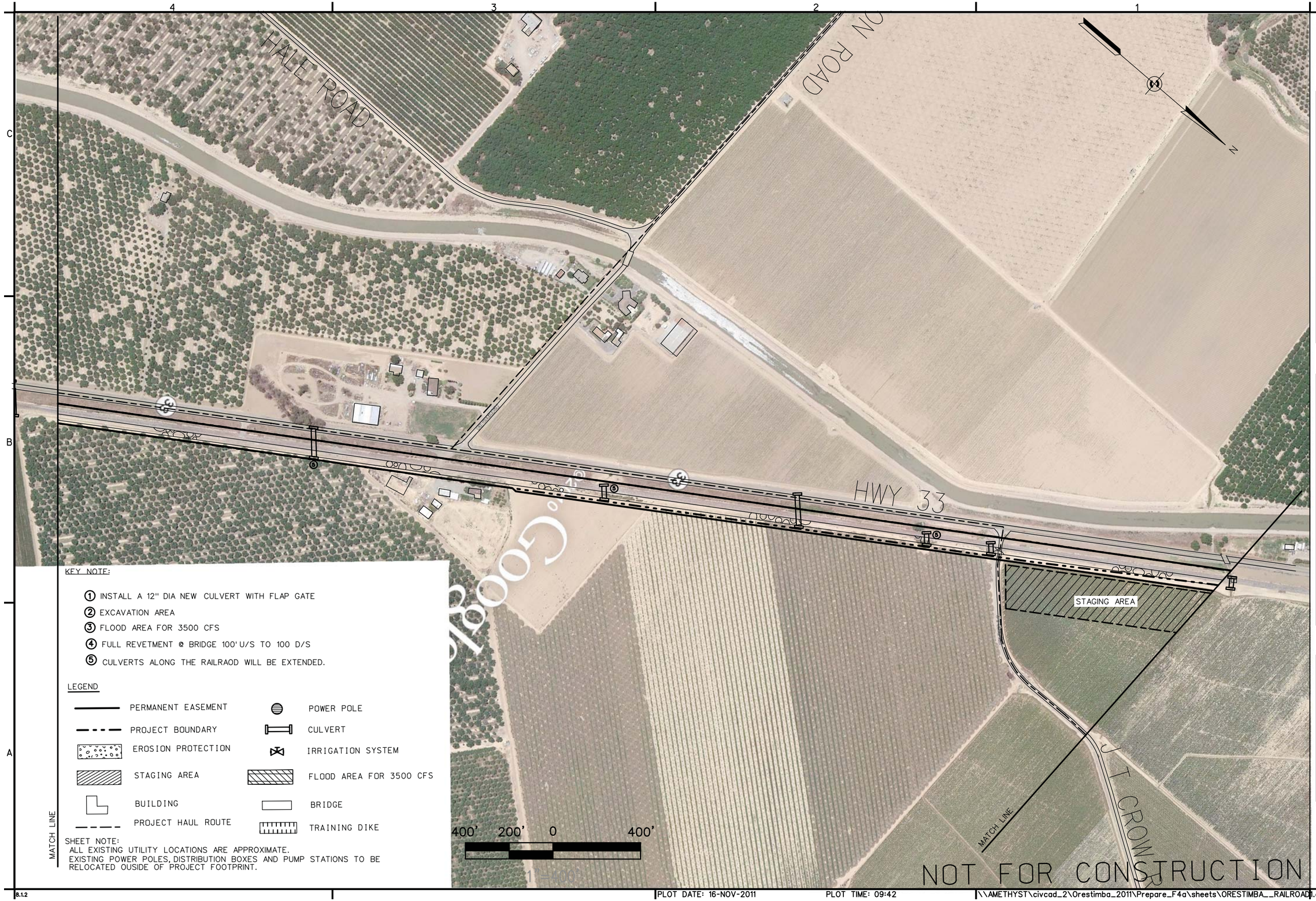
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

RAILROAD EROSION PROCTION PLAN

Sheet reference number:
PLATE 14



KEY NOTE:

1. INSTALL A 12" DIA NEW CULVERT WITH FLAP GATE
2. EXCAVATION AREA
3. FLOOD AREA FOR 3500 CFS
4. FULL REVETMENT @ BRIDGE 100' U/S TO 100 D/S
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LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- BUILDING
- PROJECT HAUL ROUTE
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SHEET NOTE:
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MATCH LINE

NOT FOR CONSTRUCTION

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Sacramento District

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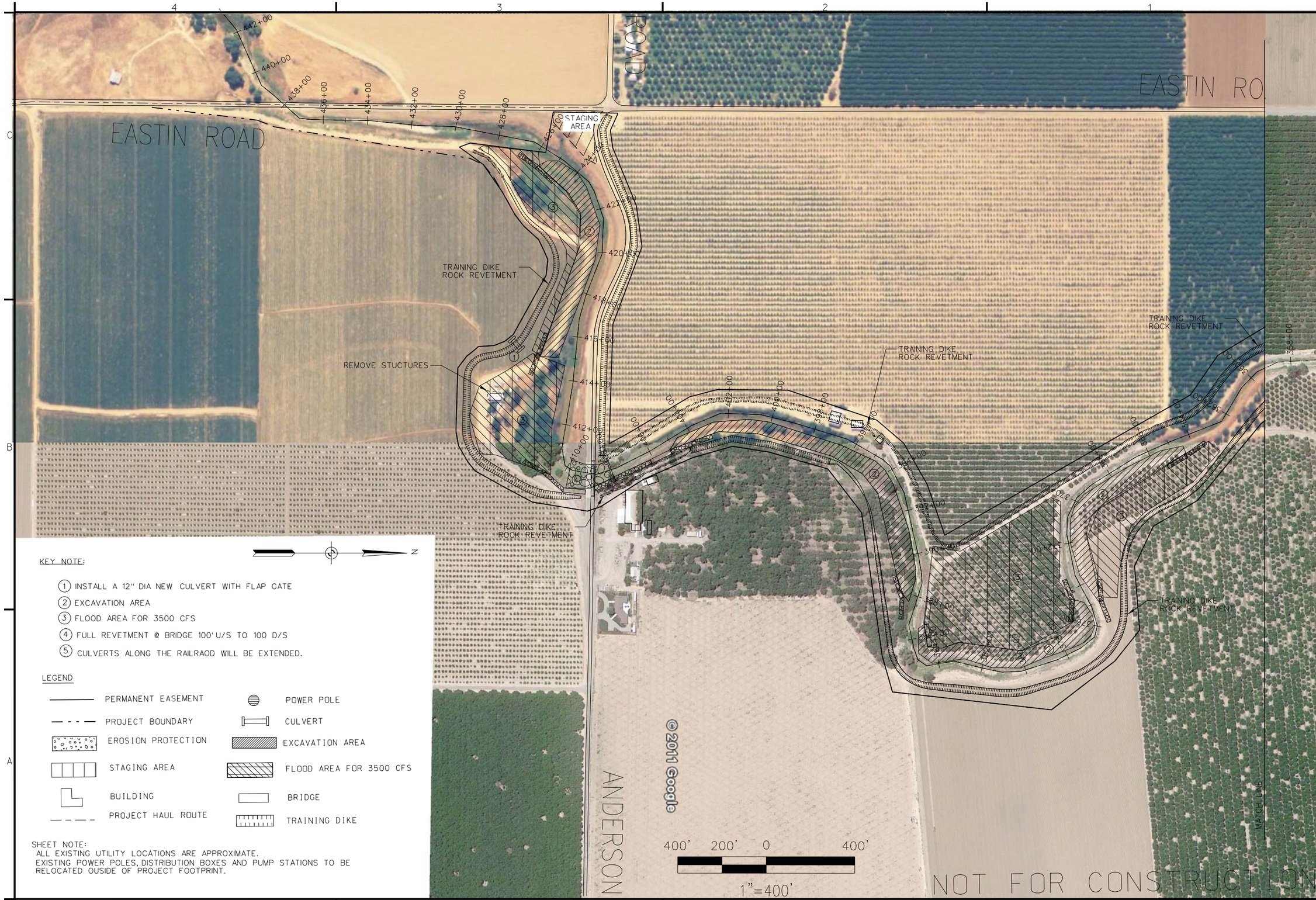
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

RAILROAD EROSION PROCTION PLAN

Sheet reference number:
PLATE 15



KEY NOTE:

1. INSTALL A 12" DIA NEW CULVERT WITH FLAP GATE
2. EXCAVATION AREA
3. FLOOD AREA FOR 3500 CFS
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LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- BUILDING
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Plot scale: $$$$scale$$$$

DEPARTMENT OF THE ARMY
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SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
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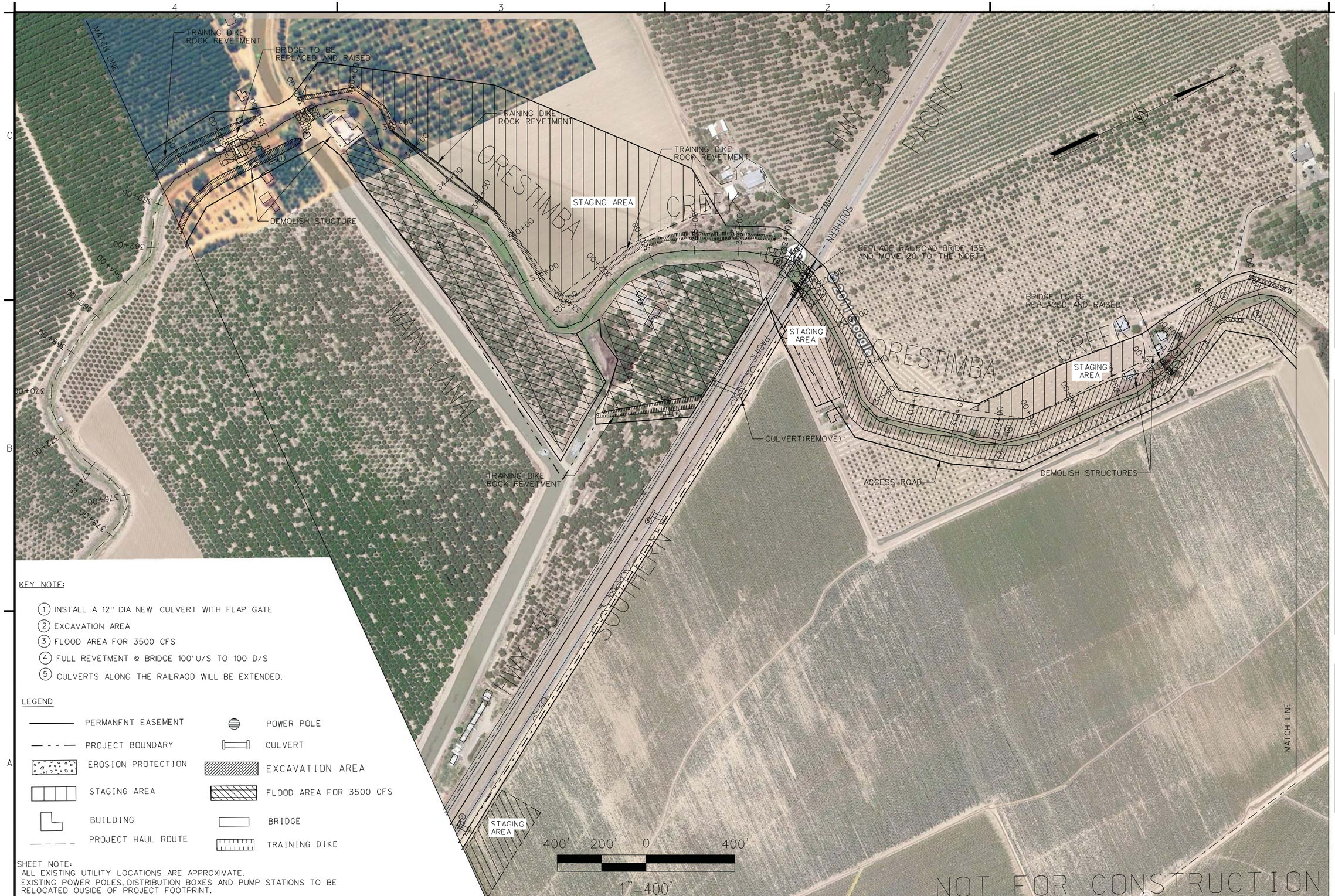
1325 "J" STREET
SACRAMENTO, CA 95814-2922

STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA CHANNEL MOD PLAN VIEW

Sheet reference number:
PLATE 16



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LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
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- STAGING AREA
- BUILDING
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Plot scale: $$$$

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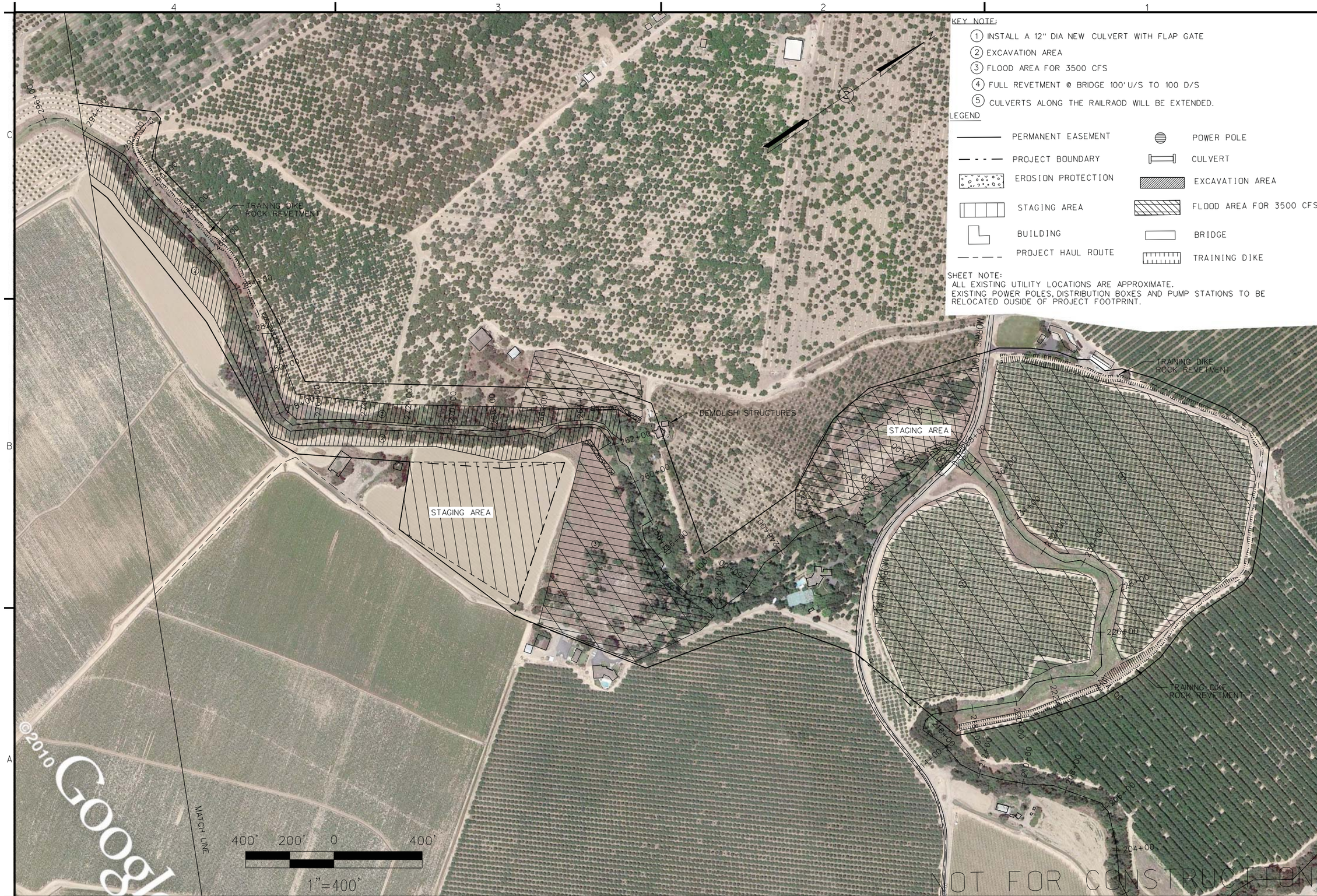
SACRAMENTO, CA 95814-2922

STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA CHANNEL MOD PLAN VIEW

Sheet reference number:
PLATE 17

8.1.2 | PLOT DATE: $$$$date$$$$ | PLOT TIME: $$$$time$$$$ | DGNSPEC



KEY NOTE:

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LEGEND

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- PROJECT BOUNDARY
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SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
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1325 "J" STREET
SACRAMENTO, CA 95814-2922

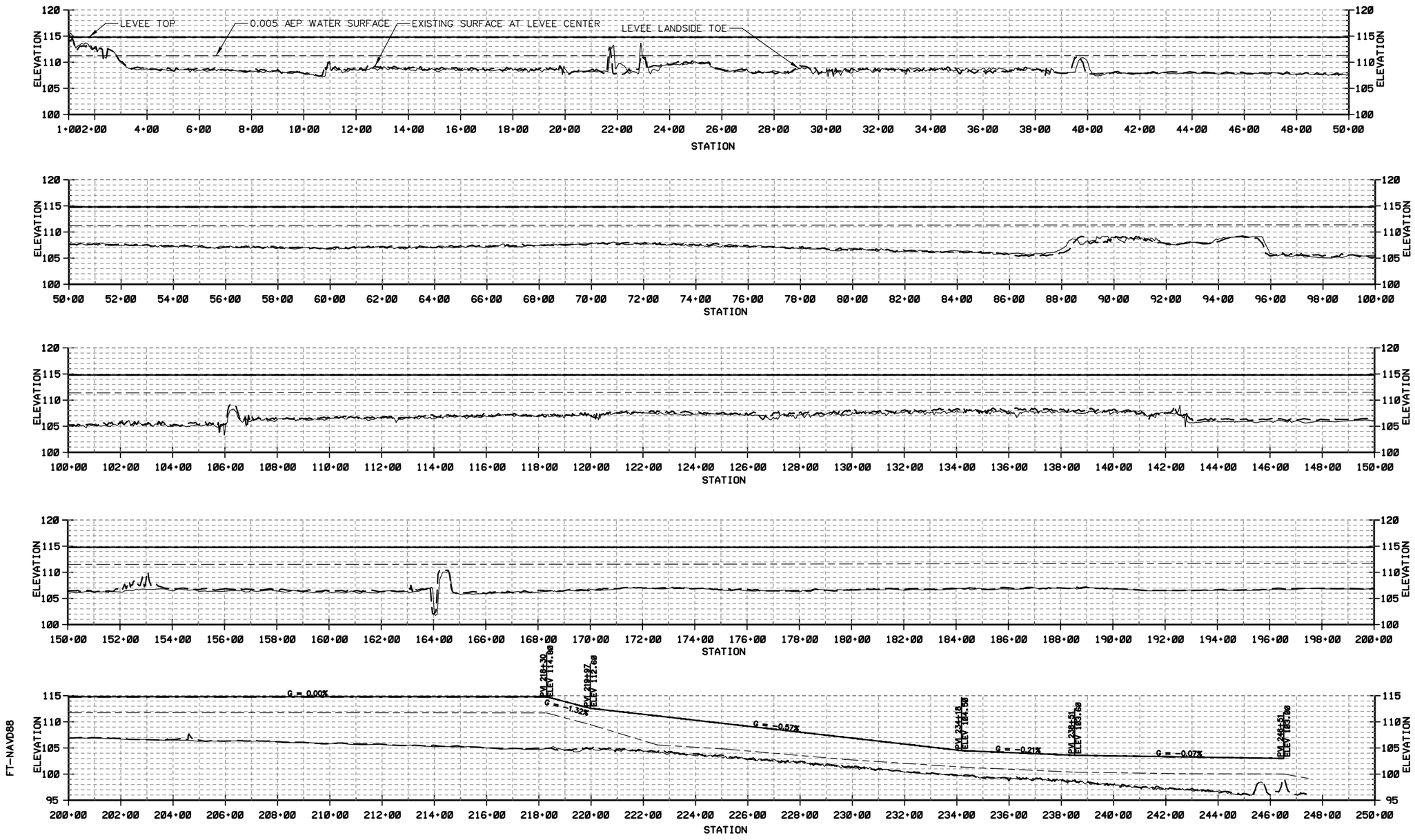
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA CHANNEL MOD PLAN VIEW

Sheet reference number:

PLATE 18

8.1.2 PLOT DATE: $$$$date$$$$ PLOT TIME: $$$$time$$$$ DGNSPEC



ORESTIMBA LPP LEVEE PROFILE

400' 200' 0 400'

H: 1"=400'

20' 10' 0 20'

V: 1"=20'

NOT FOR CONSTRUCTION

US Army Corps of Engineers
Sacramento District

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DEPARTMENT OF THE ARMY
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SACRAMENTO, CALIFORNIA

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IN-HOUSE DESIGN
1325 "J" STREET
SACRAMENTO, CA 95814-2922

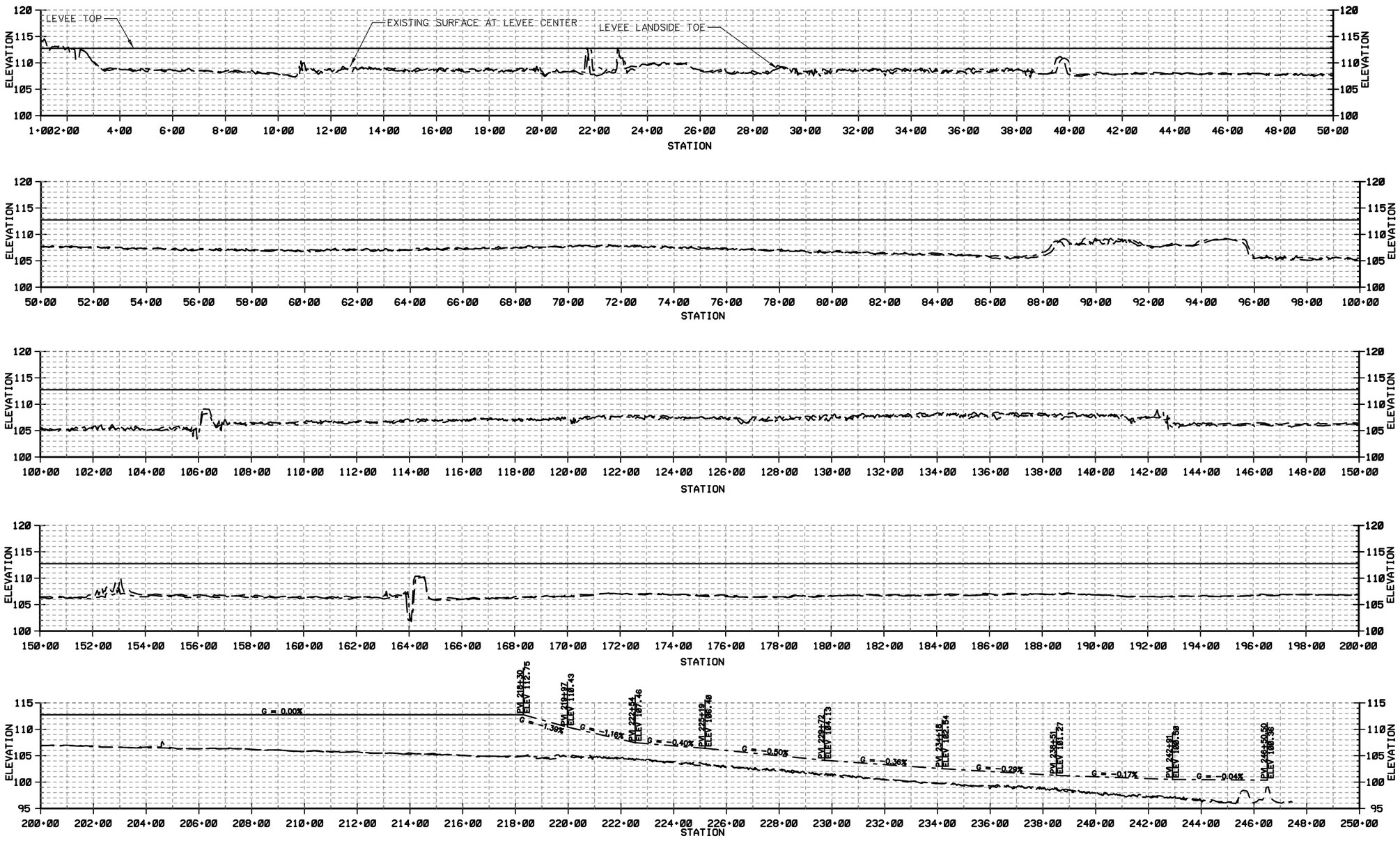
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PROFILE

Sheet reference number:
PLATE 18

8.1.2

PLOT DATE: 16-NOV-2011 PLOT TIME: 09:43 \\AMETHYST\civcad_2\Orestimba_2011\Prepare_F4a\sheets\LPP_LeveeProfile.dgn



ORESTIMBA NED LEVEE PROFILE

400' 200' 0 400'

H: 1"=400'

20' 10' 0 20'

V: 1"=20'

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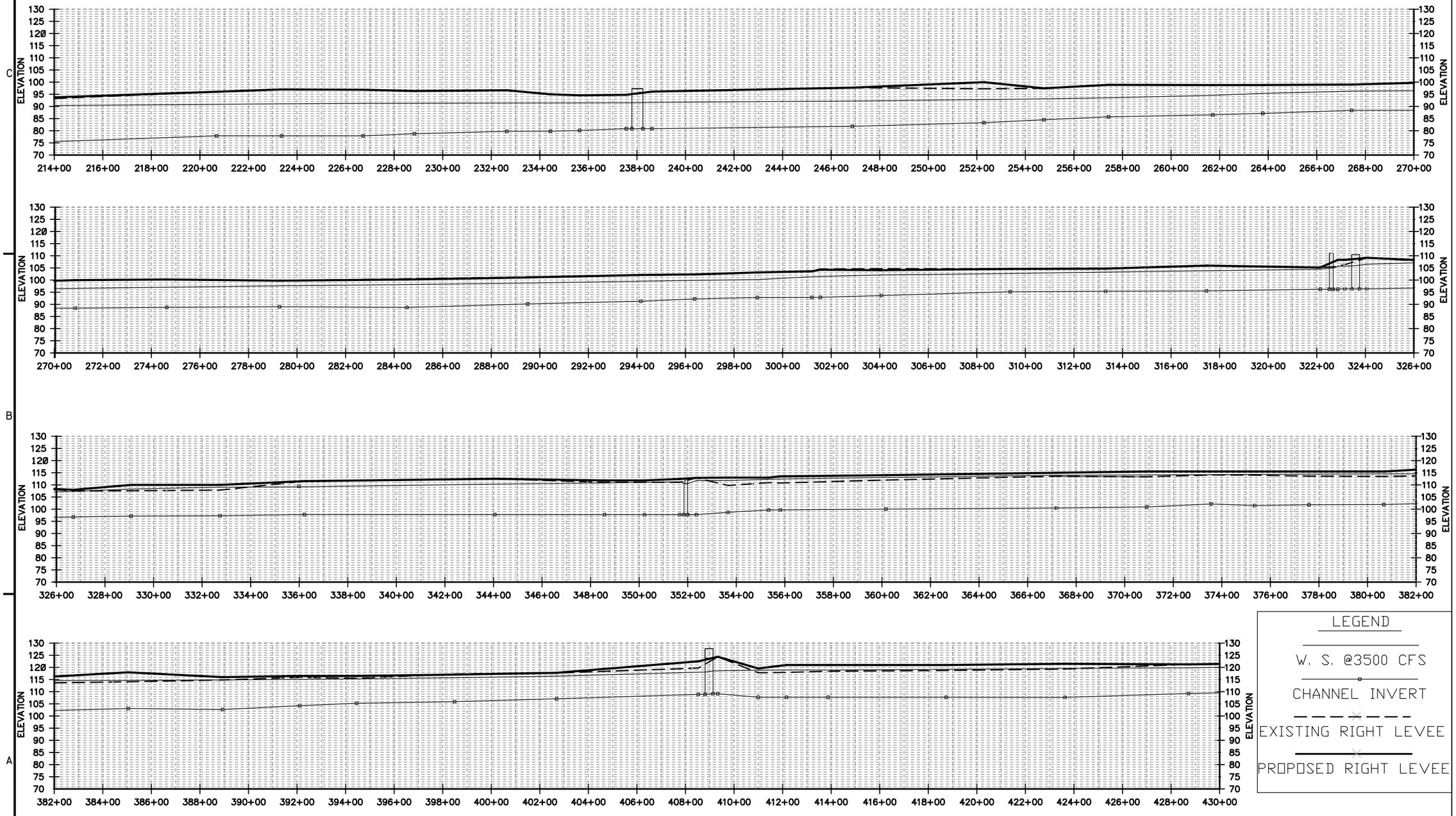
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA NED LEVEE PROFILE

Sheet reference number:

PLATE 19



LEGEND

W. S. @3500 CFS

CHANNEL INVERT

EXISTING RIGHT LEVEE

PROPOSED RIGHT LEVEE

400' 200' 0 400'

H: 1"=400'

20' 10' 0 20'

V: 1"=20'

ORESTIMBA CREEK RIGHT BANK LEVEE PROFILE

NOT FOR CONSTRUCTION

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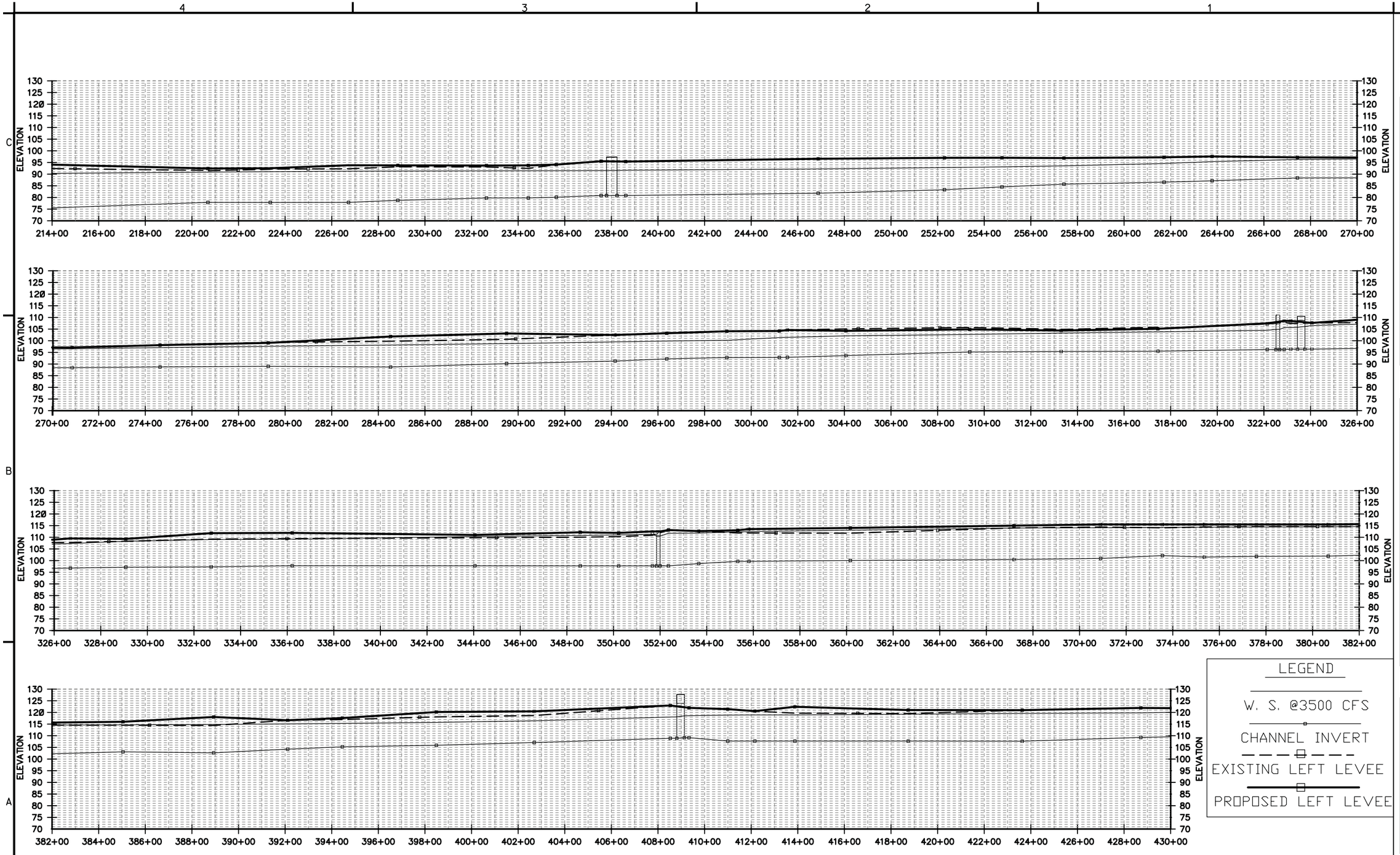
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

CREEK RIGHT BANK LEVEE PROFILE

Sheet reference number:

PLATE 20



400' 200' 0 400'

H: 1"=400'

20' 10' 0 20'

V: 1"=20'

ORESTIMBA CREEK LEFT BANK PROFILE

NOT FOR CONSTRUCTION

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Sacramento District

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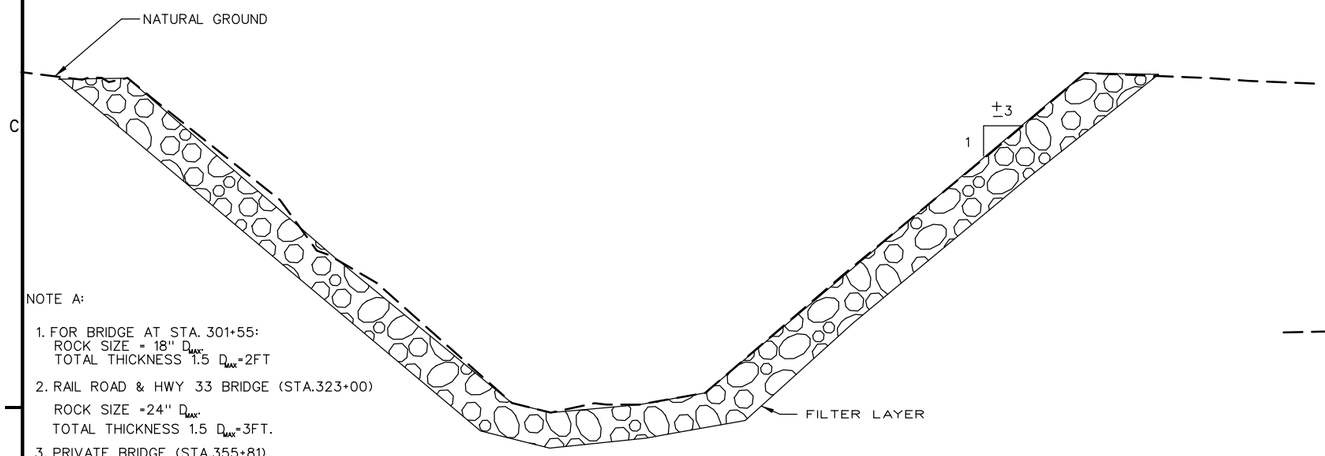
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

CREEK LEFT BANK LEVEE PROFILE

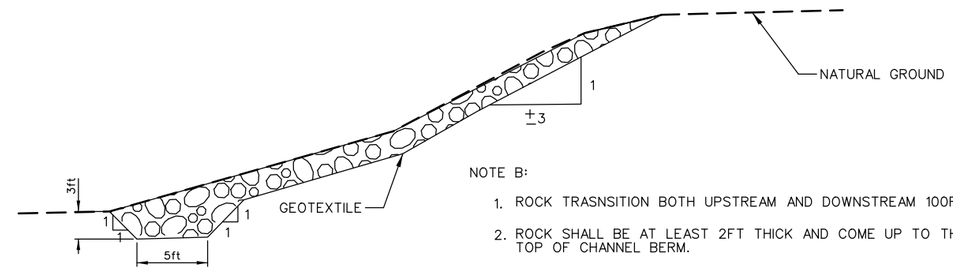
Sheet reference number:
PLATE 21



NOTE A:

1. FOR BRIDGE AT STA. 301+55:
   ROCK SIZE = 18" D_{MAX}.
   TOTAL THICKNESS 1.5 D_{MAX}=2FT
2. RAIL ROAD & HWY 33 BRIDGE (STA.323+00)
   ROCK SIZE =24" D_{MAX}.
   TOTAL THICKNESS 1.5 D_{MAX}=3FT.
3. PRIVATE BRIDGE (STA.355+81)
   ROCK SIZE =18" D_{MAX}.
   TOTAL THICKNESS 1.5 D_{MAX}=2FT.
4. MORRIS ROAD BRIDGE (STA.238+00)
   ROCK SIZE =18" D_{MAX}.
   TOTAL THICKNESS 1.5 D_{MAX}=2FT.
5. FULL REVETMENT 100FT U/S TO 100 D/S.

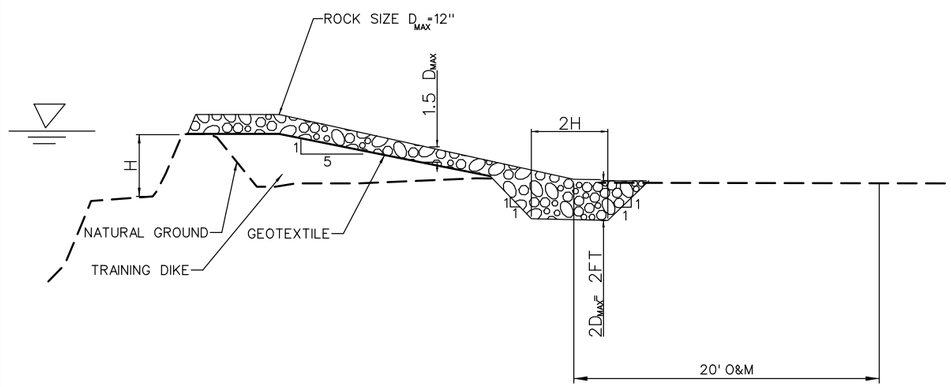
(A) TYPICAL SECTION FOR FULL REVETMENT AT BRIDGE
NOT TO SCALE — TYPICAL SECTION



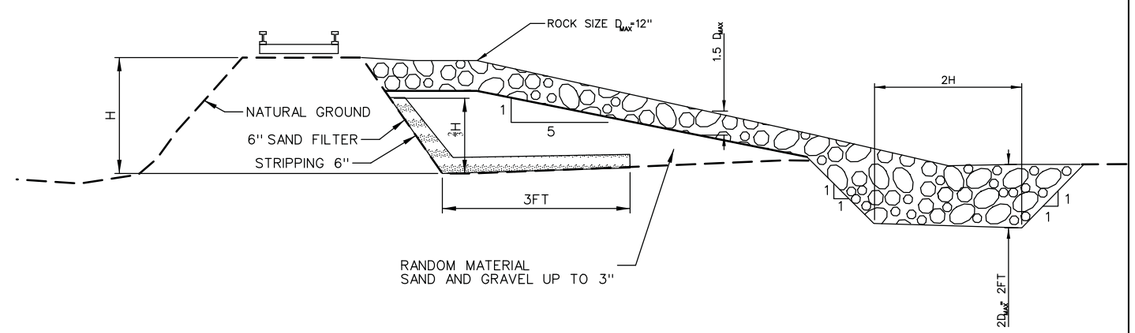
NOTE B:

1. ROCK TRASNSITION BOTH UPSTREAM AND DOWNSTREAM 100FT.
2. ROCK SHALL BE AT LEAST 2FT THICK AND COME UP TO THE TOP OF CHANNEL BERM.

(B) CHANNEL BENDS AND BOTH BEGINING AND ENDING OF CHANNEL EXCAVATION
NOT TO SCALE — TYPICAL SECTION



(C) TYPICAL SECTION FOR TRAINING DIKE
NOT TO SCALE — TYPICAL SECTION



(D) TYPICAL SECTION FOR RAILROAD OVERTOPING
NOT TO SCALE — TYPICAL SECTION

NOT FOR CONSTRUCTION

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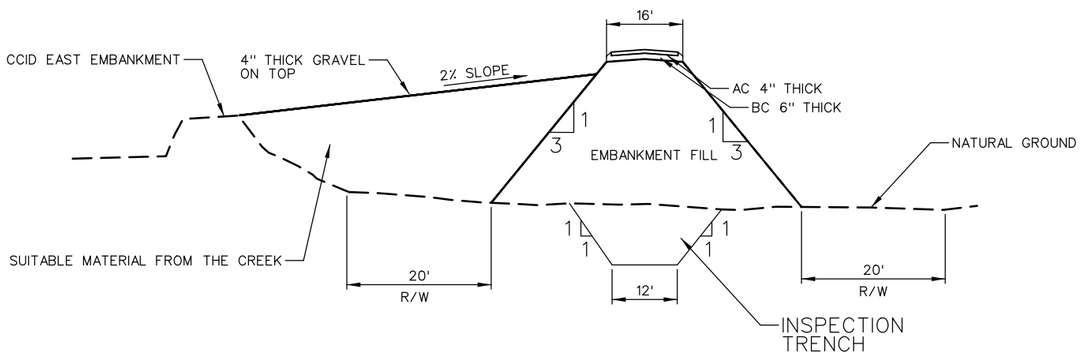
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

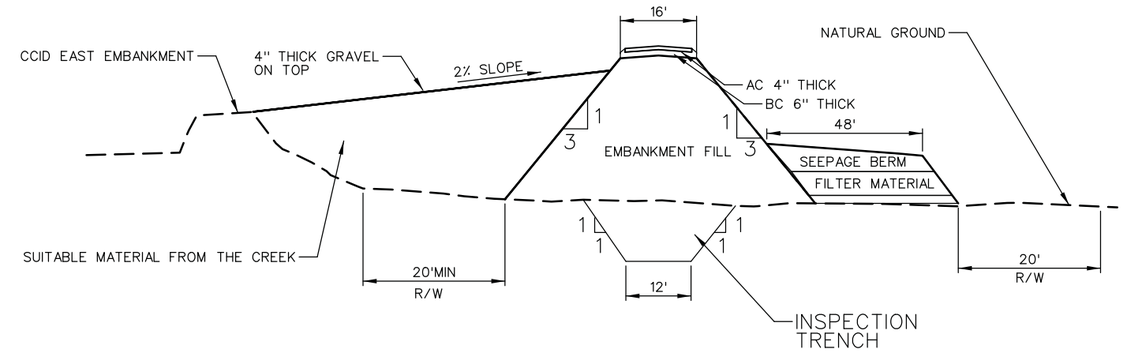
EROSION PROTECTION CROSS SECTIONS

Sheet reference number:
PLATE 22



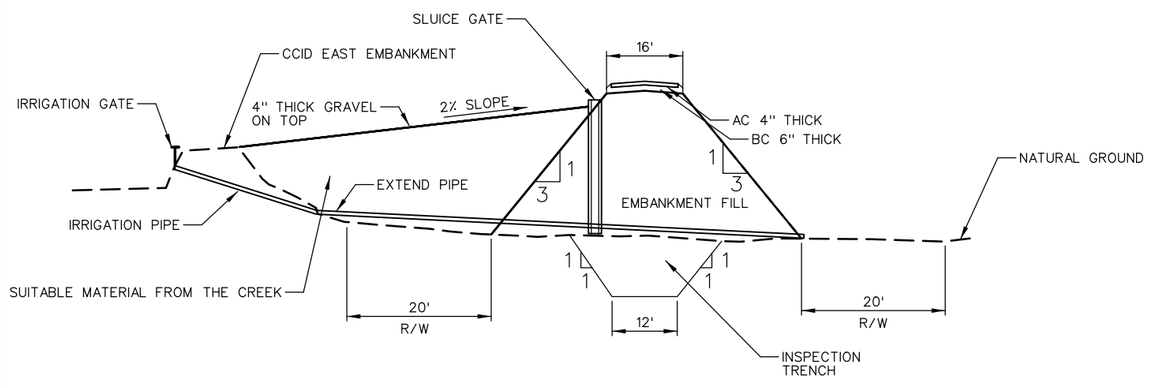
CHERVON LEVEE TYPICAL CROSS SECTION

NOT TO SCALE FROM STA. 1+00 TO 220+00



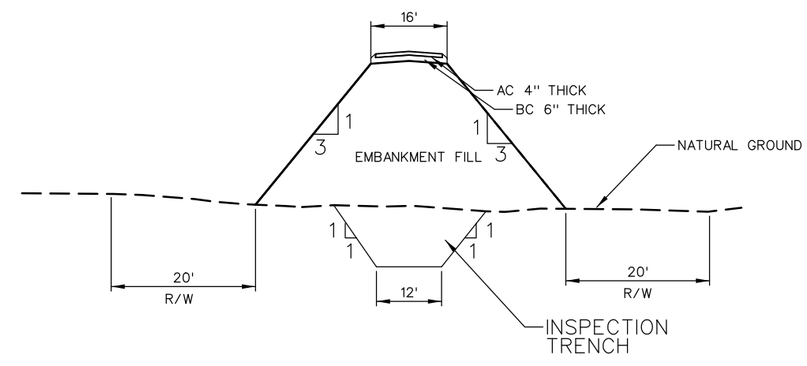
CHERVON LEVEE SEEPAGE TYPICAL CROSS SECTION

NOT TO SCALE FROM STA. 106+00 TO 164+00



CHERVON LEVEE TYPICAL CROSS SECTION

NOT TO SCALE IRRIGATION PIPE CROSSING



CHERVON LEVEE TYPICAL CROSS SECTION

NOT TO SCALE STA. 220+00 TO 245+00

NOT FOR CONSTRUCTION

US Army Corps of Engineers
Sacramento District

Symbol	Description	Date	Approved

Designed by: B. LIANG
Dwn by: B. LIANG
Reviewed by:
Submitted by:
CWES-CIV ENGR DES SEC-A
Date: DATE_APPROVED
Rev:
Spec No.:
Design File No: FILE_NO
Drawing Code: CODE
File name:
Plot date: 16-NOV-2011
Plot scale:

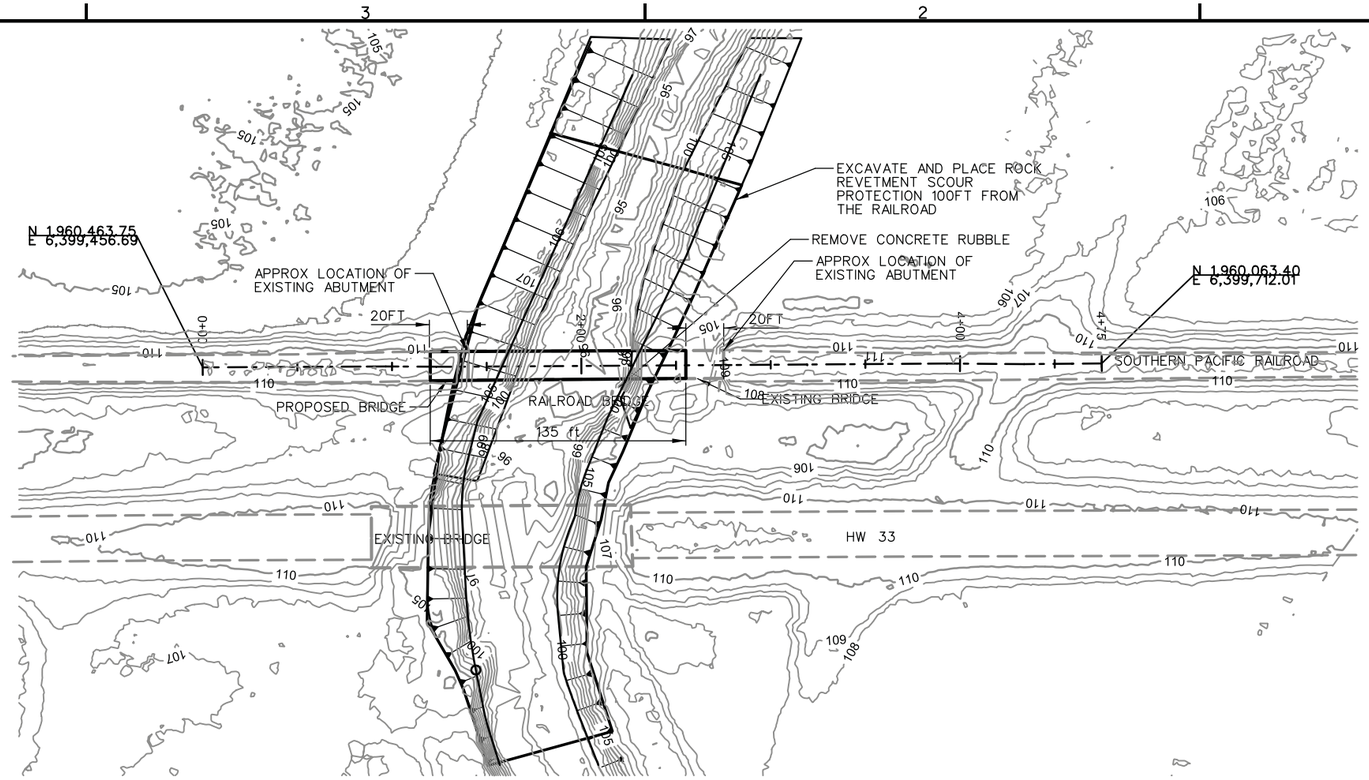
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 "J" STREET
SACRAMENTO, CA 95814-2922

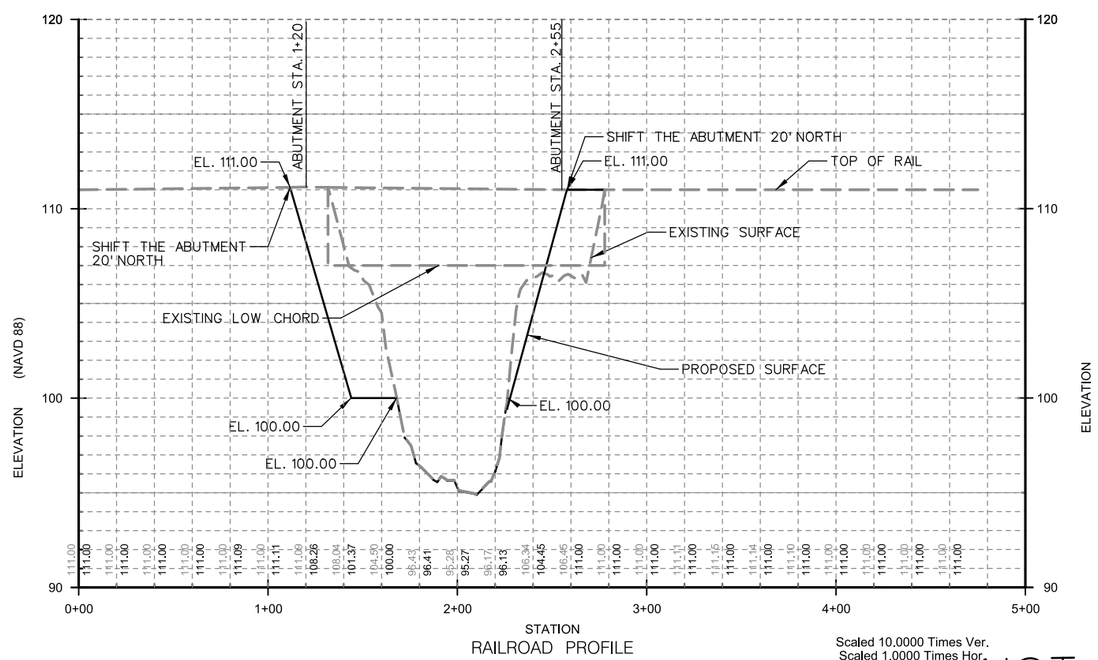
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

LEVEE TYPICAL CROSS SECTIONS

Sheet reference number:
PLATE 23



PLAN VIEW
SCALE: 1" = 40'



RAILROAD PROFILE

Scaled 10.0000 Times Ver.
Scaled 1.0000 Times Hor.

NOTES:
HORIZONTAL DATUM NAD83, MAP PROJECTION C.C.S. ZONE III, VERTICAL DATUM NAVD 88.

ALIGNMENT IS CENTERLINE OF RAILROAD TRACK. THERE ARE NO SURVEY DATA UNDER RAILROAD BRIDGE. THE EXISTING SURFACE UNDER RAILROAD BRIDGE WAS OBTAINED BY LINEAR INTERPOLATION BETWEEN UPSTREAM AND DOWNSTREAM LIDAR DATA POINTS.

TOPOGRAPHIC CONTOURS OBTAINED FORM TIN OF PHASE 1 LIDAR TOPOGRAPHY FROM CENTRAL VALLEY FLOOD EVALUATION AND DELINEATION CALIFORNIA DEPARTMENT OF WATER RESOURCES FLOWN 30 APRIL 2008.

LIDAR NOMINAL POST SPACING IS 1-METER. HORIZONTAL ACCURACY +/- 3.5 FT @ 95% CONFIDENCE LEVEL. VERTCAL ACCURACY +/- 1.2 FT @ 95% CONFIDENCY LEVEL.

LEGENDS

RECONTOURED SLOPE

80' 40' 0 80'

H:1"=80'

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Sacramento District

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Dwn by: B. LIANG
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CHIEF, CIV ENGR DES SEC.A
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Spec No.:

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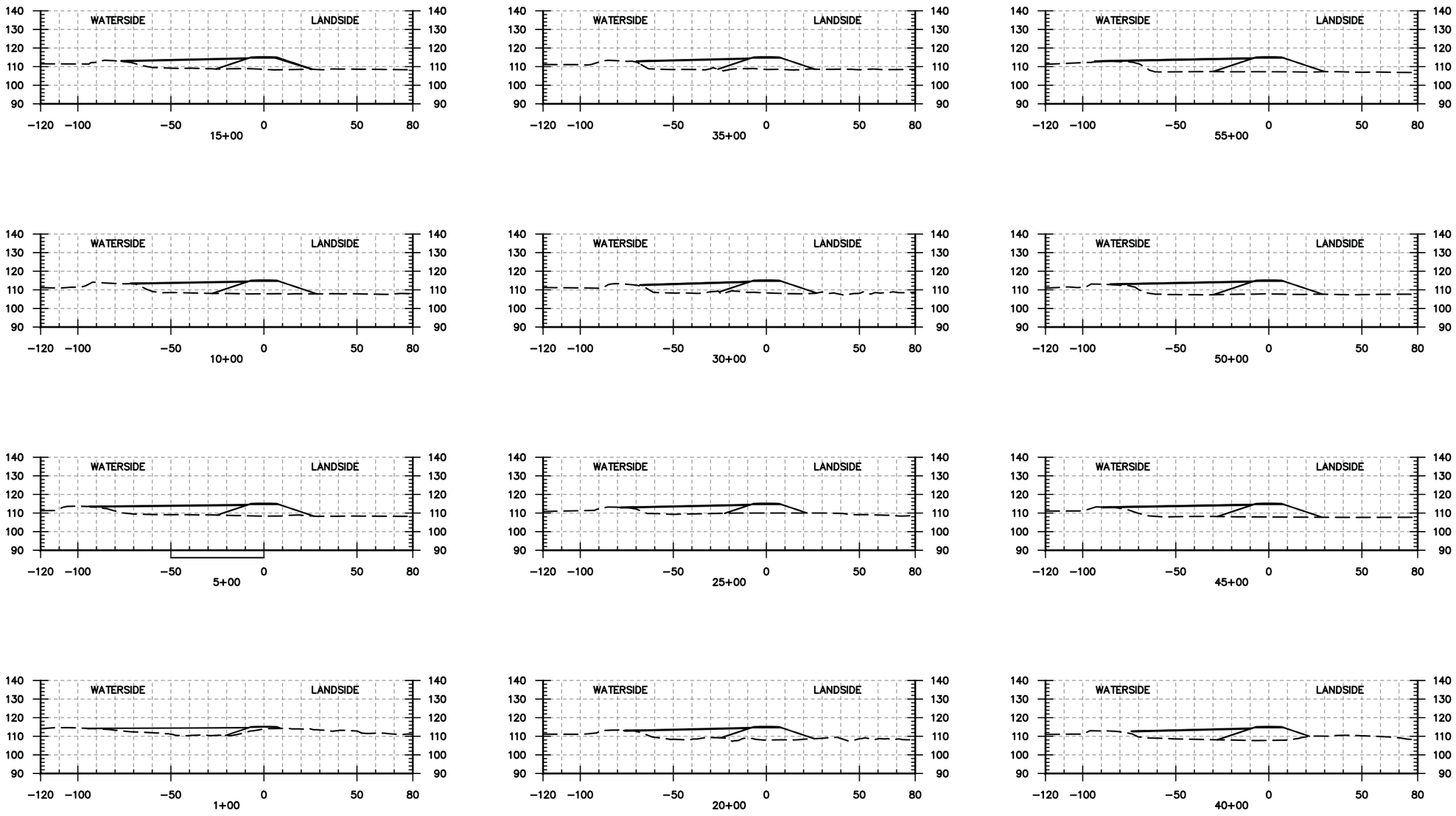
SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 "J" STREET
SACRAMENTO, CA 95814-2922

STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

RAILROAD BRIDGE CROSS SECTION

Sheet reference number:
PLATE 24



60' 30' 0 60'

1"=60'

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Sacramento District

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CWES: CIV ENGR DES SEC A

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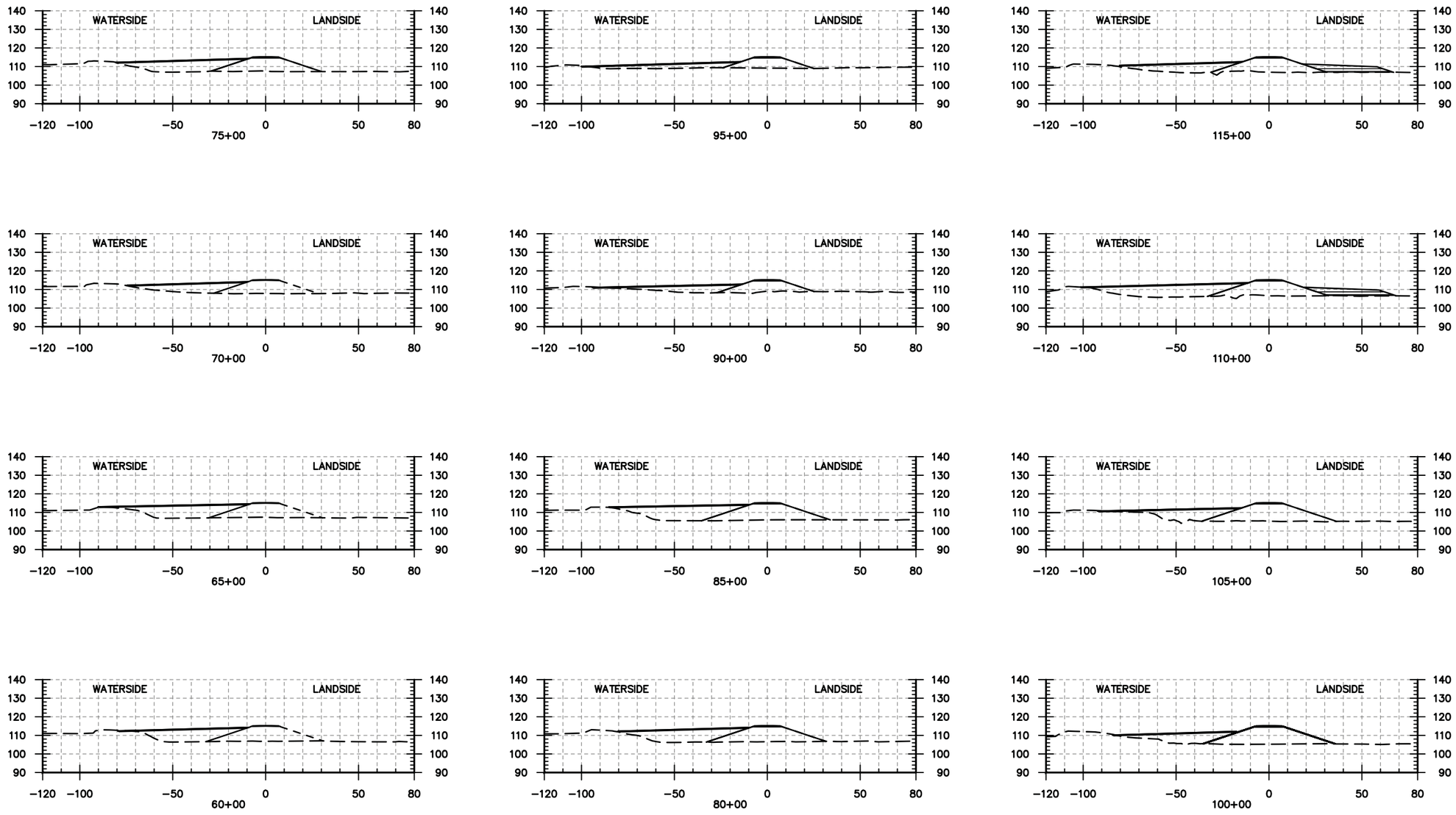
SACRAMENTO, CA 95814-2922

STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

LPP LEVEE CROSS SECTIONS
STA. 1+00 TO STA.55+00

Sheet reference number:
PLATE 25



60' 30' 0 60'

1"=60'

NOT FOR CONSTRUCTION

US Army Corps of Engineers
Sacramento District

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Plot scale:

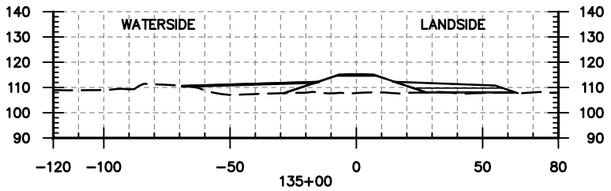
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

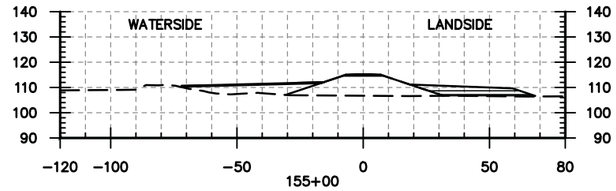
SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 "J" STREET
SACRAMENTO, CA 95814-2922

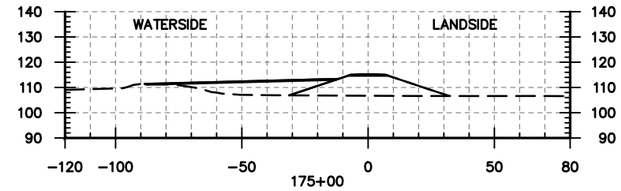
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

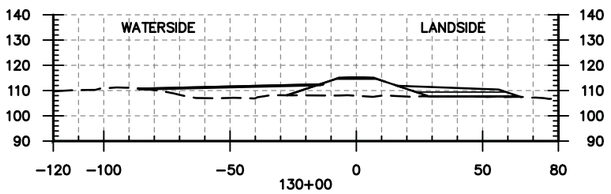
LPP LEVEE CROSS SECTIONS
STA. 60+00 TO STA. 115+00

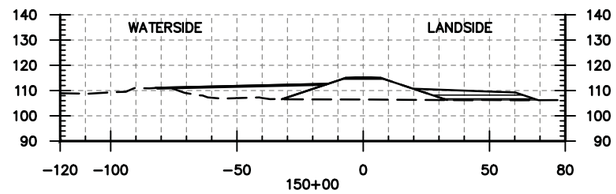
Sheet reference number:
PLATE 26

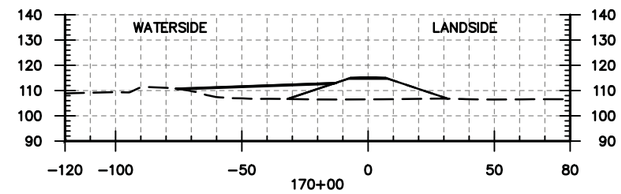


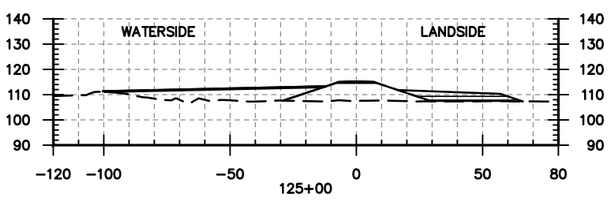


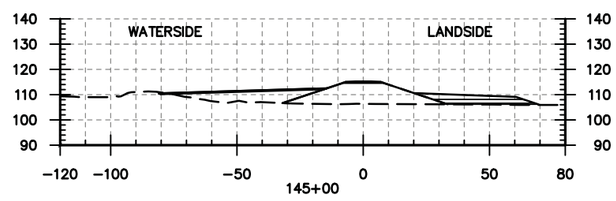


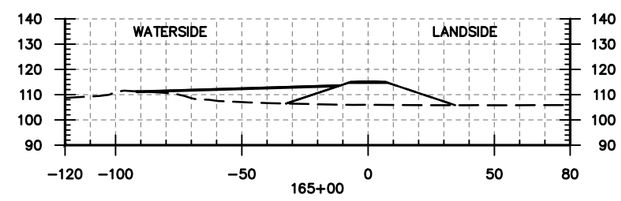


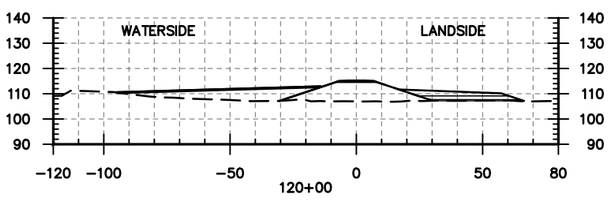


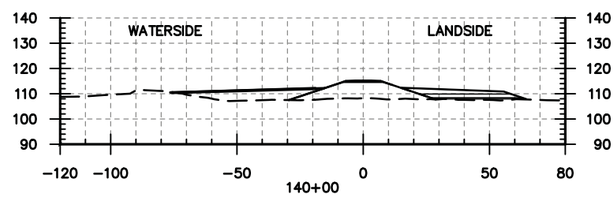


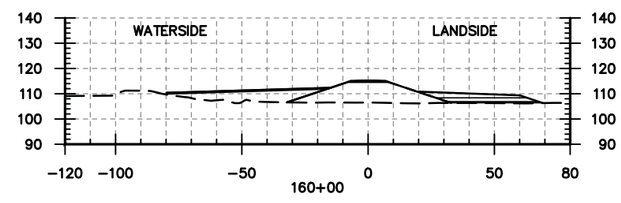












60' 30' 0 60'

1"=60'

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US Army Corps of Engineers
Sacramento District

Symbol	Description	Date	Approved

Designed by: B. LIANG
Dwn by: B. LIANG
Reviewed by:
Submitted by:
CWIES: CIV ENGR DES SEC.A

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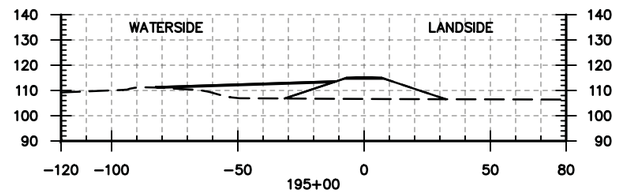
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

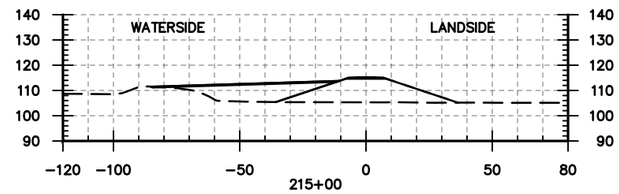
SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 "J" STREET
SACRAMENTO, CA 95814-2922

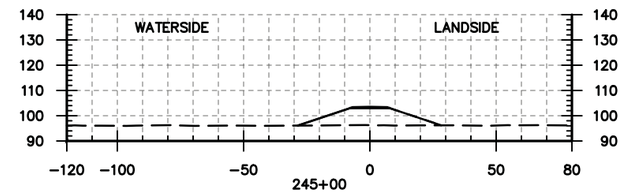
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

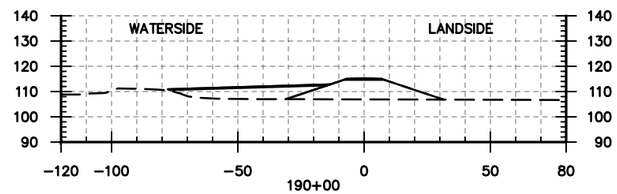
LPP LEVEE CROSS SECTIONS
STA. 120+00 TO STA.175+00

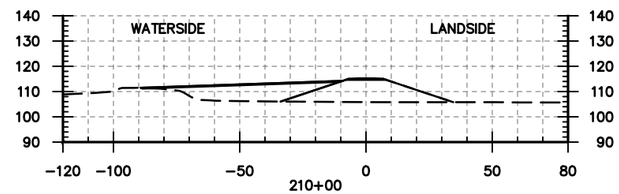
Sheet reference number:
PLATE 27

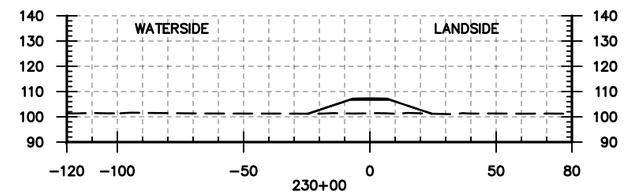


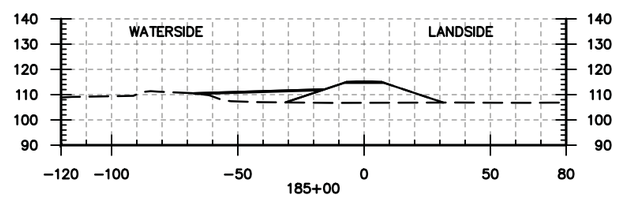


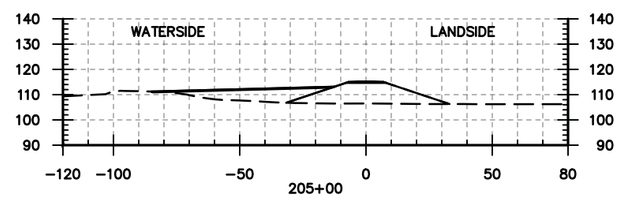


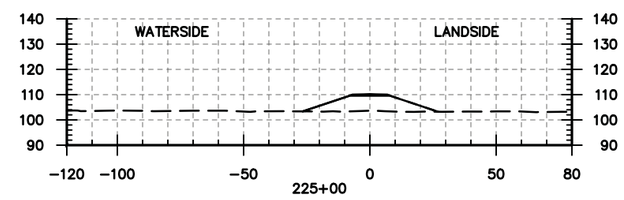


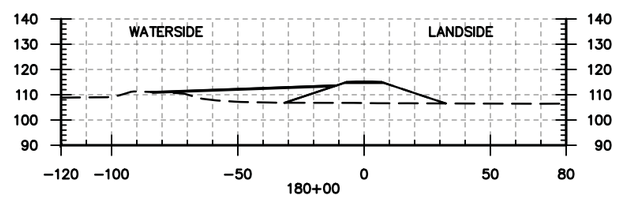


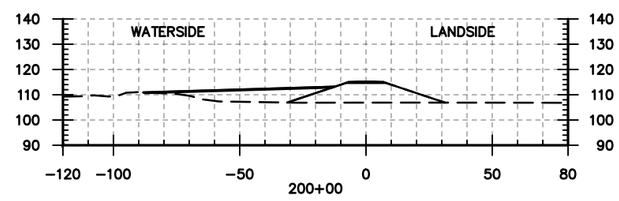


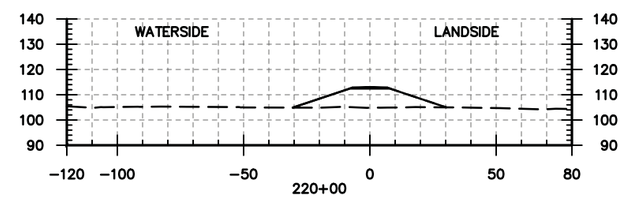












60' 30' 0 60'

1"=60'

NOT FOR CONSTRUCTION

US Army Corps of Engineers
Sacramento District

Symbol	Description	Date	Approved

Designed by: B. LIANG
Dwn by: B. LIANG
Reviewed by:
Submitted by:
CWES, CIV ENGR DES SEC.A

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DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 "J" STREET
SACRAMENTO, CA 95814-2922

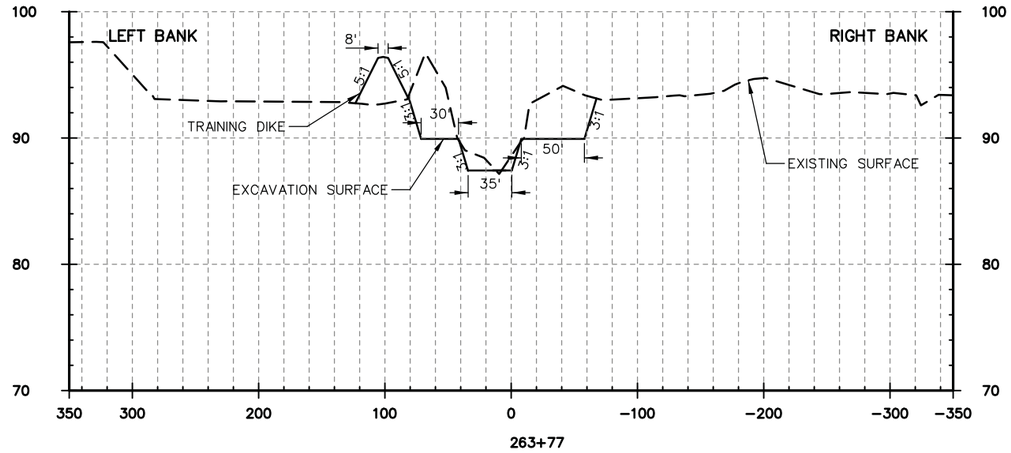
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

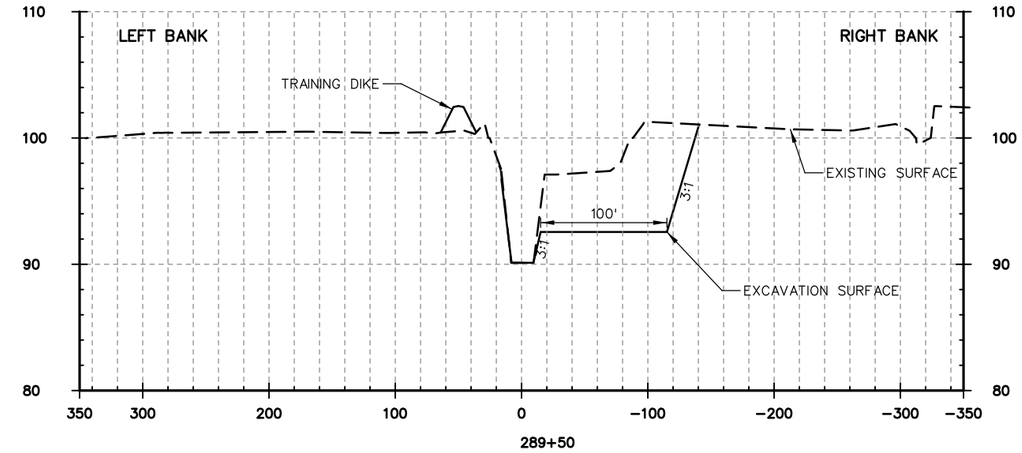
LPP LEVEE CROSS SECTIONS

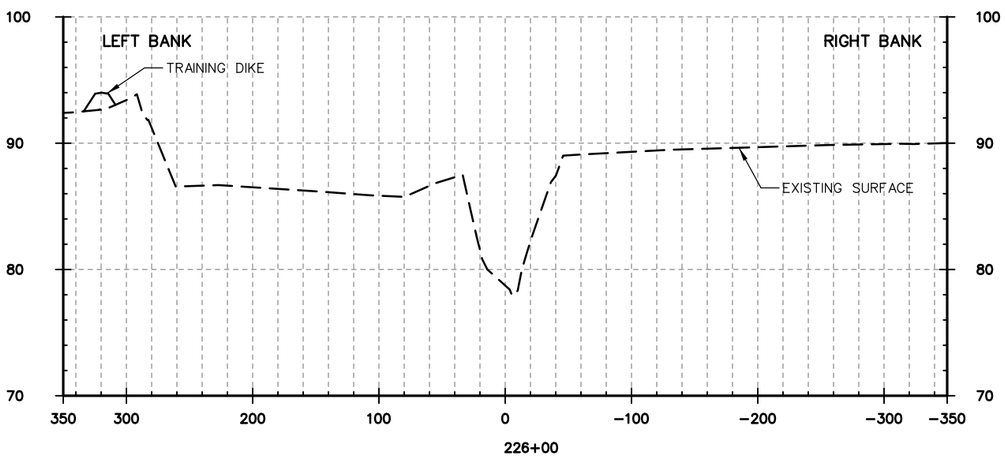
STA. 180+00 TO STA.245+00

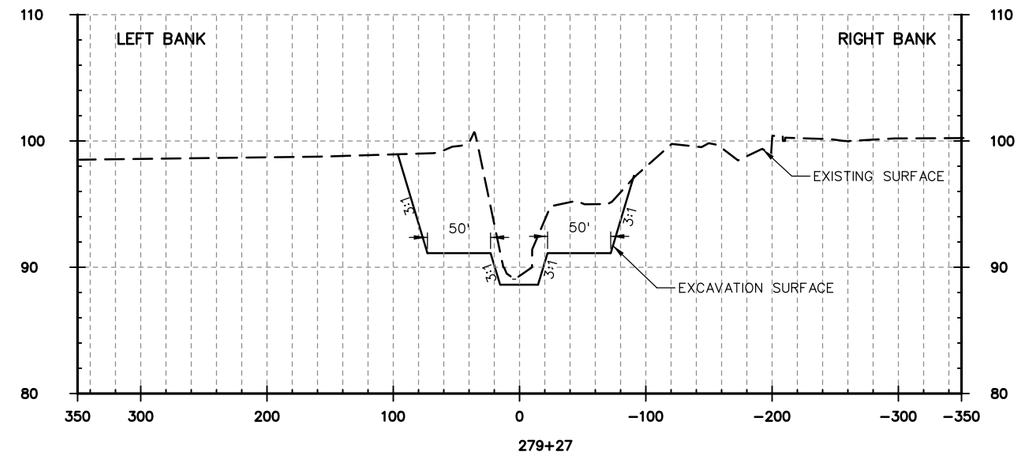
Sheet reference number:

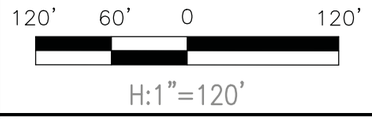
PLATE 28











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Sacramento District

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CHIEF, CIV ENGR DES SEC A

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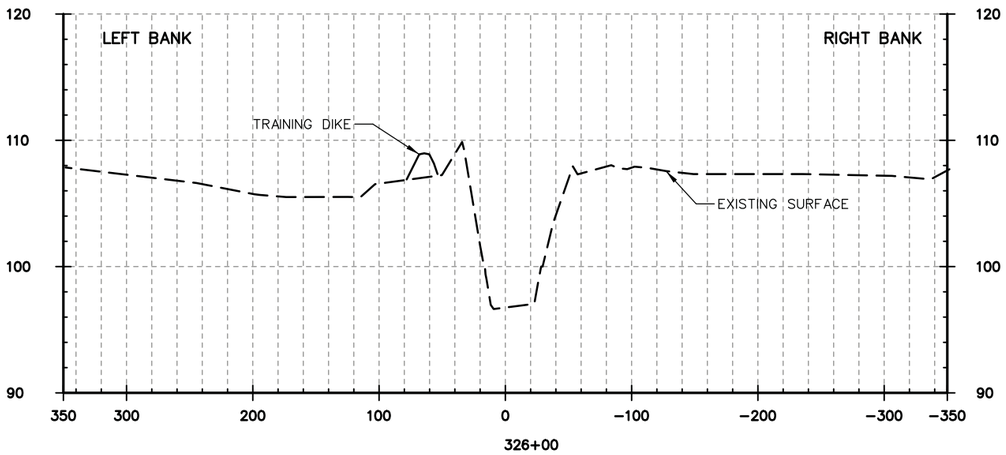
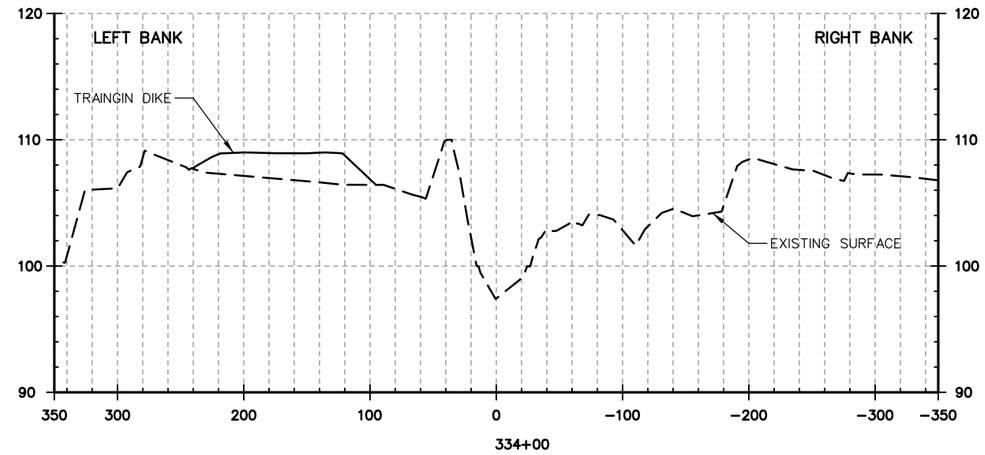
SACRAMENTO, CA 95814-2922

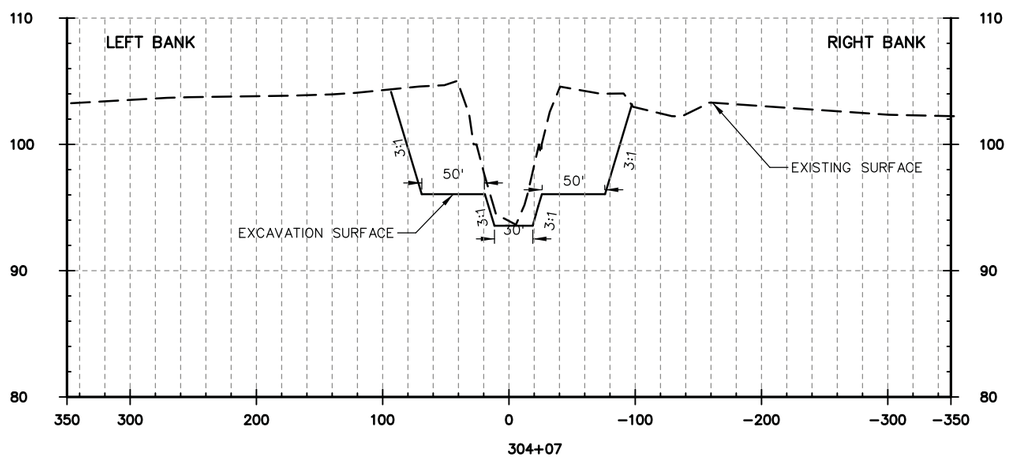
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

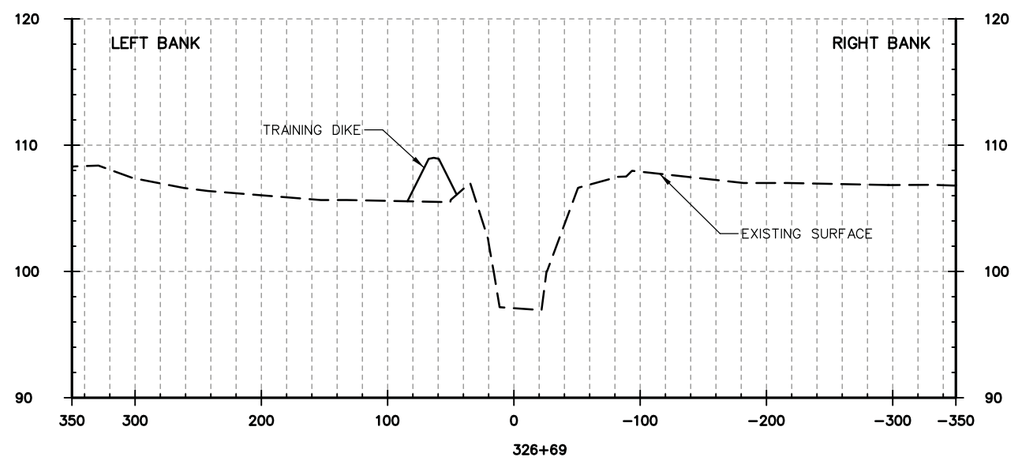
CHANNEL MOD CROSS SECTIONS

Sheet reference number:
PLATE 29









120' 60' 0 120'

H: 1"=120'

NOT FOR CONSTRUCTION

US Army Corps of Engineers
Sacramento District

Symbol	Description	Date	Approved

Designed by: B. LIANG
Dwn by: B. LIANG
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Submitted by:
CWIZE: CIV ENGR DES SEC A
Date: DATE APPROVED
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File name:
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DEPARTMENT OF THE ARMY
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SACRAMENTO, CALIFORNIA

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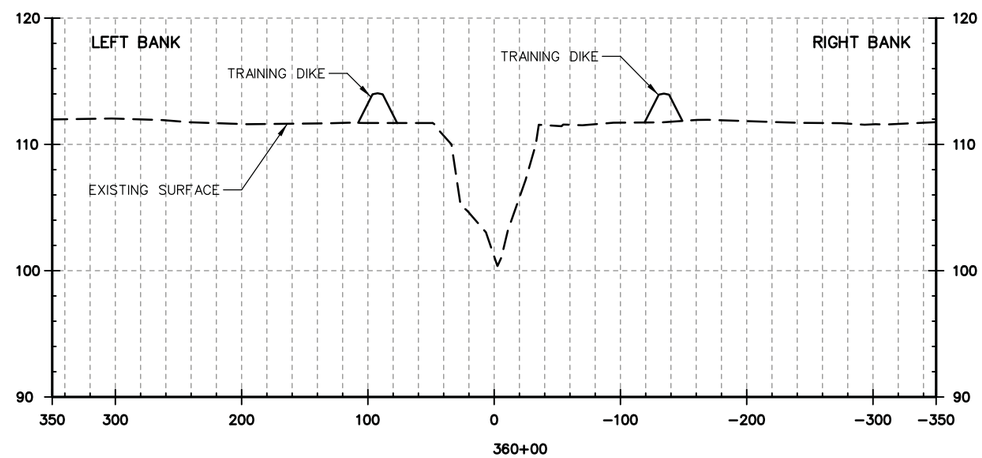
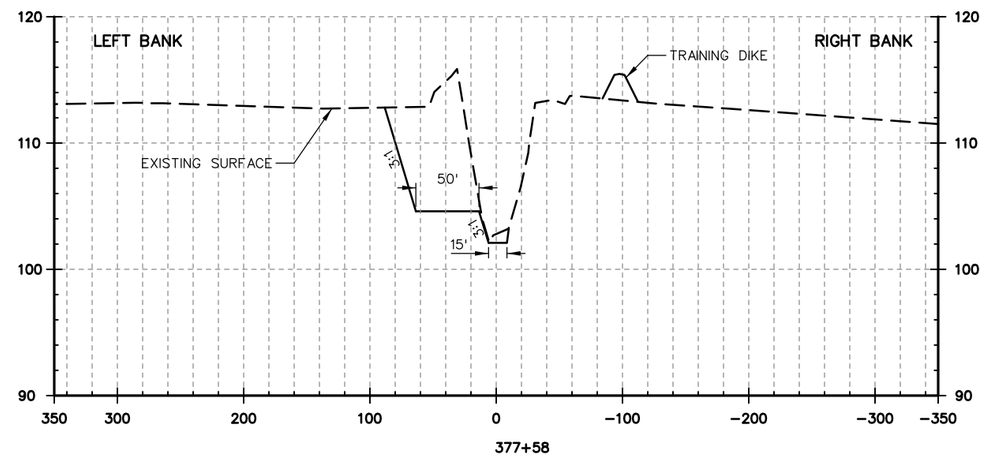
SACRAMENTO, CA 95814-2922

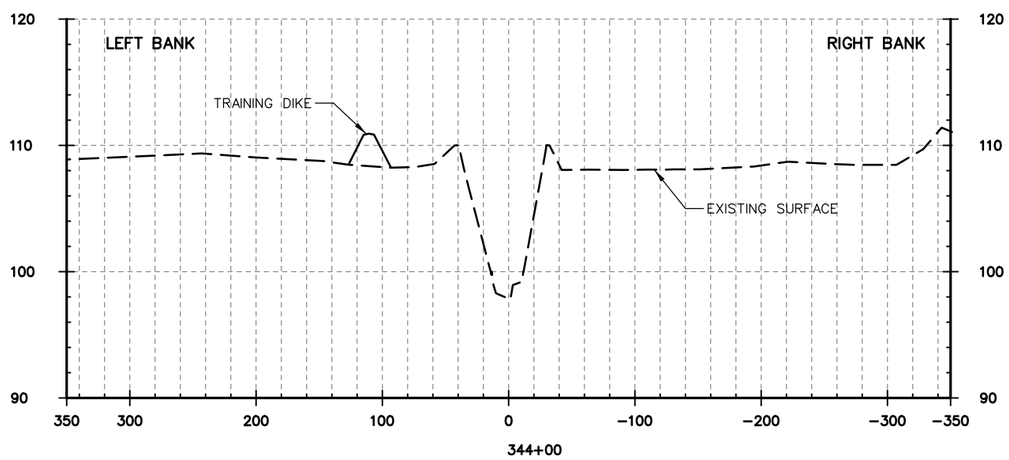
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

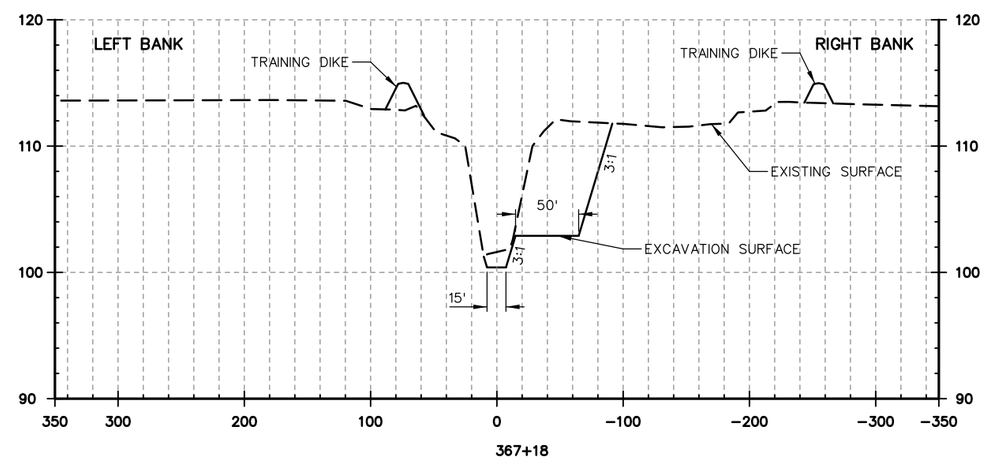
CHANNEL MOD CROSS SECTIONS

Sheet reference number:
PLATE 30









120' 60' 0 120'

H: 1"=120'

NOT FOR CONSTRUCTION

US Army Corps of Engineers
Sacramento District

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Designed by: B. LIANG
Dwn by: B. LIANG
Reviewed by:
Submitted by:
CWBES: CIV ENGR DES SEC.A

Date: DATE APPROVED
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Spec No.:
Design File No: FILE NO
Drawing Code: CODE
File name:
Plot date: 16-NOV-2011
Plot scale:

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SACRAMENTO, CALIFORNIA

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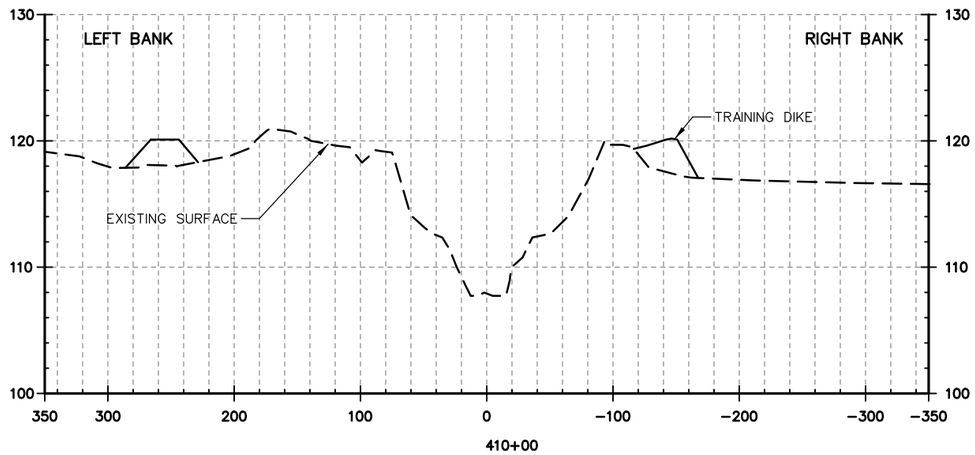
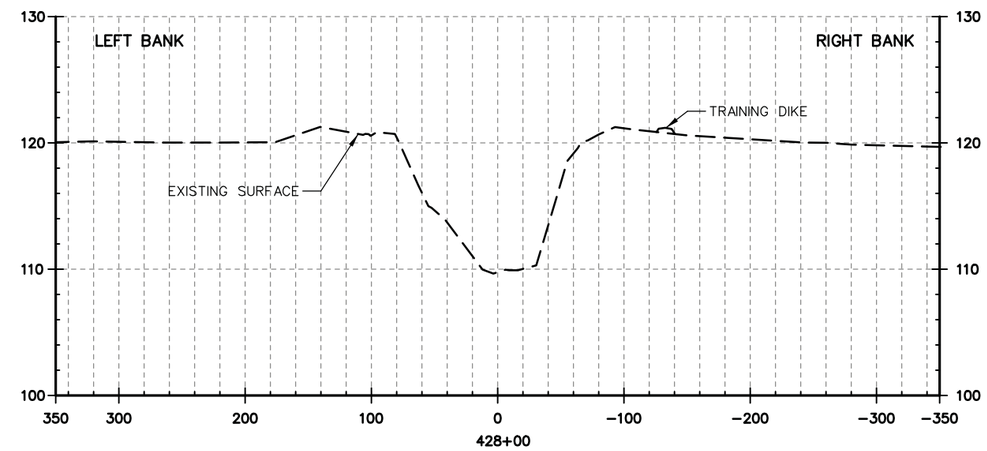
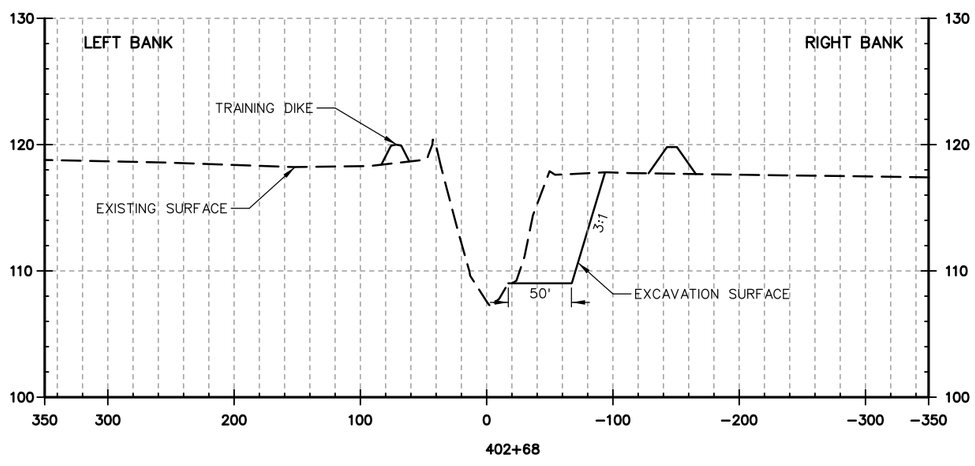
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

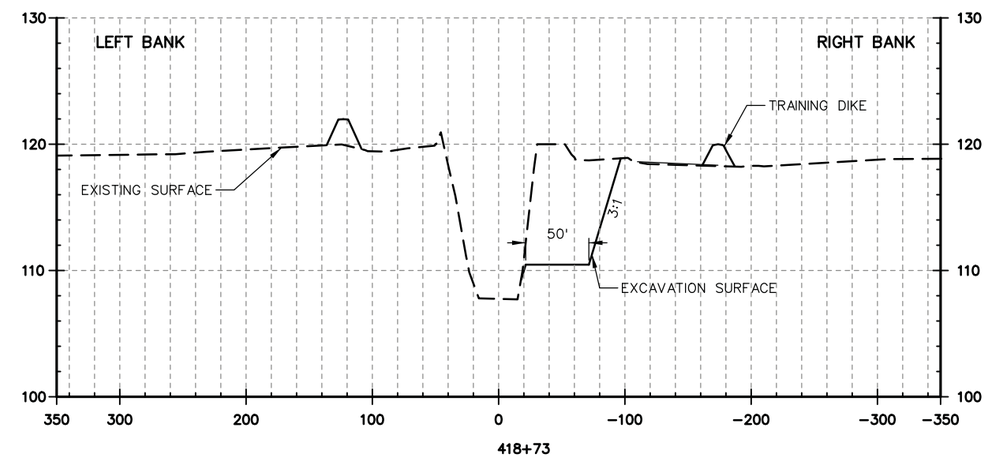
CHANNEL MOD CROSS SECTIONS

Sheet reference number:
PLATE 31









120' 60' 0 120'

H: 1"=120'

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US Army Corps of Engineers
Sacramento District

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Dwn by: B. LIANG
Reviewed by:
Submitted by:
CWIES: CIV ENGR DES SEC A

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Design File No: FILE_NO
Drawing Code: CODE
File name:
Plot date: 16-NOV-2011
Plot scale:

Date: DATE_APPROVED
Rev:

DEPARTMENT OF THE ARMY
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SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 "J" STREET
SACRAMENTO, CA 95814-2922

STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

CHANNEL MOD CROSS SECTIONS

Sheet reference number:
PLATE 32

US Army Corps
of Engineers
Sacramento District

ORESTIMBA CREEK FEASIBILITY STUDY
AFB (F4A)-ATTACHMENT A

STANISLAUS COUNTY
CALIFORNIA

FY_2012

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Approved
Chief, Engineering Division XX/XX/XX Date:
Prepared Under the Direction of
Col, Corps of Engineers District Engineer

Drawing Code:
Drawn by BENSON LIANG
Design File No: FILE

Approved Functional Adequacy
Chief, Design Br XX/XX/11 Date:
Prepared by SACRAMENTO DISTRICT DESIGN BRANCH
Designed by BENSON LIANG
Spec No.
RICHARD TORBIK XX/XX/11
Chief, Civil Engr Des Sec B Date:

STANISLAUS COUNTY CALIFORNIA
ORESTIMBA CREEK FEASIBILITY STUDY
WITHOUT CHANNEL MODIFICATION
COVER SHEET

Sheet reference number:
G-001

PLATE LIST

PLATE NO.	DESCRIPTION
	GENERAL
G-001	COVER SHEET
G-002	SHEET LIST
PLATE 01	LPP OVERALL PLAN
PLATE 02	NED OVERALL PLAN
PLATE 03	KEYMAP
PLATE 04	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 05	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 06	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 07	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 08	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 09	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 10	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 11	ORESTIMBA LPP LEVEE PLAN VIEW
PLATE 12	LPP LEVEE, HWY 33 & RAILROAD PROTECTION PLAN VIEW
PLATE 13	RAILROAD EROSION PROCTION PLAN
PLATE 14	RAILROAD EROSION PROCTION PLAN
PLATE 15	RAILROAD EROSION PROCTION PLAN
PLATE 16	RAILROAD EROSION PROCTION PLAN
PLATE 17	ORESTIMBA LPP LEVEE PROFILE
PLATE 18	ORESTIMBA NED LEVEE PROFILE
PLATE 19	LEVEE TYPICAL CROSS SECTIONS
PLATE 20	LPP LEVEE CROSS SECTIONS
PLATE 21	LPP LEVEE CROSS SECTIONS
PLATE 22	LPP LEVEE CROSS SECTIONS
PLATE 23	LPP LEVEE CROSS SECTIONS

SURVEY DATA:
HORIZONTAL DATUM NAD83, MAP PROJECTION C.C. S.
ZONE III, VERTICAL DATUM NAVD 88.

TOPOGRAPHIC CONTOURS OBTAINED FROM TIN OF PHASE 1
LIDAR TOPOGRAPHY FROM CENTRAL VALLEY FLOOD
EVALUATION AND DELINEATION CALIFORNIA DEPARTMENT OF
WATER RESOURCES FLOWN 30 APRIL 2008.

LIDAR NOMINAL POST SPACING IS 1-METER. HORIZONTAL ACCURACY
+/- 3.5 FT @ 95% CONFIDENCE LEVEL. VERTCAL ACCURACY
+/- 1.2 FT @ 95% CONFIDENCY LEVEL.

IMAGERY DATE IS JUNE 16, 2011. IMAGERY IS FROM GOOGLE EARTH.

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Dwn by: B. LIANG
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Rev.
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Design file no: FILE_NO
Drawing Code: CODE
File name:
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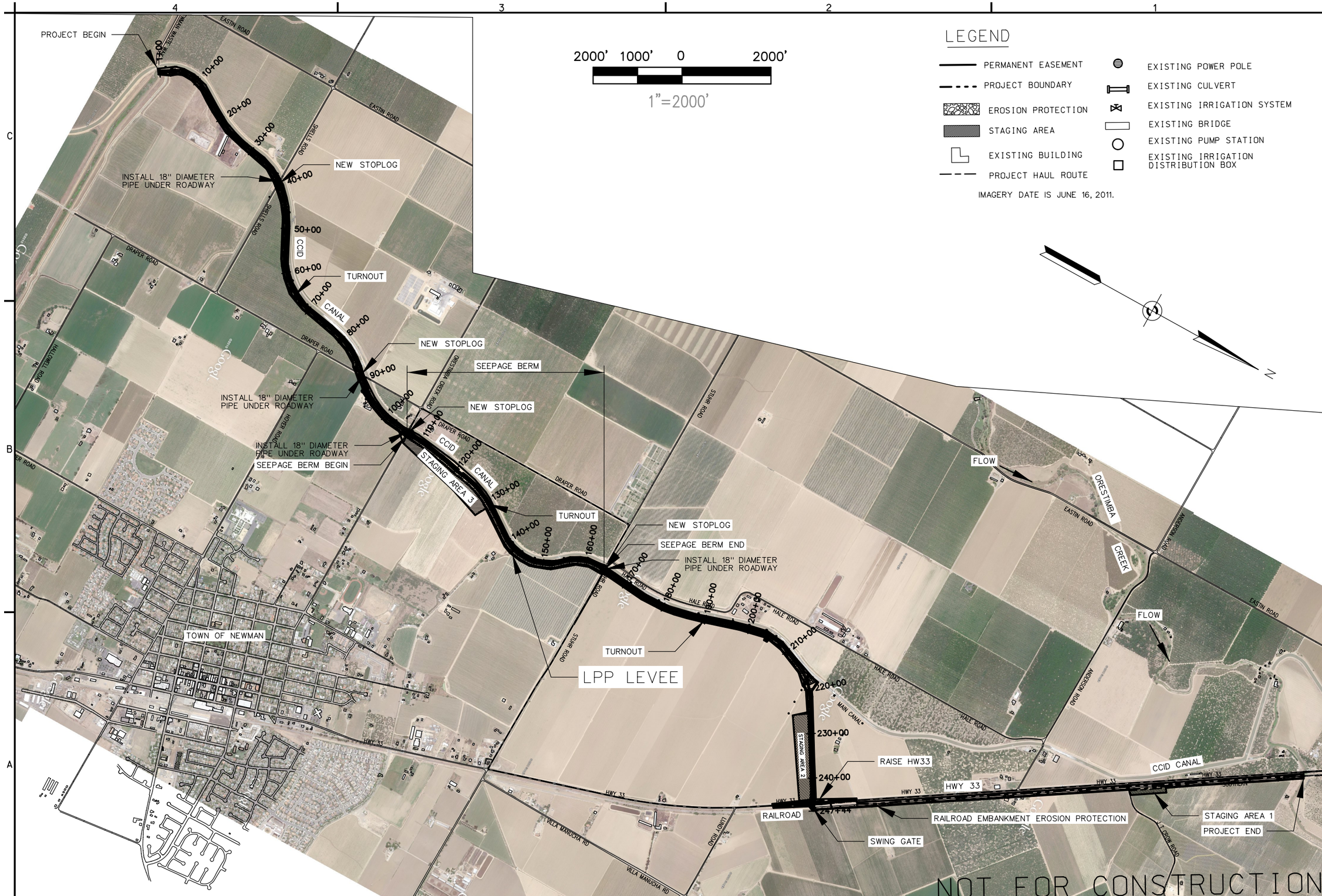
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

PLATE LIST

Sheet reference number:
G-002



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- EXISTING BRIDGE
- EXISTING PUMP STATION
- EXISTING IRRIGATION DISTRIBUTION BOX

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Plot scale:

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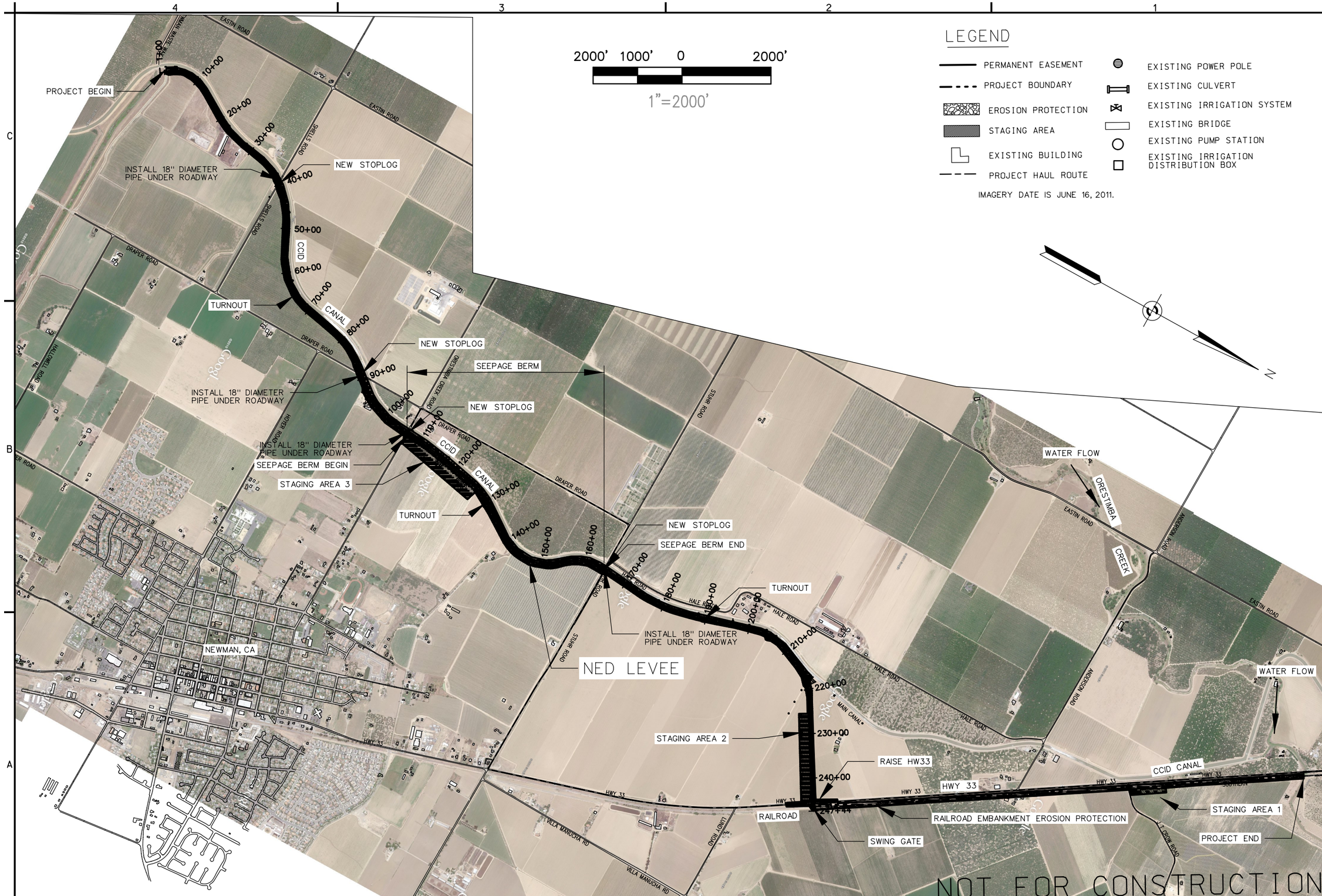
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

LPP OVERALL PLAN

Sheet reference number:
PLATE 01



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Submitted by: CHIEF, CIV ENGR DES SEC.A
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Plot date: 22-FEB-2012
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ORESTIMBA CREEK FEASIBILITY STUDY

NED OVERALL PLAN

Sheet reference number:
PLATE 02

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8.1.2 | PLOT DATE: 22-FEB-2012 | PLOT TIME: 12:33 | \\AMETHYST\civcad_2\Orestimba_2011\Prepare_F4a\NewSheets\PLATE_02_ORESTIMBA_PLAN_NED.dgn

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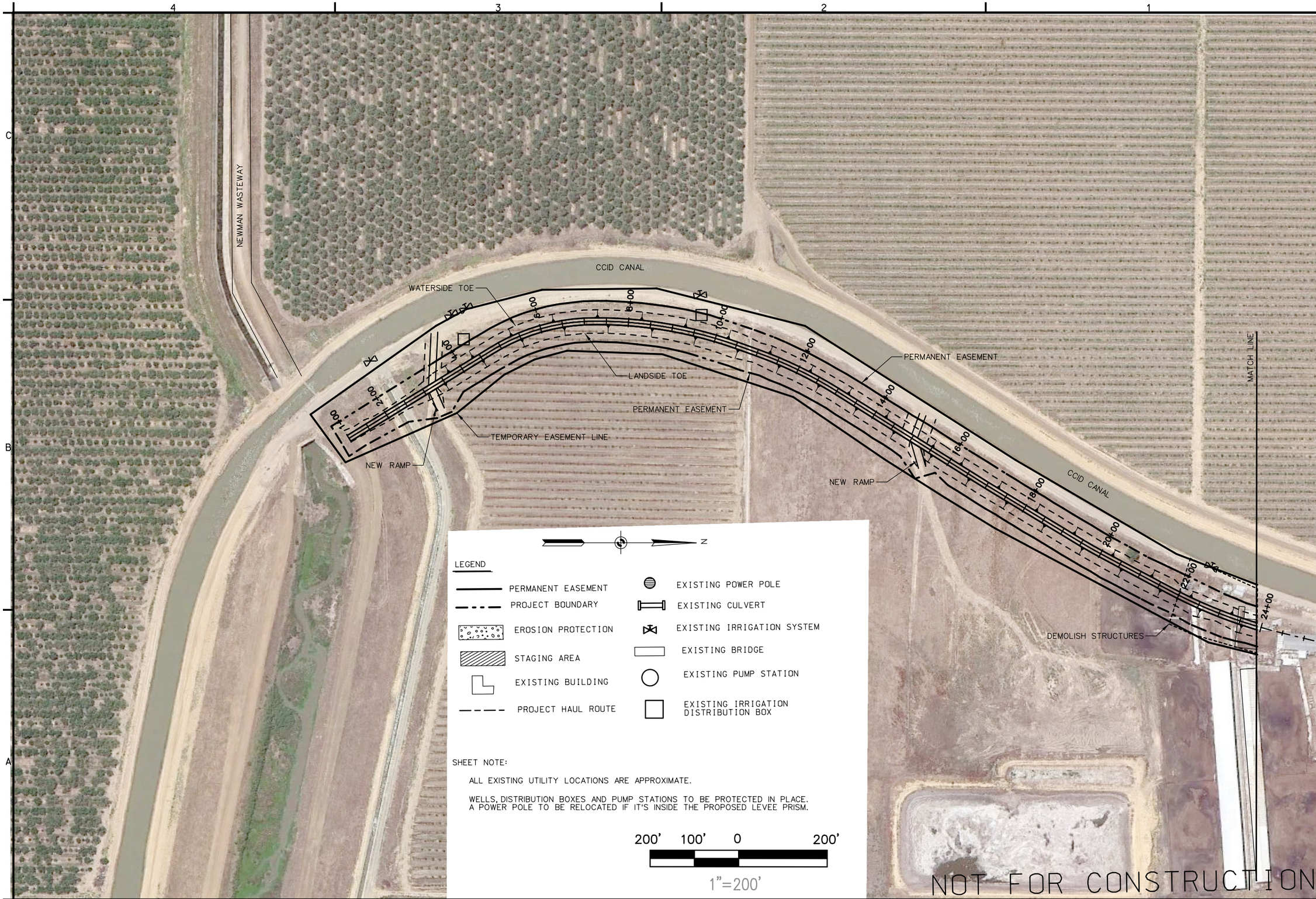
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

KEY MAP
LPP OVERALL PLAN

Sheet reference number:
PLATE 03



SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

WELLS, DISTRIBUTION BOXES AND PUMP STATIONS TO BE PROTECTED IN PLACE. A POWER POLE TO BE RELOCATED IF IT'S INSIDE THE PROPOSED LEVEE PRISM.

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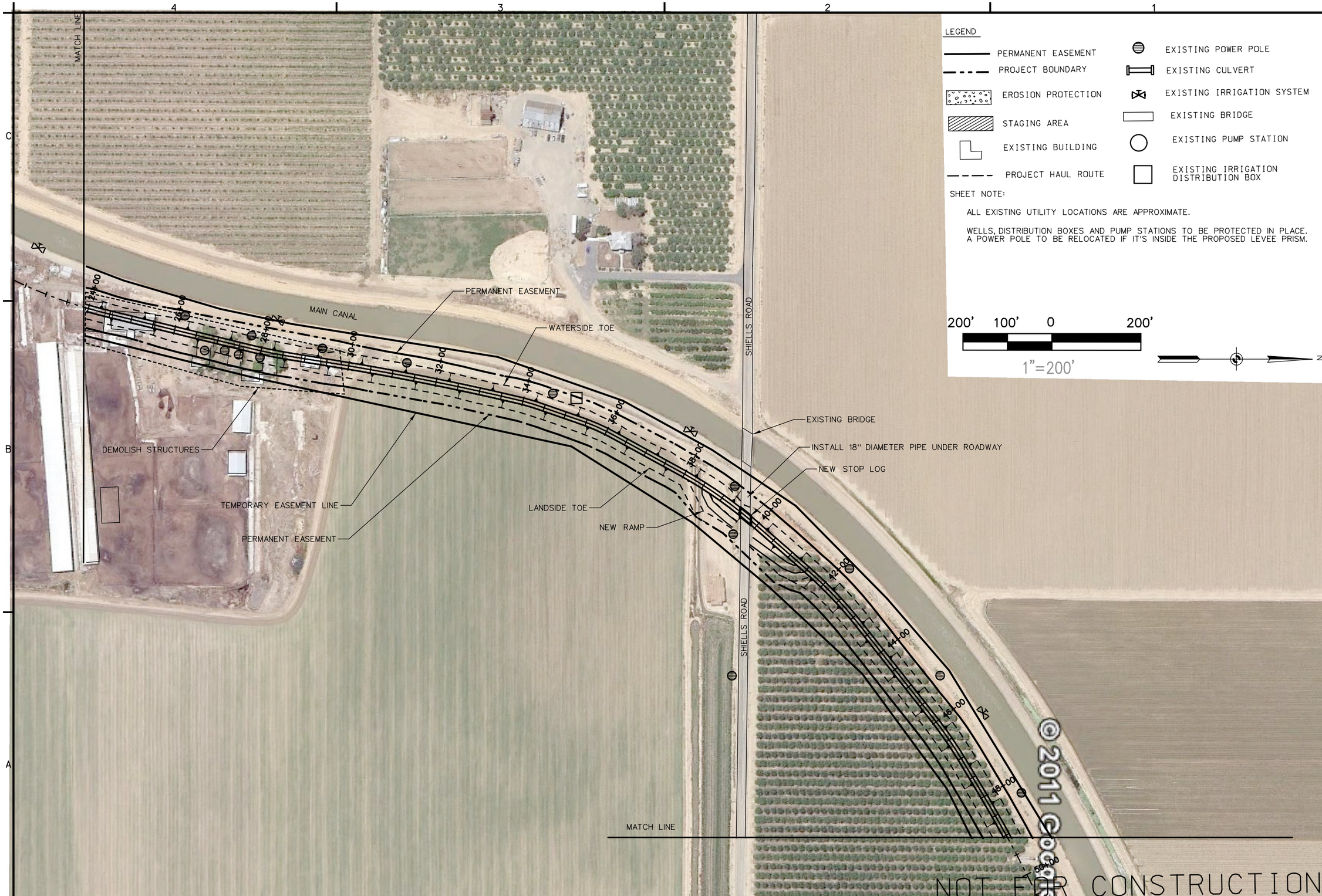
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:
PLATE 04

8.1.2 PLOT DATE: 22-FEB-2012 PLOT TIME: 12:34 \\AMETHYST\civcad_2\Orestimba_2011\Prepare_F4a\NewSheets\PLATE_04_ORESTIMBA__chevron1.dgn



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- EXISTING BRIDGE
- EXISTING PUMP STATION
- EXISTING IRRIGATION DISTRIBUTION BOX

SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

WELLS, DISTRIBUTION BOXES AND PUMP STATIONS TO BE PROTECTED IN PLACE. A POWER POLE TO BE RELOCATED IF IT'S INSIDE THE PROPOSED LEVEE PRISM.

200' 100' 0 200'

1"=200'

N

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Submitted by:
File name:
Plot date: 22-FEB-2012
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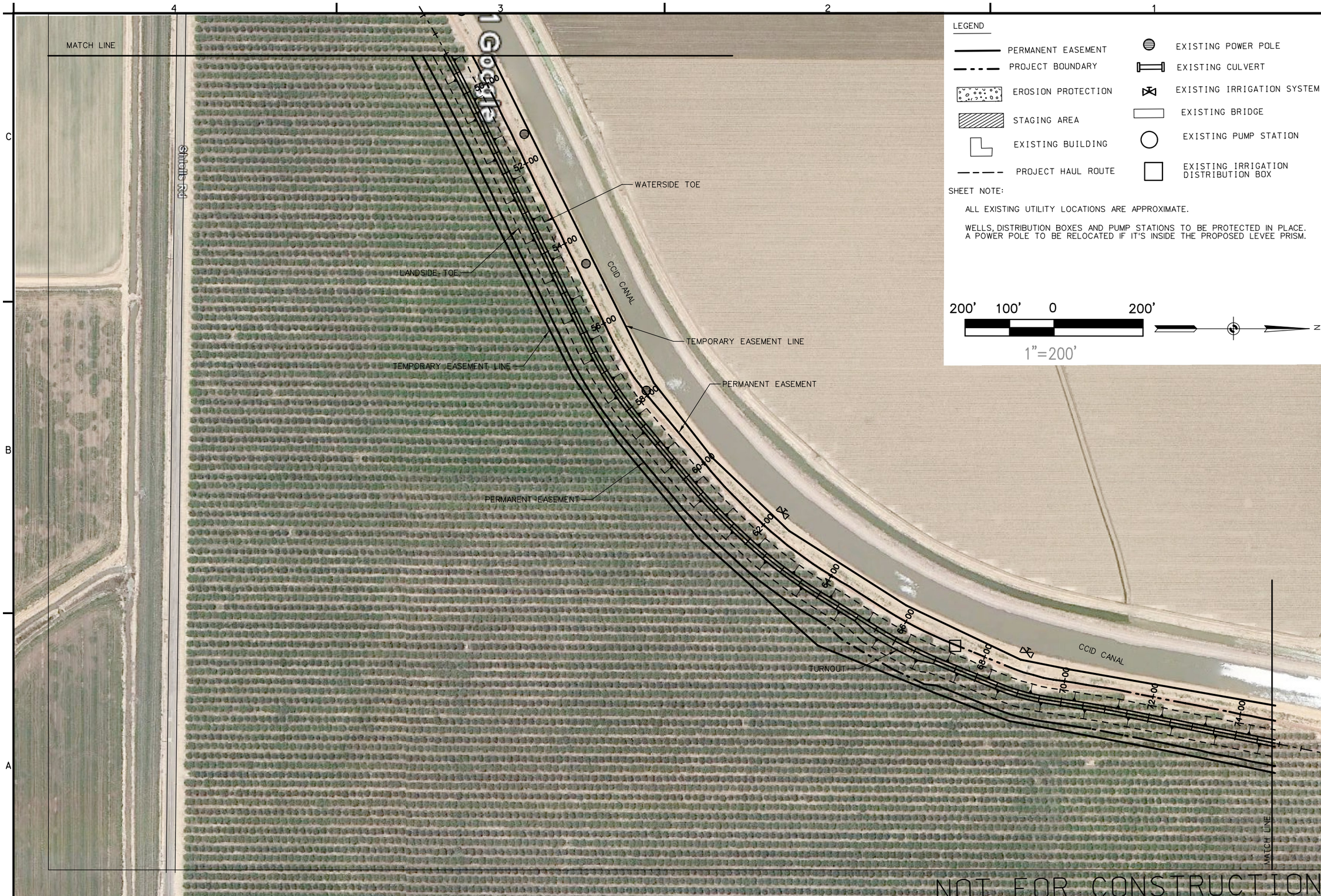
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 05



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
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WELLS, DISTRIBUTION BOXES AND PUMP STATIONS TO BE PROTECTED IN PLACE. A POWER POLE TO BE RELOCATED IF IT'S INSIDE THE PROPOSED LEVEE PRISM.

200' 100' 0 200'

1"=200'

N

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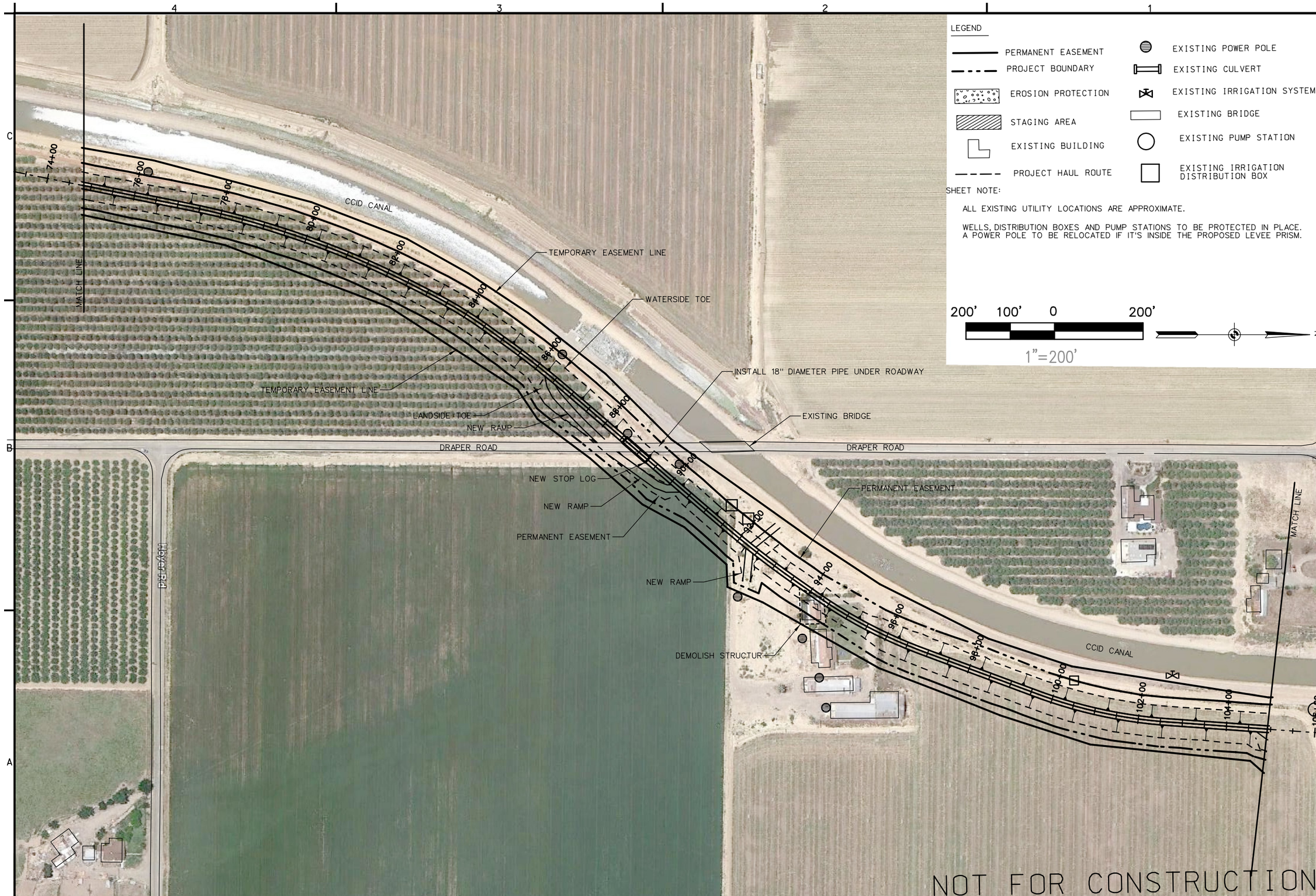
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 06



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
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SHEET NOTE:

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200' 100' 0 200'

1"=200'

N

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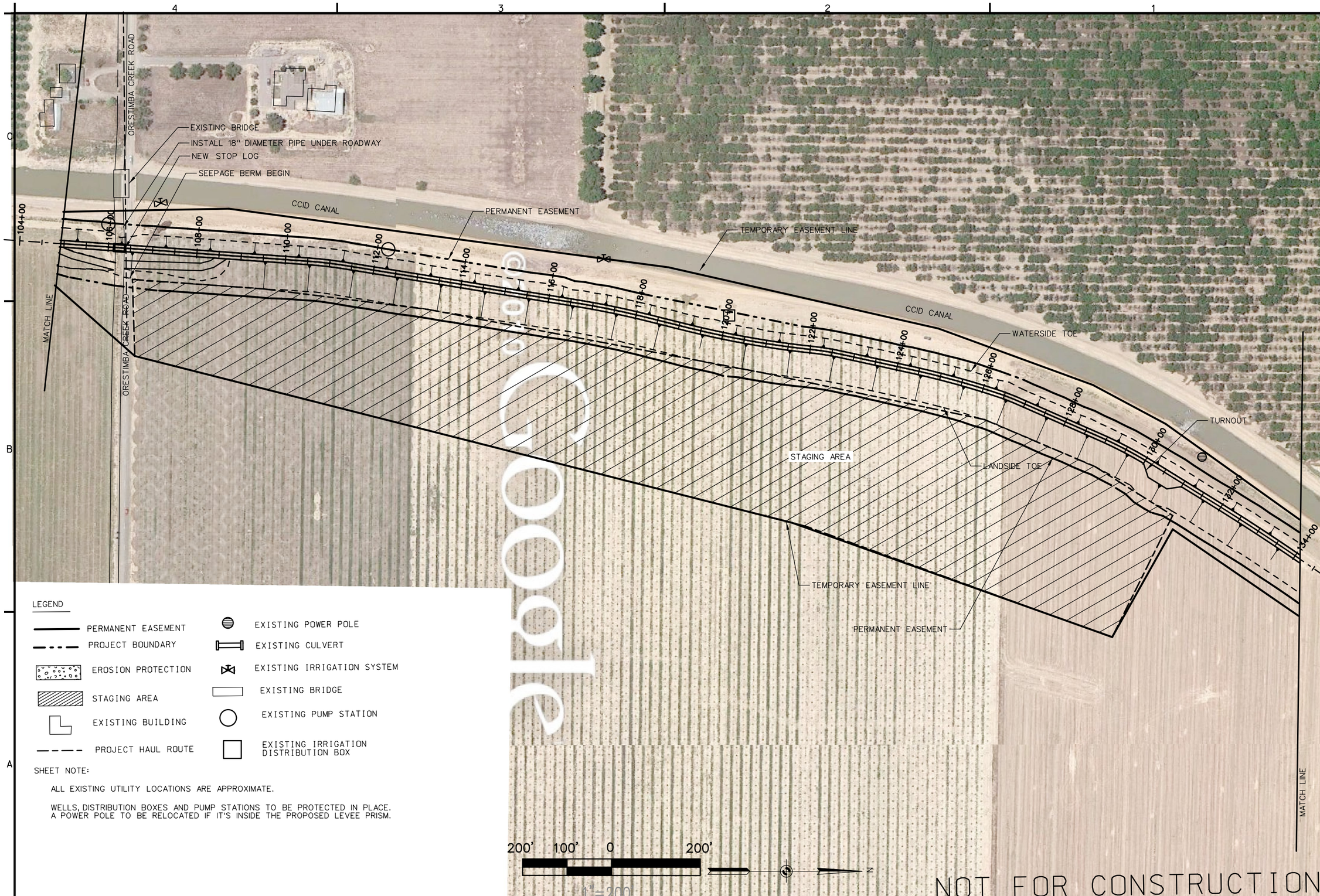
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 07



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
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Plot date: 22-FEB-2012
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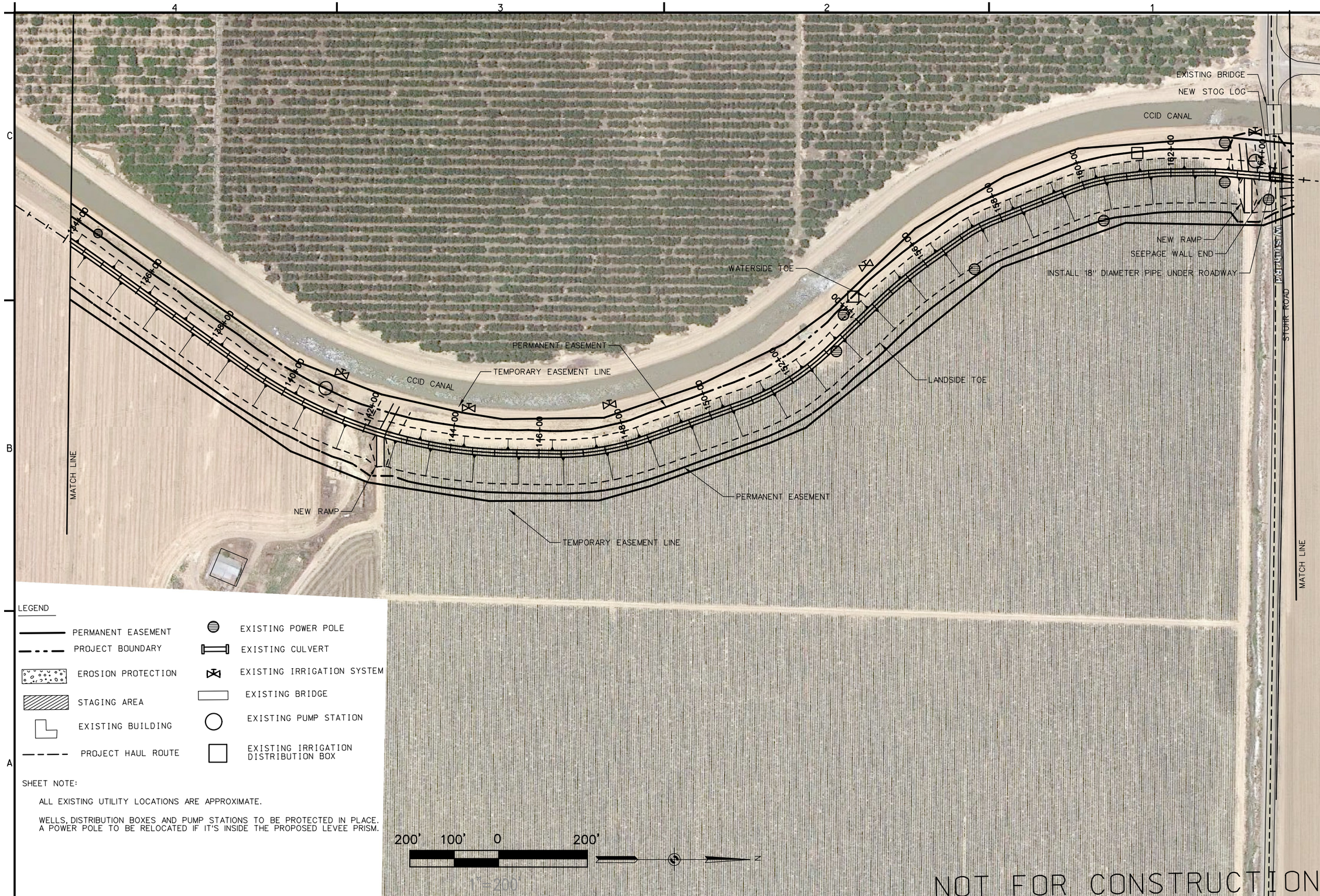
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:
PLATE 08

8.1.2 PLOT DATE: 22-FEB-2012 PLOT TIME: 12:36 \\AMETHYST\civcad_2\Orestimba_2011\Prepare_F4a\NewSheets\PLATE_08_ORESTIMBA__chevron5.dgn



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
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Drawing Code: CODE
Submitted by:
File name:
Plot date: 22-FEB-2012
Plot scale:
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STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

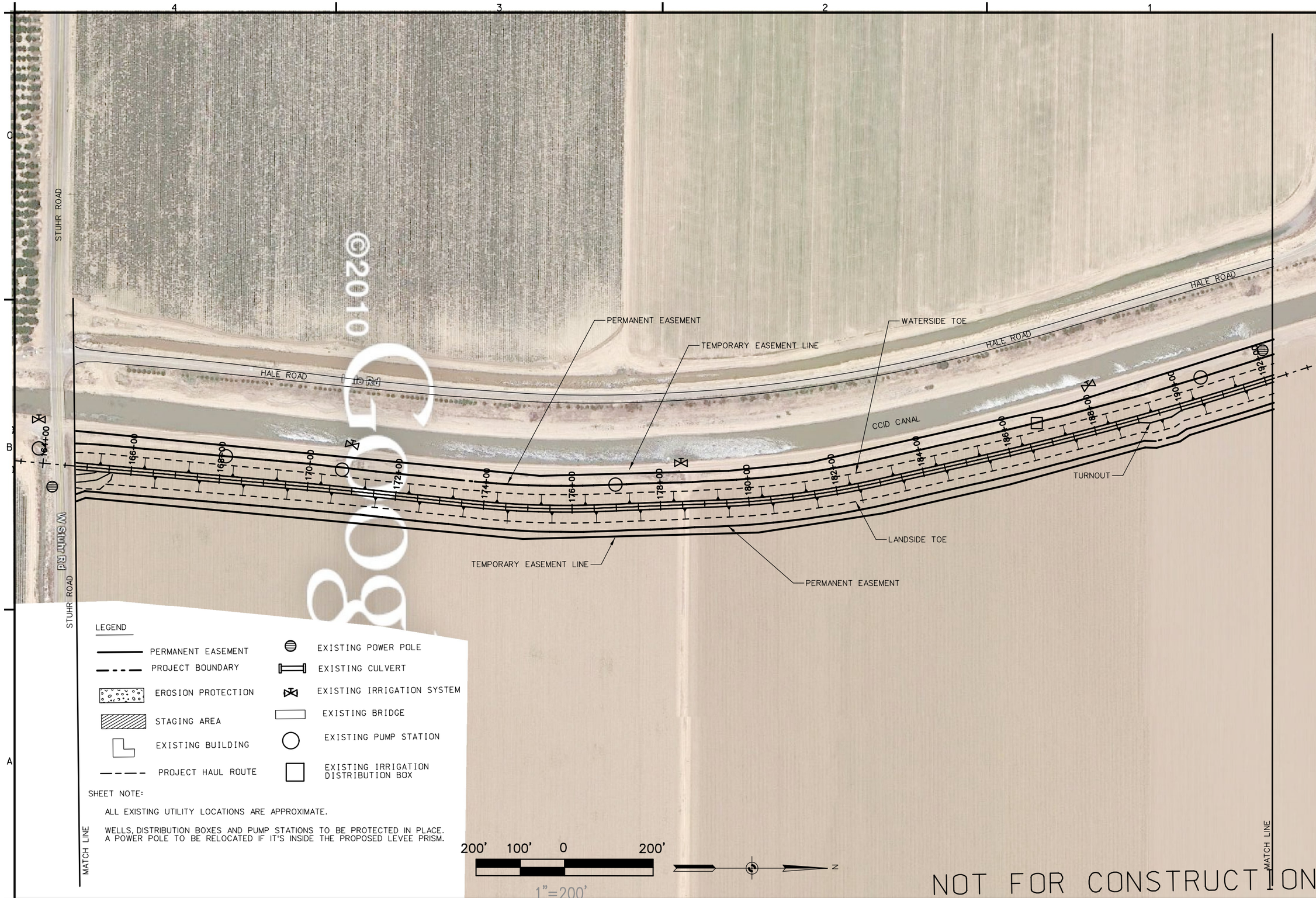
ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 09

8.1.2

PLOT DATE: 22-FEB-2012 PLOT TIME: 12:36 \\AMETHYST\civcad_2\Orestimba_2011\Prepare_F4a\NewSheets\PLATE_09_ORESTIMBA__chevron6.dgn



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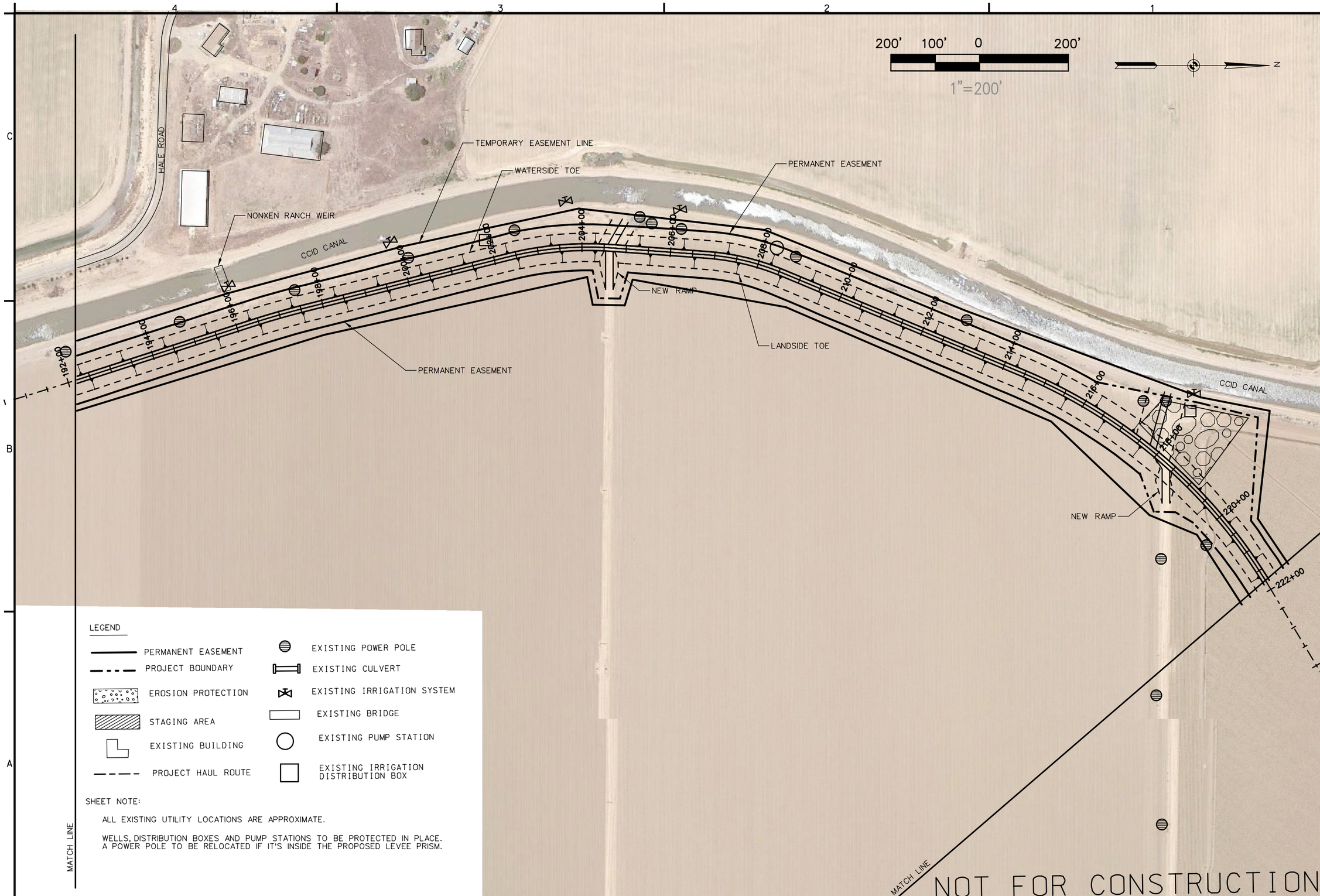
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:
PLATE 10



LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- EXISTING BRIDGE
- EXISTING PUMP STATION
- EXISTING IRRIGATION DISTRIBUTION BOX

SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

WELLS, DISTRIBUTION BOXES AND PUMP STATIONS TO BE PROTECTED IN PLACE. A POWER POLE TO BE RELOCATED IF IT'S INSIDE THE PROPOSED LEVEE PRISM.

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Plot date: 22-FEB-2012
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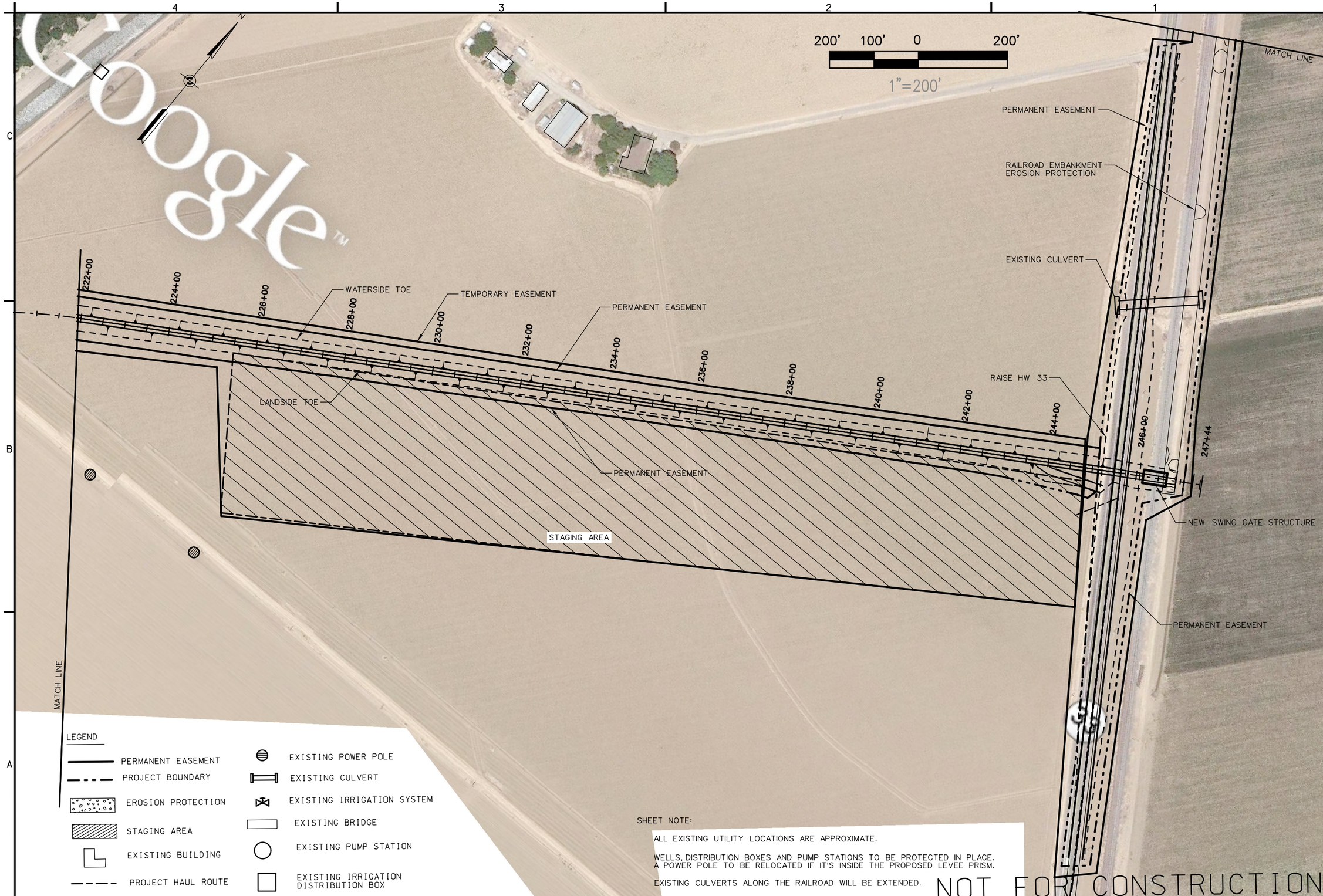
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PLAN VIEW

Sheet reference number:

PLATE 11



SHEET NOTE:

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WELLS, DISTRIBUTION BOXES AND PUMP STATIONS TO BE PROTECTED IN PLACE. A POWER POLE TO BE RELOCATED IF IT'S INSIDE THE PROPOSED LEVEE PRISM.

EXISTING CULVERTS ALONG THE RAILROAD WILL BE EXTENDED.

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Submitted by:
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File name:
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SACRAMENTO, CA 95814-2922

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ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE,HIGHWAY 33
AND RAILROAD PROTECTION PLAN VIEW

Sheet reference number:
PLATE 12

LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
- EXISTING BRIDGE
- EXISTING PUMP STATION
- EXISTING IRRIGATION DISTRIBUTION BOX

200' 100' 0 200'

1"=200'

SHEET NOTE:

ALL EXISTING UTILITY LOCATIONS ARE APPROXIMATE.

EXISTING CULVERTS ALONG THE RAILROAD WILL BE EXTENDED.

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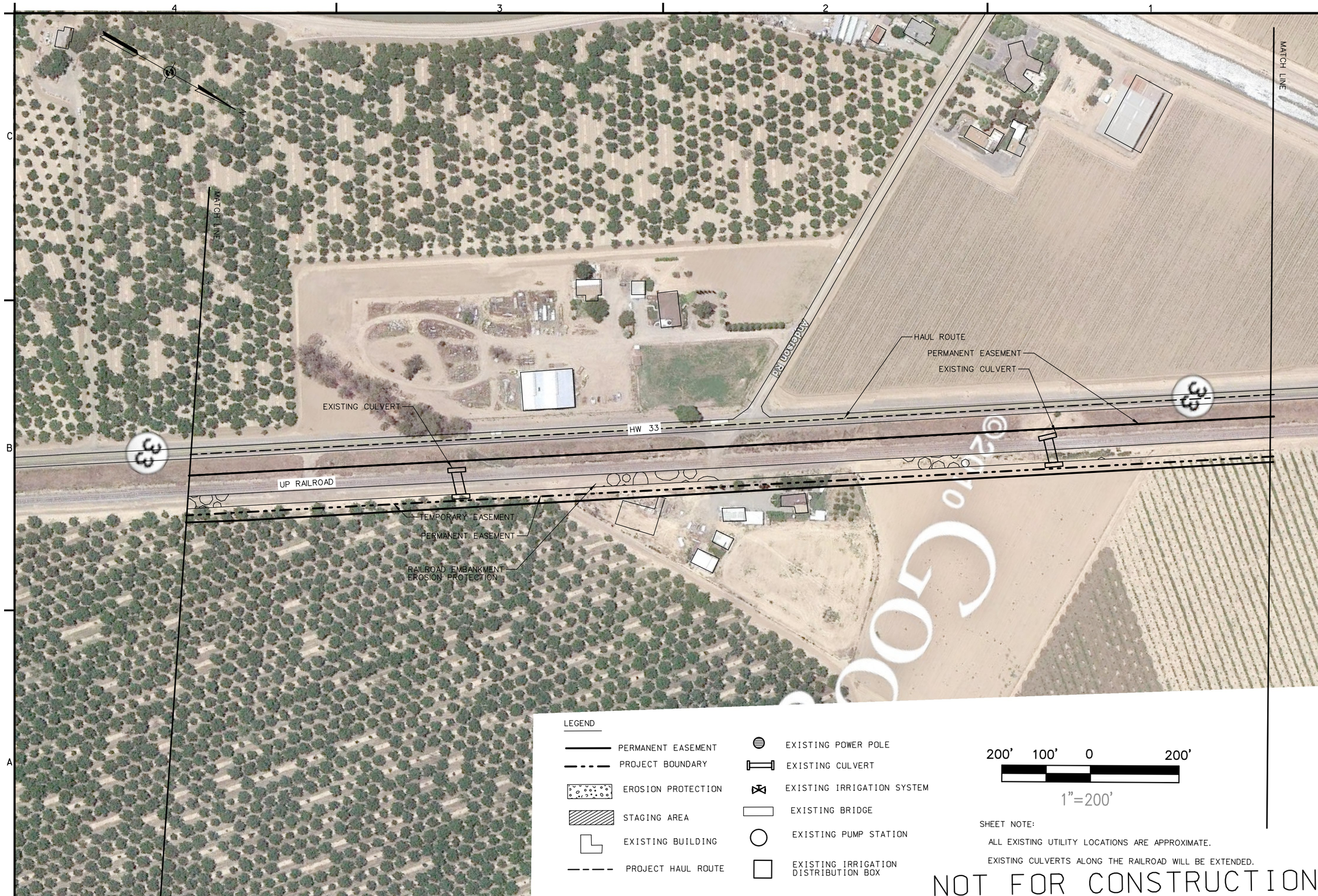
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

RAILROAD EMBANKMENT
EROSION PROTECTION PLAN VIEW

Sheet reference number:

PLATE 13



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ORESTIMBA CREEK FEASIBILITY STUDY

RAILROAD EMBANKMENT
EROSION PROTECTION PLAN VIEW

Sheet reference number:
PLATE 14

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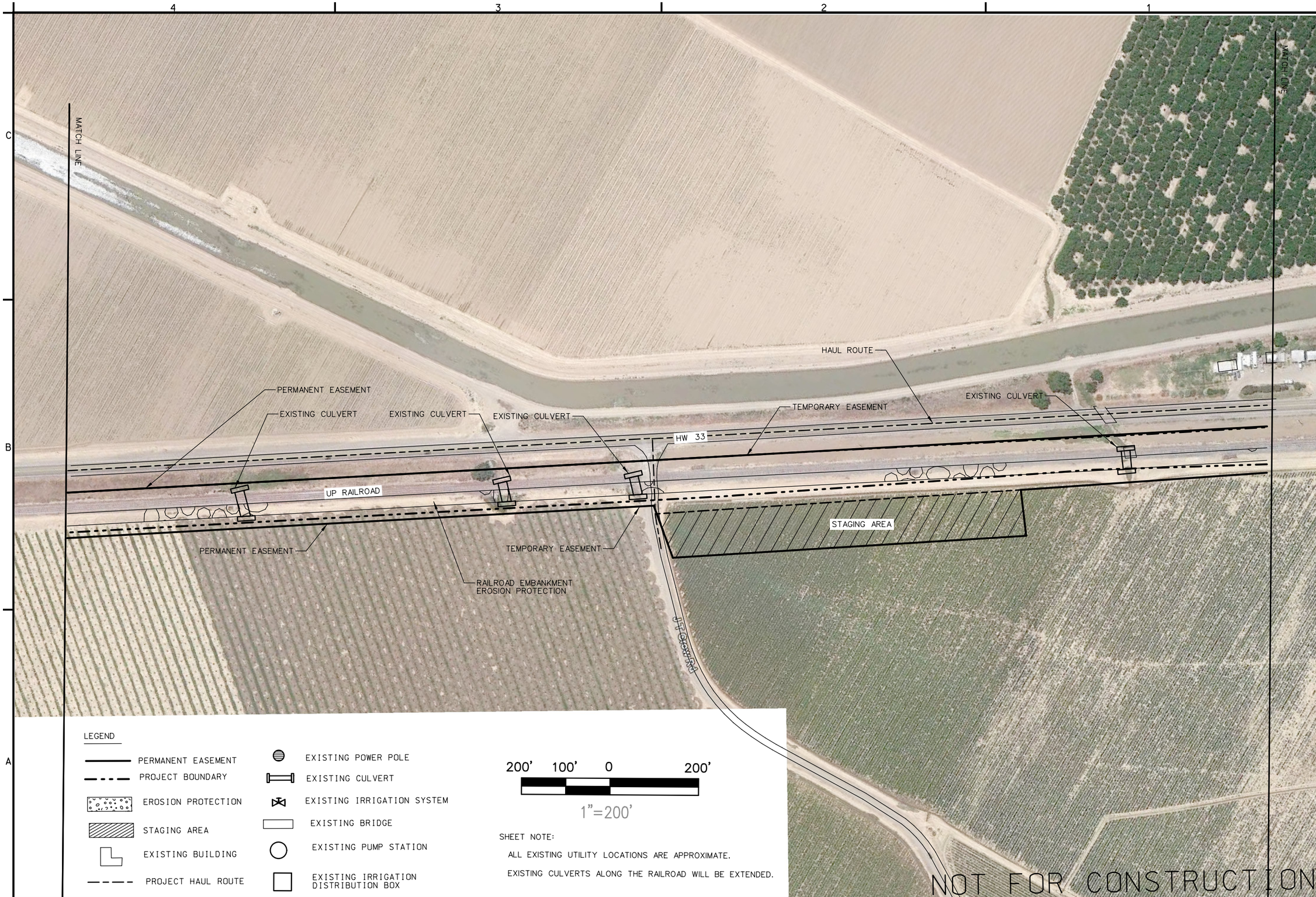

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RAILROAD EMBANKMENT
EROSION PROTECTION PLAN VIEW

Sheet reference number:
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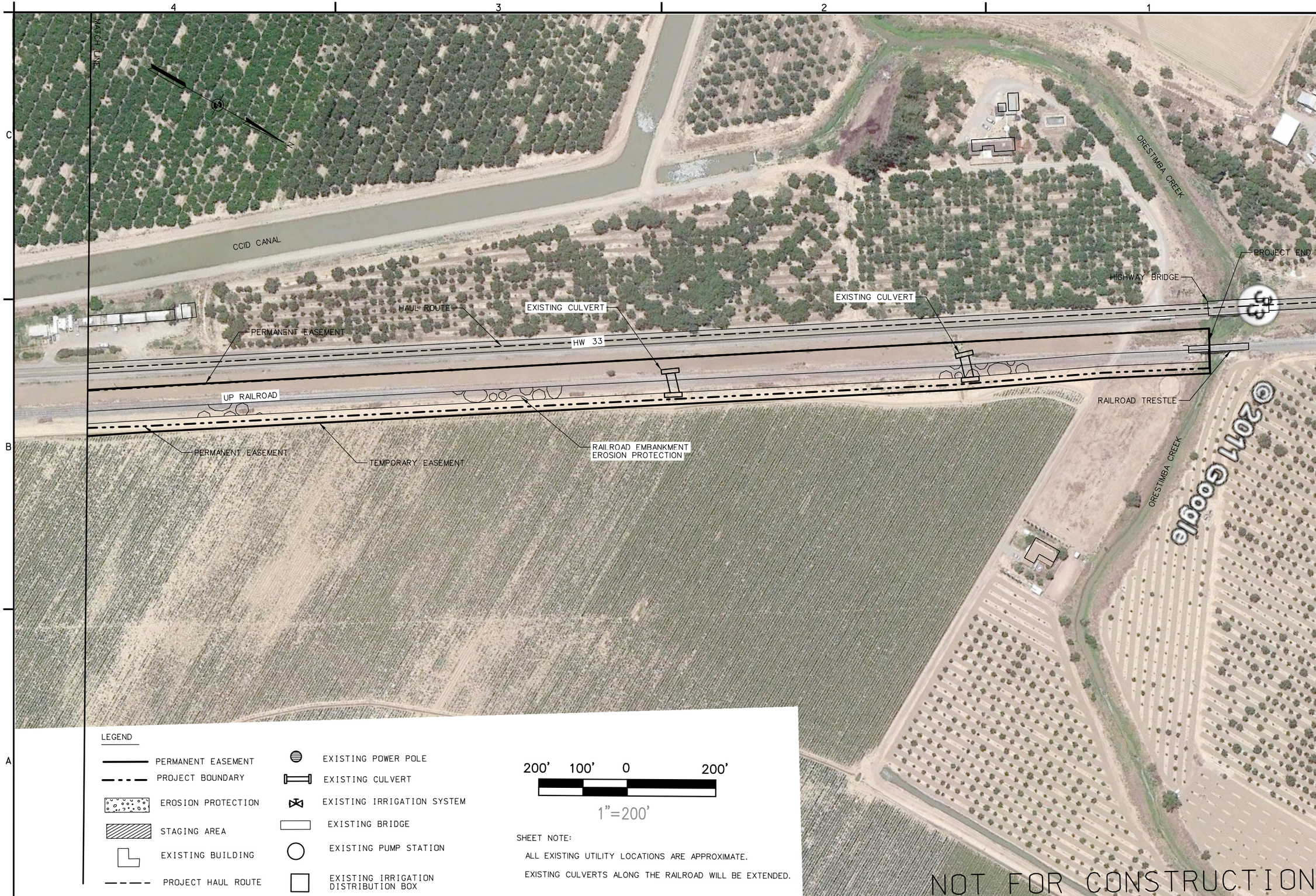

LEGEND

- PERMANENT EASEMENT
- PROJECT BOUNDARY
- EROSION PROTECTION
- STAGING AREA
- EXISTING BUILDING
- PROJECT HAUL ROUTE
- EXISTING POWER POLE
- EXISTING CULVERT
- EXISTING IRRIGATION SYSTEM
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200' 100' 0 200'

1"=200'

SHEET NOTE:

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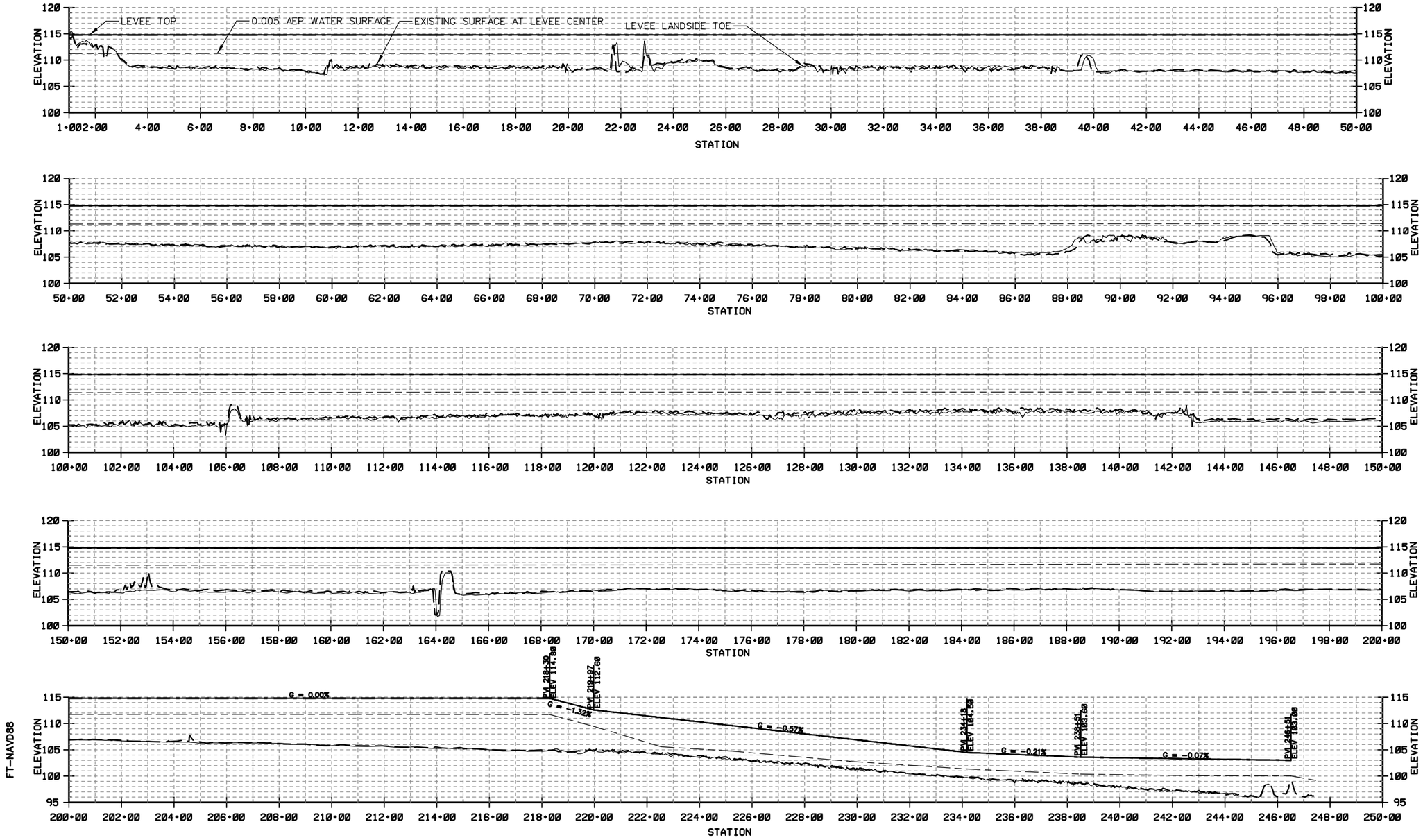
ORESTIMBA CREEK FEASIBILITY STUDY

RAILROAD EMBANKMENT
EROSION PROTECTION PLAN VIEW

Sheet reference number:
PLATE 16



ORESTIMBA LPP LEVEE PROFILE

400' 200' 0 400'

H: 1"=400'

20' 10' 0 20'

V: 1"=20'

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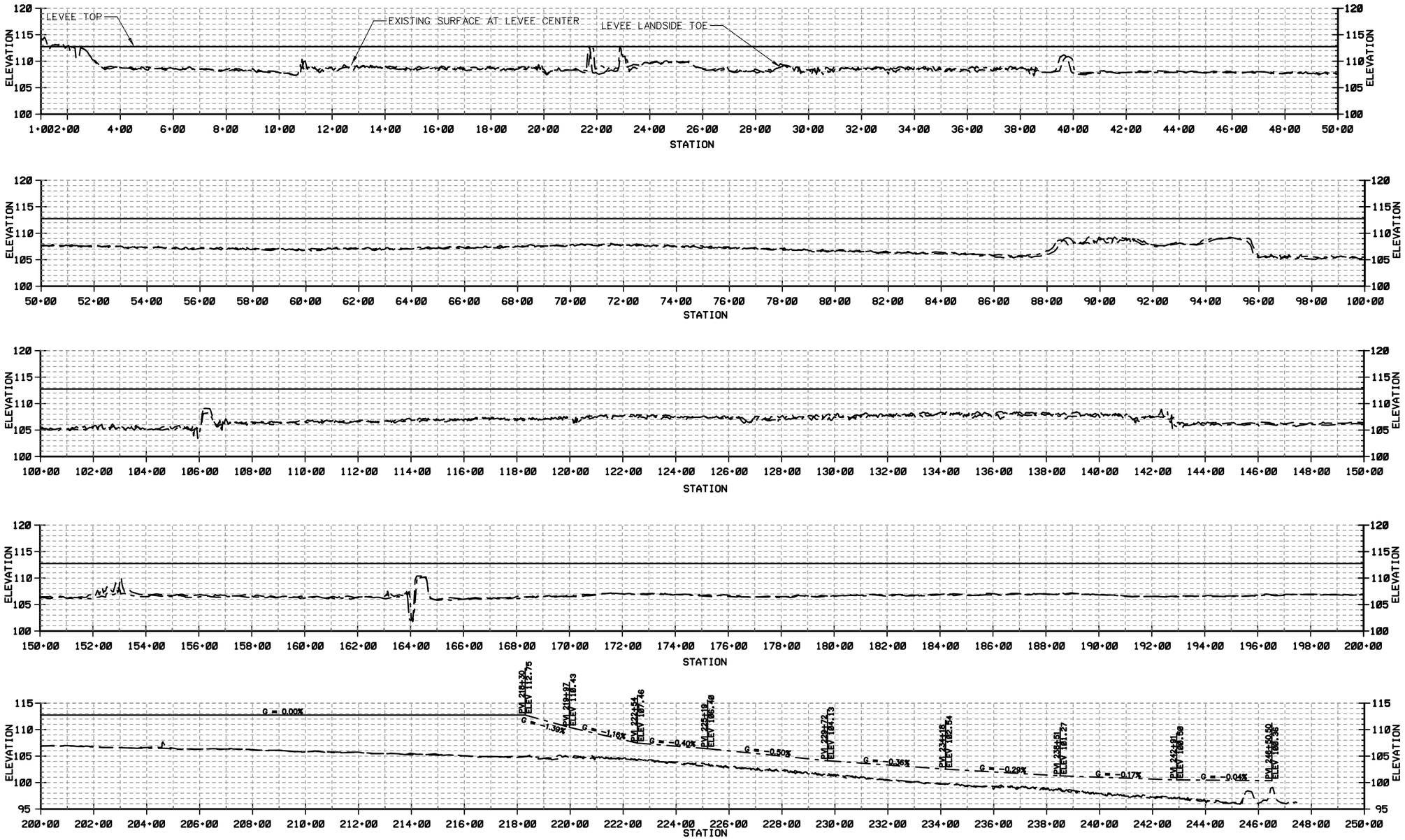
ORESTIMBA CREEK FEASIBILITY STUDY

ORESTIMBA LPP LEVEE PROFILE

Sheet reference number:
PLATE 17



ORESTIMBA NED LEVEE PROFILE

400' 200' 0 400'

H: 1"=400'

20' 10' 0 20'

V: 1"=20'

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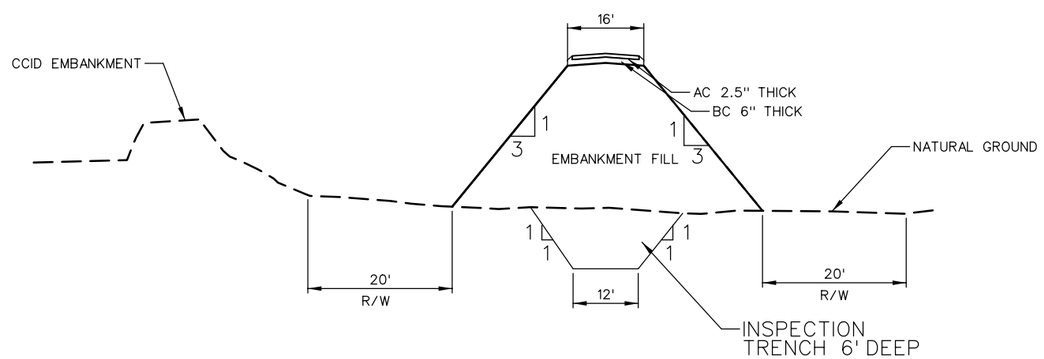
ORESTIMBA NED LEVEE PROFILE

Sheet reference number:
PLATE 18



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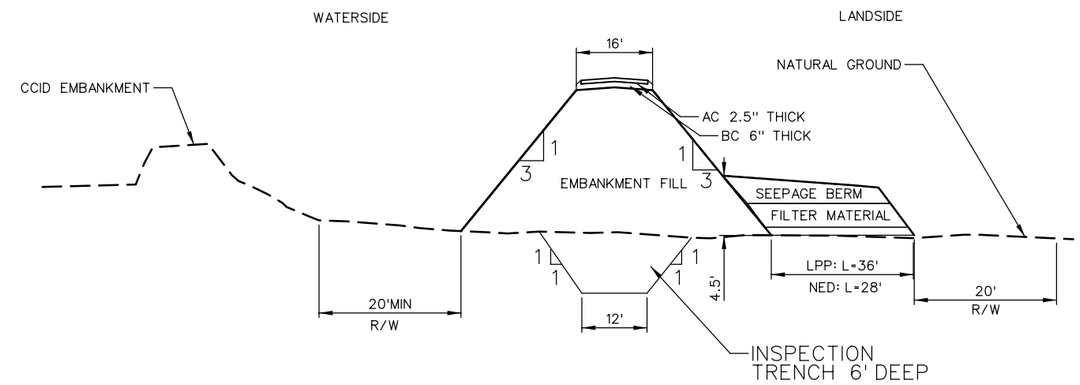
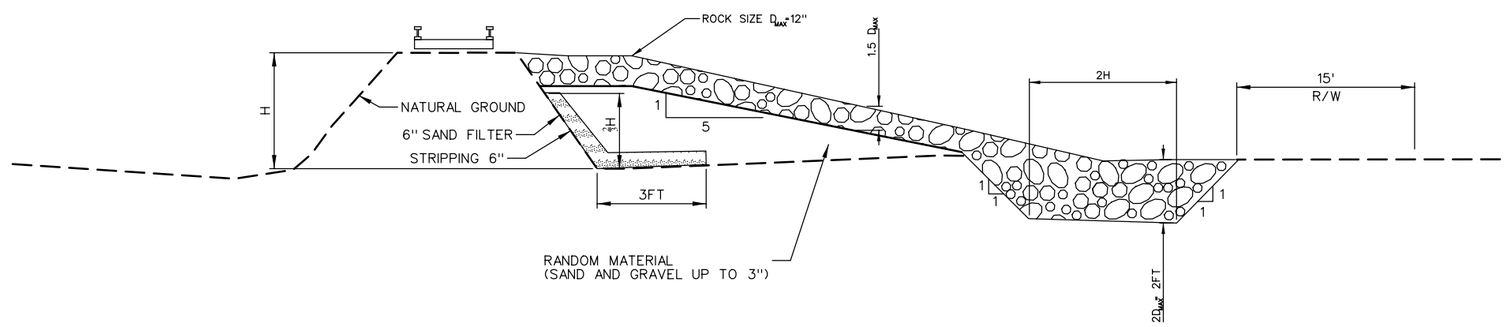
NOT TO SCALE FROM STA. 1+00 TO 106+70
FROM STA. 164+25 TO 245+00



(B) CHERVON LEVEE SEEPAGE TYPICAL CROSS SECTION

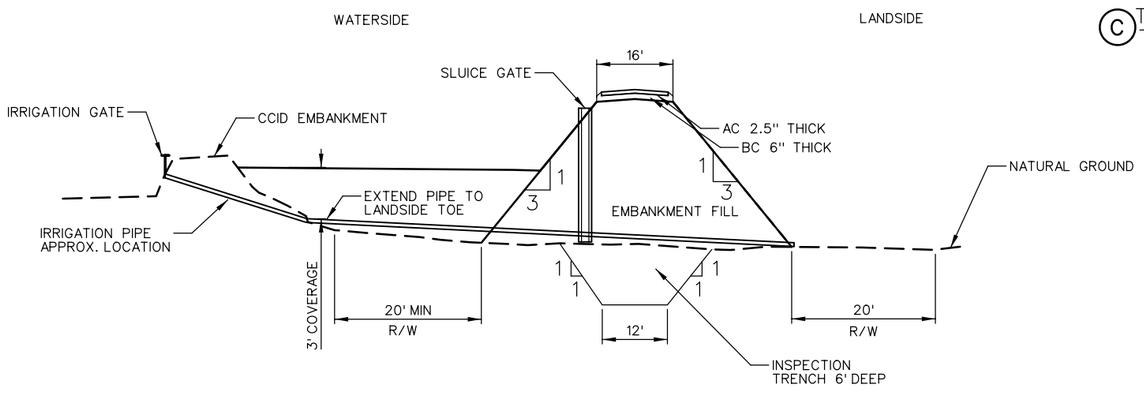
NOT TO SCALE FROM STA. 106+70 TO 164+25

SHEET NOTE:
LPP LEVEE HAS 2.5"AC AND 6"BC ON THE TOP OF LEVEE,
BUT NED LEVEE HAS ONLY 6" GRAVEL ON THE TOP OF LEVEE.
LPP SEEPAGE BERM L =28' AND NED SEEPAGE BERM L =26'.



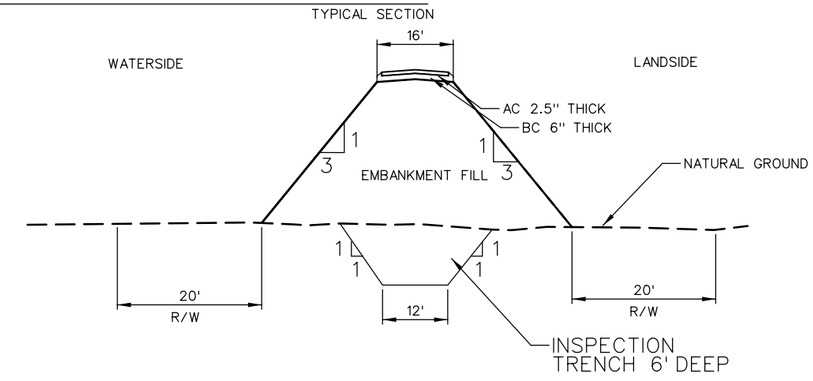
(C) TYPICAL SECTION FOR RAILROAD EMBANKMENT PROTECTION

NOT TO SCALE TYPICAL SECTION



(D) CHERVON LEVEE TYPICAL CROSS SECTION

NOT TO SCALE IRRIGATION PIPE CROSSING



(E) CHERVON LEVEE TYPICAL CROSS SECTION

NOT TO SCALE STA. 220+00 TO 245+00

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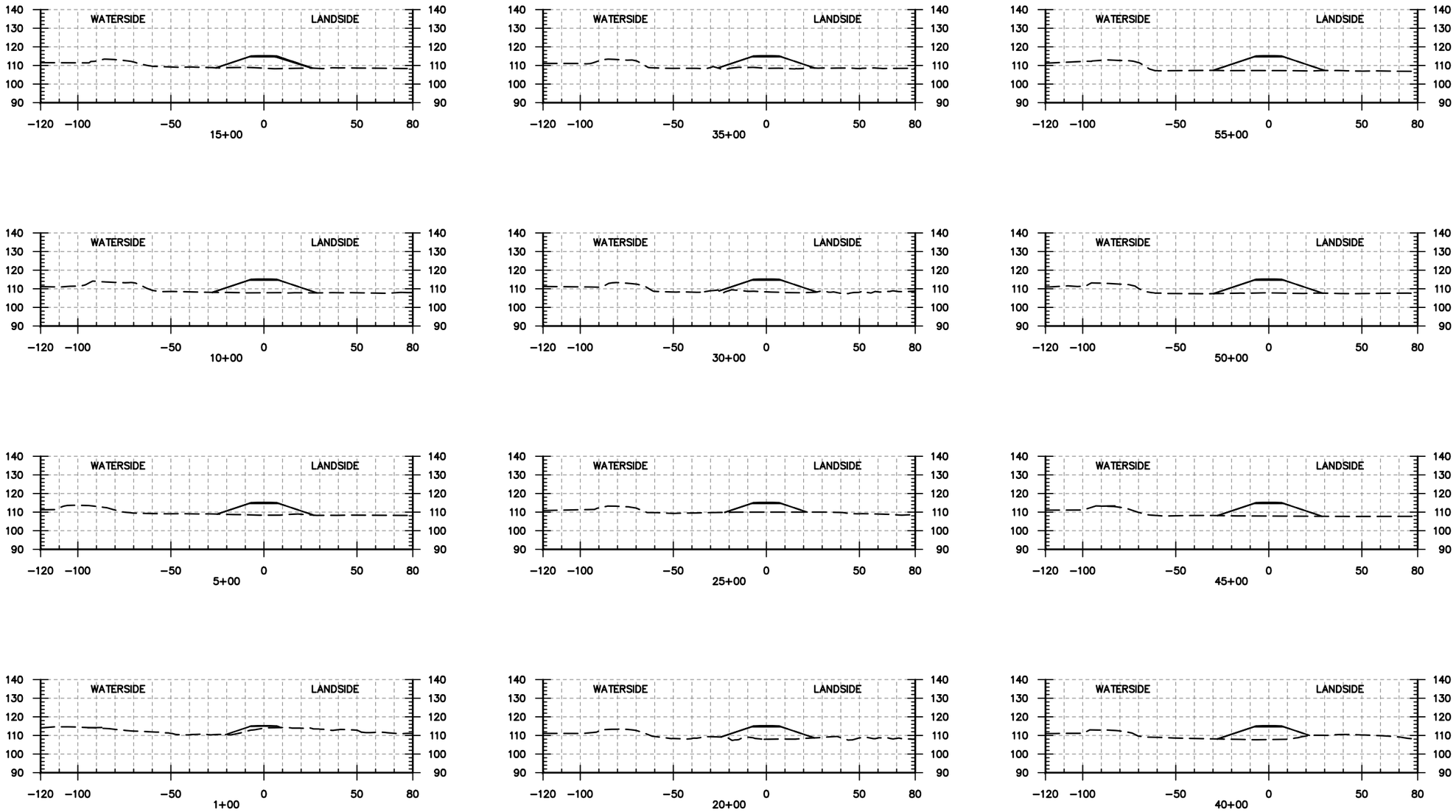
ORESTIMBA CREEK FEASIBILITY STUDY

LEVEE TYPICAL CROSS SECTIONS

Sheet reference number:
PLATE 19



60' 30' 0 60'

1"=60'

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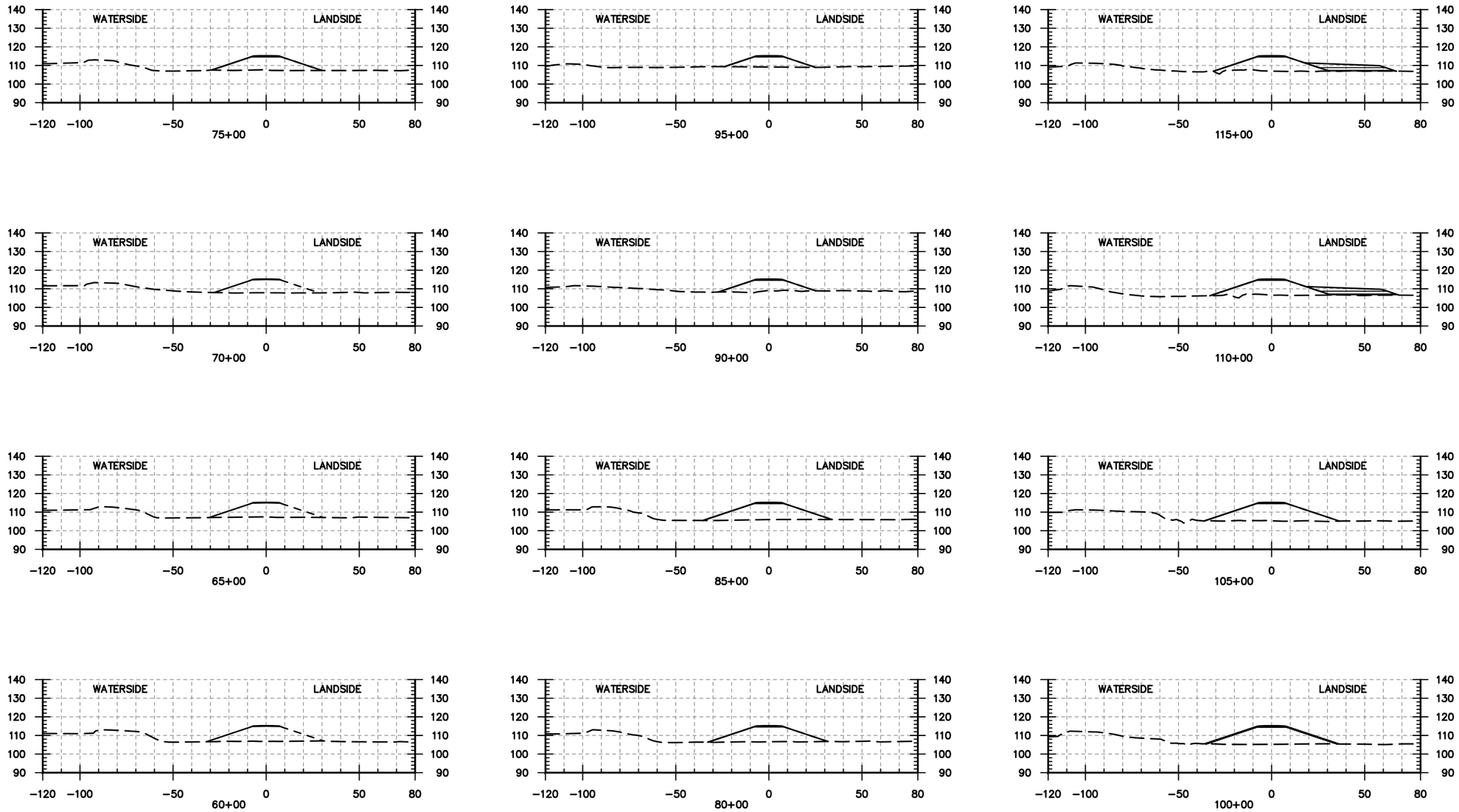
LPP LEVEE CROSS SECTIONS

STA. 1+00 TO STA.55+00

Sheet reference number:

PLATE 20



60' 30' 0 60'

1"=60'

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ORESTIMBA CREEK FEASIBILITY STUDY

LPP LEVEE CROSS SECTIONS
STA. 60+00 TO STA.115+00

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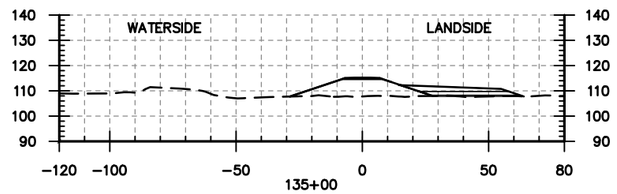
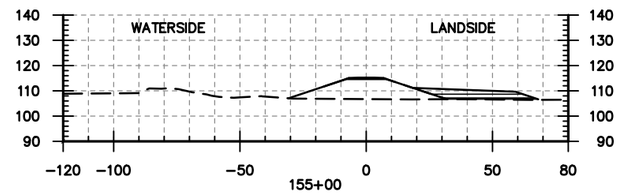
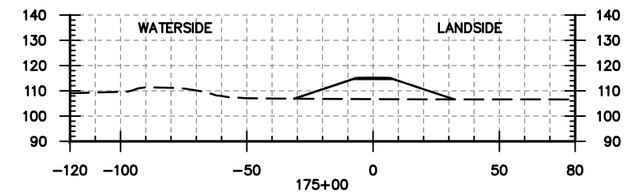
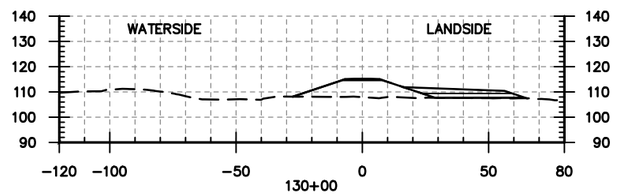
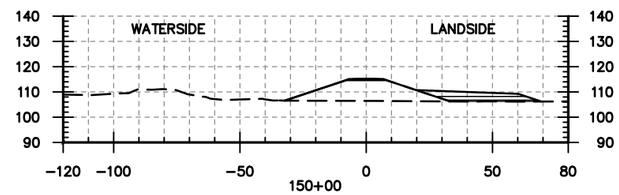
PLATE 21

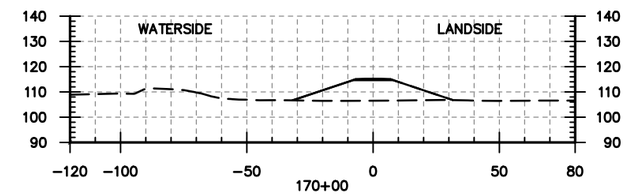


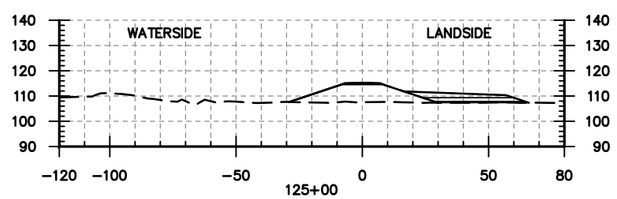


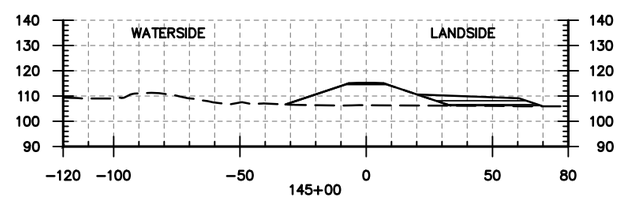


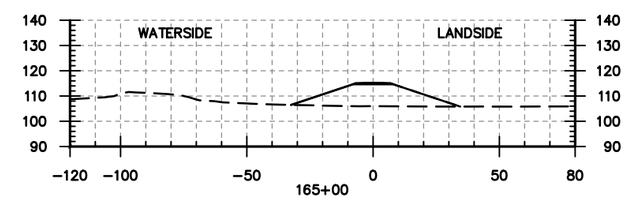


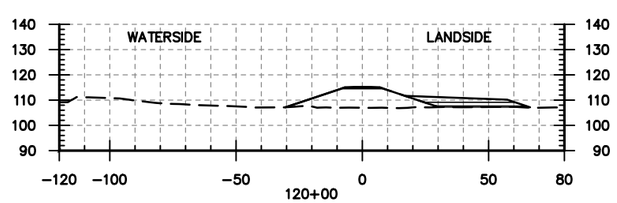


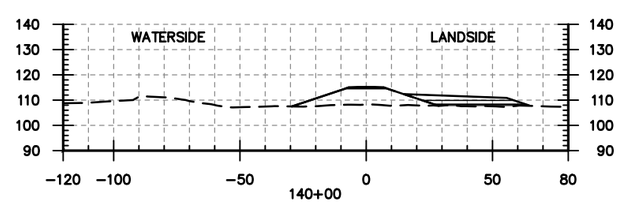


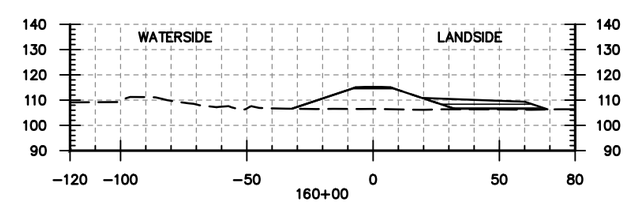












60' 30' 0 60'

1"=60'

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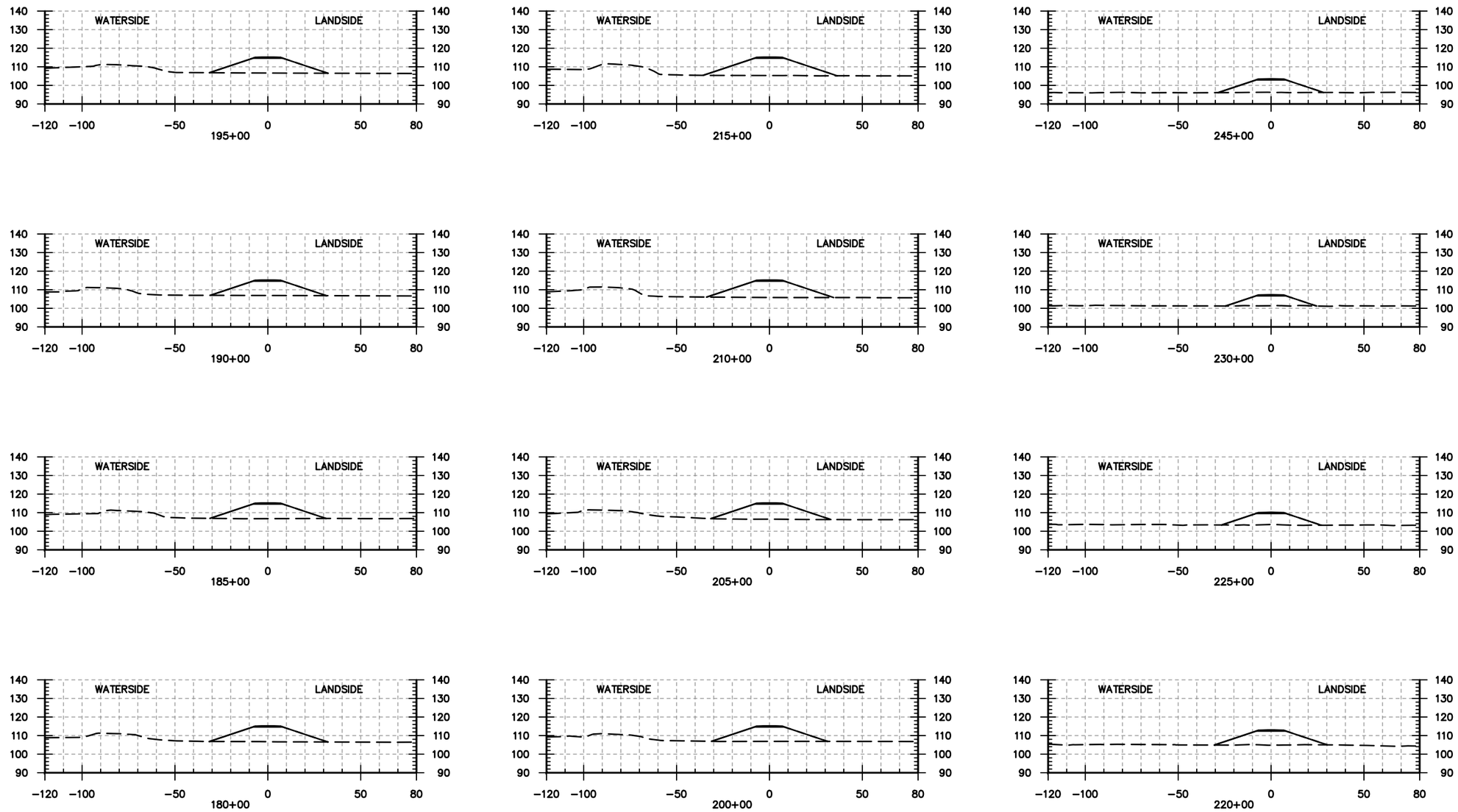
STANISLAUS COUNTY CA
ORESTIMBA CREEK FEASIBILITY STUDY

LPP LEVEE CROSS SECTIONS
STA. 120+00 TO STA.175+00

Sheet reference number:
PLATE 22



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ORESTIMBA CREEK FEASIBILITY STUDY

LPP LEVEE CROSS SECTIONS

STA. 180+00 TO STA.245+00

Sheet reference number:

PLATE 23

Orestimba Creek Feasibility Study
DRAFT Report

Stanislaus County, California

FLOOD RISK MANAGEMENT PROJECT

APPENDIX C3
Hydraulic Design

Hydraulic Analysis Section
Engineering Division
Sacramento District

December 2012

DRAFT

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DRAFT

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Existing (Without-Project)
24. 20% (1/5) ACE Event Floodplain
25. 10% (1/10) ACE Event Floodplain
26. 5% (1/20) ACE Event Floodplain
27. 2% (1/50) ACE Event Floodplain
28. 1% (1/100) ACE Event Floodplain
29. 0.5% (1/200) ACE Event Floodplain
30. 0.2% (1/500) ACE Event Floodplain

Chevron Levee - Profiles B and C
31. Chevron Levee Design Profiles
32. 20% (1/5) ACE Event Floodplain
33. 10% (1/10) ACE Event Floodplain
34. 5% (1/20) ACE Event Floodplain
35. 2% (1/50) ACE Event Floodplain
36. 1% (1/100) ACE Event Floodplain
37. 0.5% (1/200) ACE Event Floodplain
38. 0.2% (1/500) ACE Event Floodplain
39. Change in Flood Depth, 20% (1/5) ACE Flood Event
40. Change in Flood Depth, 10% (1/10) ACE Flood Event
41. Change in Flood Depth, 5% (1/20) ACE Flood Event
42. Change in Flood Depth, 2% (1/50) ACE Flood Event
43. Change in Flood Depth, 1% (1/100) ACE Flood Event
44. Change in Flood Depth, 0.5% (1/200) ACE Flood Event
45. Change in Flood Depth, 0.2% (1/500) ACE Flood Event

Chevron Levee-Profiles B and C with 3,500 CFS Channel Modifications
46. 20% (1/5) ACE Event Floodplain
47. 10% (1/10) ACE Event Floodplain
48. 5% (1/20) ACE Event Floodplain
49. 2% (1/50) ACE Event Floodplain
50. 1% (1/100) ACE Event Floodplain
51. 0.5% (1/200) ACE Event Floodplain
52. 0.2% (1/500) ACE Event Floodplain

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53. Change in Flood Depth, 20% (1/5) ACE Flood Event
54. Change in Flood Depth, 10% (1/10) ACE Flood Event
55. Change in Flood Depth, 5% (1/20) ACE Flood Event
56. Change in Flood Depth, 2% (1/50) ACE Flood Event
57. Change in Flood Depth, 1% (1/100) ACE Flood Event
58. Change in Flood Depth, 0.5% (1/200) ACE Flood Event
59. Change in Flood Depth, 0.2% (1/500) ACE Flood Event

Attachments

Attachment A. Chevron Levee 30% Design Drawings

Attachment B. Chevron Levee with 3,500cfs Channel Modifications 30% Design Drawings

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1.0 Introduction

1.1 Purpose and Scope

The purpose of this report is to describe hydraulic analyses performed in support of the Orestimba Creek Feasibility Study. The report describes the existing hydraulic conditions and future without-project hydraulic conditions, as well as the development and evaluation of a final array of alternatives to reduce flood risk within the study area. The final alternatives consist of a Without-Project Plan, Tentative National Economic Development (NED) Plan, and a Locally Preferred Plan (LPP).

Maps of the study area and watershed are presented in Plates 1 and 2, respectively. The study area is focused on Orestimba and Crow Creek flood sources. Floodplain modeling and mapping extended from roughly the California Aqueduct on the west to the San Joaquin River on the east. Coincident floodplains from the 2002 Sacramento-San Joaquin Comprehensive Study were used for the San Joaquin River.

Floodplain delineations are provided for 20% (1/5), 10% (1/10), 5% (1/20), 2% (1/50), 1.0% (1/100), 0.5% (1/200), and 0.2% (1/500) Annual Chance of Exceedance events (n-ACE events) for each alternative. The floodplain delineations reflect median hydrologic and hydraulic conditions (see March 2008 Hydrology Report). The estimated project performance for each design using risk and uncertainty is described in the Economics Appendix to the Feasibility Study report. Median design elevations described herein should not be confused with FEMA or California State requirements for freeboard or certainty.

All elevations provided herein are relative to the NAVD88 vertical datum and NAD83 Horizontal datum. Horizontal coordinates are projected to the California State Plane Zone III coordinate system. The conversion between NAVD88 and NGVD29 is approximately 2.40 feet in this area. Expressed as an equation, the conversion is Elevation (NGVD29) = Elevation (NAVD88) minus 2.40 feet.

1.2 Background

The U.S. Army Corps of Engineers, together with Stanislaus County, and the State of California conducted this feasibility study to select a plan that reduces flood risk within the Orestimba Creek floodplain and the town of Newman, California. The goal of the study is to identify a cost effective, technically feasible and locally acceptable project that best reduces flood risk and flood damages and complies with all Federal, State, and local laws and regulations.

1.3 Plan Selection

Alternative plans were evaluated through an iterative planning process. The alternatives presented in this appendix are considered to be the final array and were the outcome of multi-disciplinary analysis at three levels of increasing detail. Throughout this process the concept of absolute accuracy versus relative accuracy was considered. At each level of analysis the assessment of the existing and without project conditions was improved. Although it would appear that every plan should be compared to the most accurate assessment of existing conditions, this is not necessary because the relative accuracy between plans is sufficient to select the most optimal plan to move forward.

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Preliminary alternatives were evaluated at a qualitative level of detail using hydraulic assumptions and calculations suitable for describing the range of alternatives. Preliminary alternatives are described in the main feasibility study report. Several preliminary alternatives were retained for further analysis and were evaluated using additional qualitative and quantitative engineering analyses. Analyses included reservoir modeling, floodplain hydraulic modeling, and qualitative assessments of sedimentation issues. The level of detail for hydraulic assumptions was limited to that required to decide which plans to carry forward. These preliminary alternatives are presented in the F4 Draft Hydraulic Appendix. Preliminary alternatives retained for further analysis were described as the final array of alternatives.

Final alternatives were evaluated primarily through quantitative analysis. Analyses of final alternatives are described in this report.

2.0 STUDY AREA

2.1 General

The study area is defined by the Orestimba and Crow Creek alluvial fan which extends radially from the coastal range east to the San Joaquin River, a distance of eight miles. A sediment engineering and channel stability analysis conducted in 2000 by Tetra Tech indicated the alluvial fan is relatively inactive and channel instability is not a major hazard. The study area includes the towns of Newman and Crows Landing. Principal sources of flooding within the study area include Orestimba Creek, Crow Creek, and the San Joaquin River. Alternatives to reduce flood damages from the San Joaquin River were not evaluated in this Feasibility Study. However, floodplains of the San Joaquin River were included to show their extent and account for residual flooding.

Orestimba Creek is an unregulated stream that originates from the eastern slopes of the Coast Range in Stanislaus County. At the foothill line near the California Aqueduct, the creek drains approximately 134 square miles. From the California Aqueduct to the Delta Mendota Canal (DMC), the average bed slope of the creek is 19.5 feet per mile (0.004 feet per feet) and the channel has a larger cross sectional area than downstream. Below the DMC, the slope lessons to around 10 feet per mile (0.002 feet per feet) and the cross sectional area decreases. The change in bed slope and cross sectional area corresponds to a decrease in the channel capacity to around 1,600 cfs. Downstream of Morris Road, the bankfull capacity of the creek increases to around 3,500cfs. Peak flows of 1,600 and 3,500cfs have a roughly 50% (1/2) ACE and 20% (1/5) AEP respectively.

Crow Creek is an unregulated stream that originates from the eastern slope of the Coast range. At the foothill line the creek drains approximately 27 square miles and forms a smaller alluvial fan that merges with the larger Orestimba Creek fan. Just below the foothill line the creek crosses the embankment of the DMC through a small culvert. The creek is conveyed east from the DMC through a series of small ditches.

The San Joaquin River is highly regulated and originates from the western slopes of the Sierra Nevada Mountains and eastern slopes of the Coastal Range. The river flows to the north along the eastern side of the study area. Within the study area, the drainage area varies from 9,520 to 9,684 square miles.

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Floodwaters in excess of channel capacity distribute over the broad Orestimba and Crow Creek alluvial fan as shallow unconfined flow (less than 3 feet depth). The location and depth of flooding can vary from event to event due to floodplain sedimentation and small topographic changes between floods. Modern farm practices such as land leveling can also impact the depth and location of flooding.

Raised embankments of the Central California Irrigation District (CCID) Main Canal, Highway 33, and the California Northern Railroad (CNRR) have altered the natural drainage pattern of the alluvial fan. These features intercept shallow floodwaters moving east and redirect them to the north or south. The embankments overtop at low points along their vertical profile. As a result, the depth and location of flooding is sensitive to grade changes along these features.

The study area is dominated by agricultural land use, with residential development concentrated in the town of Newman. Although Newman is situated approximately 3.5 miles from the Orestimba Creek channel, CCID Canal and railroad embankments direct flood overflows into town.

2.2 Stream Gages.

Stage and flow data are available for five stream gages within the study area. Four of the stream gages are operated by the United States Geological Survey (USGS) and one stream gage is operated by California Department of Water resources. Steam gages are listed in Table 1 and shown on Plate 1.

Table 1 Stream Gages, Orestimba Feasibility Study Area

Gage Name	Area (Sq Mi)	Agency	Gage Number	Period of Record	Type
Orestimba Creek at Newman	134	USGS	11274500	1932-2010	S,Q
Orestimba Creek below Highway 33	150	DWR	B08735	1973-2010	S,Q
Orestimba Creek at River Road nr Crows Landing	151	USGS	11274538	1992-2010	S,Q
San Joaquin River nr Newman	9,520	USGS	11274000	1968-2010	S,Q
San Joaquin River at Crows Landing	9,694	USGS	11274550	1996-2010	S,Q
Note: S-Stage, Q-Discharge					

2.3 Historical Floods.

Historical floods have damaged agricultural land and crops, residential and commercial properties, and local road and irrigation infrastructure. Floods have required extensive emergency operations, including levee construction, evacuation, road closure, monitoring, and traffic control. In some locations local landowners have reduced flood damages by constructing 2-3 foot tall floodwalls or elevating structures relative to the surrounding ground.

Stream flow records at USGS Gage 11274500, Orestimba Creek near Newman, indicate annual peak flows have exceeded the estimated channel capacity of 1,600cfs 34 times from 1932 to 2010. A comparison of peak annual maximum flows over the period of record at the Orestimba Creek near Newman gage and downstream Orestimba Creek at River Road gage is shown on Plate 4. The downstream gage shows the limits of the upstream capacity and the volume of

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floodwaters conveyed by the floodplain. The five largest floods of record based on annual maximum peak flow at the Orestimba creek near Newman gage are listed in Table 2. A description of the two most recent floods is provided below.

Table 2
Five Largest Annual Maximum Floods 1932-2007, Orestimba Creek near Newman Gage

Water Year	Annual Maximum Peak Date	Annual Maximum Peak Flow (cfs)	Annual Maximum Mean Daily Flow (cfs)	Maximum Runoff Volume (acre-feet)		
				6-Hour	12-Hour	24-Hour
1995	3/10/1995	12,000	4,260	4,695	7,310	9,473
1958	4/2/1958	10,200	3,010	NA	NA	NA
1998	2/3/1998	9,470	4,550	3,816	6,448	9,622
1963	2/1/1963	8,300	2,090	NA	NA	NA
1986	2/19/1986	6,990	2,790	NA	NA	NA

NA – Not Available

a. 1995 Flood. The 10 March 1995 storm event produced the largest peak runoff of the 1932 to 2007 record. The event had a peak flow of 12,000 cfs at the Orestimba Creek near Newman gage and a peak flow of 2,650 cfs at the Orestimba Creek near River Road gage. This shows the substantial volume of floodwaters conveyed by the floodplain. As described in the hydrology appendix, in terms of peak discharge, the ACE was approximately 1.7% (1/60). Floodwaters were intercepted and forced south into the City of Newman by the CNRR embankment. A map of flooding within the city of Newman was provided by the city (City of Newman, 1997). The map showed some flooding within the city limits on the east side of the CNRR embankment but this was the result of an overloaded storm drain system. The map only covered the city limits. Aerial photographs of the flood were not available for this study. A plot of the 1995 flood hydrograph recorded at the Orestimba Creek near Newman gage is provided in Plate 5.

b. 1998 Flood. The 3 February 1998 storm event produced the third largest peak runoff of the 1932 to 2007 record. The event had a peak flow of 9,470cfs at the Orestimba Creek at Newman gage and peak flow of 2,340 cfs at the Orestimba Creek near River road gage. Similar to the 1995 event, this shows the substantial volume of floodwaters that was conveyed by the floodplain. Based on the March 2008 Hydrology Report, the event had a 2.9% (1/35) ACE. The 12-hour and 24-hour runoff volumes are similar to the 1995 flood event. As with the 1995 event, floodwaters were intercepted by the Highway 33 and CNRR embankments and forced south into the town of Newman. A sluice gate completed by CCID on 5 January 1998 was used to discharge water from the CCID main canal into the Newman Wasteway where it was conveyed to the San Joaquin River. Video provided by the City of Newman showed multiple locations where the CCID main canal was overtopped. The video also showed an excavator removing a significant amount of debris that had collected on the CNRR railroad trestle. Oblique aerial photographs of the flooding extent were reviewed and compared to model results within the

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inundation area. A plot of the 1998 flood hydrograph recorded at the Orestimba Creek near Newman gage is provided in Plate 5.

3.0 EXISTING CONDITIONS

The following describes existing hydrologic and hydraulic conditions within the study area.

3.1 Hydrology

Hydrology of the Orestimba Creek watershed was updated and certified by the Sacramento District in March 2008. The March 2008 Hydrology Report is provided as a separate appendix to the Feasibility Study Report. The following is a brief overview of the hydrologic data used in the hydraulic analysis.

a. General. Orestimba and Crow Creeks are ephemeral, with the highest flows usually occurring in late winter. The watersheds contain steep mountain canyons above the foothill line. Within the study area, elevations vary from 45 feet above mean sea level at the San Joaquin River to less than 200 feet at the foothill line near the California Aqueduct. Upstream of the study area, elevations extend to 3,600 feet at the headwaters of Orestimba creek. A map of the watershed is provided as Plate 2.

The climate is temperate and characterized by hot, dry summers and mild winters. During winter, fog can occur in the lower areas. Normal annual precipitation ranges from 11.2 inches at Newman to over 18 inches in the higher mountains of the Orestimba drainage. Ninety-one percent of the precipitation occurs between November and April. Snowfall is negligible and does not affect runoff. It is rare for summer temperatures to exceed 110°F and winter temperatures to fall below 27°F.

b. Flood Frequency Analysis. Flood frequency analysis for the Orestimba Creek watershed was updated and certified by the Sacramento District in March 2008. The March 2008 Hydrology Report is provided as a separate appendix to the Feasibility Study Report. Flood frequency analyses were based on the Orestimba Creek near Newman Gage record from 1932 to 2007 and hydrologic modeling of the ungaged sub-basins. Inclusion of the hydrologic record since 2007 would only add four years to the 76 year period of record. The 2008 hydrologic analysis is considered adequate for the feasibility study report because the additional record length would have minimal impacts on the statistical results. Flood frequency statistics for the Orestimba Creek near Newman Gage gage are provided in Table 3. A table of discharges by frequency and duration is provided in Table 4. A plot of the flood frequency curve is provided as Plate 6.

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Table 3
Flood Frequency Statistics, USGS Gage Orestimba Creek near Newman

Flood Duration	Log Mean	Log Standard Deviation	Log Skew (Adopted)	Record (Years)	
				Years Evaluated	Years Used
Peak	3.0782	0.5636	-0.60	76	45
1-Day	2.7177	0.5026	-0.50	75	45
3-Day	2.5011	0.5161	-0.50	75	45
5-Day	2.3638	0.5279	-0.50	75	45
7-Day	2.2651	0.5448	-0.55	75	45
10-Day	2.1548	0.5552	-0.60	75	45
15-Day	2.0283	0.5788	-0.70	75	45
20-Day	1.9299	0.5905	-0.70	75	45
30-Day	1.8071	0.6015	-0.70	75	45

Table 4
Flood Frequency, USGS Gage Orestimba Creek near Newman

Flood Duration	Duration Average Discharge by AEP (cfs)							
	1/2 AEP	1/5 AEP	1/10 AEP	1/20 AEP	1/50 AEP	1/100 AEP	1/200 AEP	1/500 AEP
Peak	1360	3630	5680	7950	11210	13830	16550	20260
1-Day	570	1410	2130	2930	4090	5040	6030	7400
3-Day	350	880	1340	1860	2630	3250	3910	4830
5-Day	260	650	1010	1420	2010	2500	3020	3740
7-Day	210	540	840	1170	1660	2050	2470	3040
10-Day	160	430	660	920	1290	1590	1900	2320
15-Day	120	330	520	710	990	1200	1410	1690
20-Day	100	270	430	590	820	1000	1180	1420
30-Day	80	210	330	460	650	790	940	1130

c. Orestimba and Crow Creek Hydrographs. The March 2008 Hydrology Report provides hydrographs for the n-ACE events at seven hydrologic index points. Plate 2 shows the location of the hydrologic index points.

Main hydrologic index point ORES1 is the runoff from a storm centered in the watershed above USGS Gage-Orestimba Creek near Newman (Gage No.11274500). The gage is located just downstream of the California Aqueduct. Hydrologic index point ORES2 is located on Orestimba Creek at the DMC. Hydrologic index point ORES3 is located on Orestimba Creek 0.5 miles east of Eastin Road. Hydrologic index point ORES4 is located on Orestimba Creek at the CCID main canal. Main hydrologic index point CROW1 represents runoff from Crow Creek watershed above Interstate Highway 5. Hydrologic index point CROW2 is located on Crow Creek at the DMC.

Balanced 30-day hydrographs were generated for each sub-basin using multiple 5-day storm waves to create a 30-day flood series. The hydrographs are based on a storm centered above the ORES1hydrologic index point and concurrent rainfall above the remaining areas. Peak hourly flows at each sub basin outlet are presented in Table 5. During initial hydraulic analyses, it was found that 96 hour hydrographs were sufficient for the 20% (1/5) ACE through 0.5% (1/200)

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ACE hydraulic models to create maximum stages throughout the study area. However, in some tests 120 hours were needed to reach maximum stages for the 0.2% (1/500) ACE event. In order to maintain consistency, 120 hour long hydrographs were used for all event simulations. Plots showing 120 hours of the flood hydrograph peak are provided for these six hydrologic index points in Plate 7.

Table 5
Modeled Peak Hourly Sub-Basin Discharge at Hydrologic Index Points

Main or Local Flow (Model Sub-Basin)	Hydrologic Index Point	Drainage Area (Sq Mi)	Peak Hourly Discharge by Main-stem ACE (cfs) 1/						
			20% (1/5) ACE	10% (1/10) ACE	5.0% (1/20) ACE	2.0% (1/50) ACE	1.0% (1/100) ACE	0.5% (1/200) ACE	0.2% (1/500) ACE
Local (ORSUB4)	ORES2	9.3	43	67	93	134	164	198	246
Local (ORSUB5)	ORES3	1.8	8	13	18	26	32	38	47
Local (ORSUB6)	ORES4	5.6	26	41	56	81	99	120	149
Local (ORSUB7)	ORES5	5.7	26	41	58	83	101	122	152
Main (CRSUB1)	CROW1	27.0	277	462	686	1,015	1,319	1,648	2,213
Local (CRSUB2)	CROW2	3.9	15	24	40	49	53	69	87
1/ All flows are concurrent local flows for a Storm Centered above the Orestimba Creek at Newman Gage.									

d. Alluvial Fan Local Hydrographs. For floodplain modeling, runoff hydrographs of minor sub-basins, not included in the 2008 Hydrology Report, were estimated. These minor sub-areas do not drain directly to Orestimba Creek or Crow Creek but would result in additional flooding behind proposed project features. Plate 2 shows the location of the hydrologic index points.

Sub-basins were delineated at three locations along the CCID canal and five locations along the railroad embankment. Local hydrographs were derived at these locations by scaling the local ORSUB5 hydrograph by the drainage area ratio. The ORSUB5 sub-basin has similar hydrologic characteristics as the local alluvial fan sub-basins. Sub-basin flow estimates are described in Table 6.

Table 6
Estimated Peak Hourly Sub-Basin Discharge at Aluvial Fan Local Hydrologic Index Points

Main or Local Flow (Model Sub-Basin)	Hydrologic Index Point	Drainage Area (Sq Mi)	Peak Hourly Discharge by Main-stem ACE (cfs) 1/						
			20% (1/5) ACE	10% (1/10) ACE	5.0% (1/20) ACE	2.0% (1/50) ACE	1.0% (1/100) ACE	0.5% (1/200) ACE	0.2% (1/500) ACE
Local (CCID SUB1)	CCID1	2.8	13	20	28	41	50	60	74
Local (CCID SUB2)	CCID2	5.1	23	37	52	74	92	109	135
Local (CCID SUB3)	CCID3	4.4	20	32	44	64	79	94	116
Local (CNRR SUB1)	CNRR1	0.3	1	2	3	4	5	6	8
Local (CNRR SUB2)	CNRR2	1.0	4	7	10	15	18	21	26
Local (CNRR SUB3)	CNRR3	1.3	6	9	13	19	23	28	34
Local (CNRR SUB4)	CNRR4	1.0	4	7	10	15	18	21	26
Local (CNRR SUB5)	CNRR5	2.6	12	19	26	38	47	56	69
1/ All flows are concurrent local flows for a Storm Centered above the Orestimba Creek at Newman Gage.									

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3.2 Hydraulics

Hydraulic analysis of the study area included a field assessment of existing conditions, development of a one-dimensional hydraulic model of the Orestimba Creek channel, and development of a two-dimensional hydraulic model of the floodplain. The accuracy of the model approach is deemed adequate for feasibility level analysis and selection of the tentative NED plan and LPP plan. It is recommended that more detailed hydraulic analysis be conducted during PED level analysis to refine details.

a. Field Assessment. Based on field reviews and anecdotal evidence, the following items were considered in the analysis of existing conditions.

Orestimba Creek appears to overtop its banks at a bend just upstream of Anderson Road more frequently than other locations. This location is referred to locally as Horseshoe Bend. A picture of the local levee on the right bank just upstream of Anderson Road is provided in Plate 8.

The CCID canal is contained by embankments that follow the natural contour of the alluvial fan. The upstream ground surface and canal profile are nearly level. As a result, floodwaters intercepted by the embankment are dispersed north and south along the contour line. Several pumps near Anderson Road are used to discharge floodwaters at a low point on the west landward toe of the embankment into the CCID main canal once runoff and Oretimba Creek subside (CCID, 2012). These are sometimes augmented with portable pumps. Some of the ponded water returns to the creek by gravity when the flood recedes. A picture of the CCID main canal at Anderson Road is provided in Plate 8.

Anderson Road Bridge is lower than the CCID main canal embankment. During large floods, Anderson Road Bridge acts as an overchute spillway that discharges floodwaters from the west side of the canal to the east side. In the past, landowners have placed sand bags across the bridge to prevent the floodwaters from crossing. Therefore, overflow of the canal at the Anderson Road Bridge is not reliable.

Landowners along Anderson Road just east of the canal have constructed 2-3 foot tall berms and floodwalls around their homes to reduce damages. One of the landowners was interviewed and indicated that floodwalls were effective at reducing flood damages.

Similar to the CCID canal embankment, floodwaters are also intercepted by the CNRR embankment. The ground upstream of the embankment slopes south and floodwaters are directed towards the town of Newman. There are several small culverts through the CNRR embankment for drainage and irrigation water. These culverts are overwhelmed during large floods but provide interior drainage as the floods recede. A picture of the CNRR embankment is provided in Plate 8.

Debris collects on the CNRR railroad trestle during floods. Locals have used a backhoe to remove debris in the past but there is no signed agreement or standard operating procedure. A photograph (date unknown) of collected debris at the CNRR trestle is provided in Plate 8. A video during the 1998 flood shows a backhoe on the trestle removing accumulated debris.

A large portion of the study area is actively farmed. Flood extents and channel conveyance can be influenced by land leveling activities commonly used in modern agricultural business.

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Due to the large amount of floodplain storage in the form of ponding and shallow flow on the alluvial fan surface, the extent of flooding may be more related to long duration runoff volume than peak discharge.

CCID completed a raise of the Main Canal levee embankment on 16 August 2000. The embankment was raised approximately 2 to 2.5 feet north of Draper Weir, 1.0 feet to Stuhr Road, 1.0 to 1.5 feet to Anderson Road and 1.0 feet north to Orestimba Creek (CCID, 2009). This work was completed after the 1995 and 1998 floods. This should be considered when comparing models based on more recent topographic conditions to past flood events.

b. Topographic Data. Topographic data were obtained from a variety of sources including 2008 DWR LIDAR, 1999 aerial topographic maps, USGS 7.5 minute topographic maps, and 2002 aerial topographic maps. Plate 3 shows the extent of sources of topographic data used in the study.

The primary source of topographic data was LIDAR mapping conducted in 2008 by the California Department of Water Resources. The minimum expected horizontal accuracy was tested to meet or exceed a 3.5-foot horizontal accuracy at 95 percent confidence level using RMSE(r) x 1.7308 as defined by the National Standards for Spatial Data Accuracy (NSSDA). Final Ground surface LIDAR point data in was tested to meet a 0.6-foot vertical accuracy in un-obscured areas and 1.2 foot in obscured areas at the 95% confidence level. Horizontal coordinates were based on the NAD83 datum projected to the UTM coordinate system. For this study, horizontal coordinates were converted to the California State Plane Zone III coordinate system using the Corpscon computer program. The vertical datum was NAVD88.

The secondary source of topographic data was mapping conducted by Cartwright Aerial Surveys for Stanislaus County. The mapping was based on conventional aerial photogrammetric methods. Aerial photography was flown 24 February 1999. Mapping data were provided in both Digital Terrain Model (compilation points and break lines) and topographic contour formats. The mapping meets map accuracy standards for 5-foot contour interval 1inch= 800 foot map scale in clear and open areas. The Orestimba Creek channel and the town of Newman areas were also mapped at a more accurate 2-foot contour interval 1inch= 200 foot map scale in clear and open areas. Horizontal coordinates were based on NAD 83 the datum projected to the California State Plane Zone III coordinate system. The vertical datum was NAVD88.

The USGS 10 meter National Elevation Dataset was utilized for evaluation of the watershed but not used in hydraulic modeling. All National Elevation Dataset data are distributed in geographic coordinates in units of decimal degrees, and in conformance with the North American Datum of 1983 (NAD 83) (USGS, 2009). All elevation values are provided in units of meters, and are referenced to the North American Vertical Datum of 1988 (NAVD 88) over the conterminous United States (USG, 2009). The NED dataset does not specify the acquisition dates. It was noted that this data predates construction of the California Aqueduct.

Topographic mapping and hydraulic model results from the 2002 Sacramento and San Joaquin Comprensive study were utilized to define residual floodplains along the San Joaquin River. Horizontal coordinates were based on the NAD 83 datum projected to the California State Plane Zone III coordinate system. The mapping was referenced to the NGVD29 vertical datum. The topographic data and model results were converted to NAVD88 using a conversion factor of 2.73 feet. The conversion factor was based on comparing the published National Geodetic Survey

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NAVD88 elevation of the benchmark "Freeport" (located within the study area) to the elevation used in the Comprehensive Study mapping control.

c. San Joaquin River Floodplains. San Joaquin River 10% (1/10), 5% (1/20), 2% (1/50), 1.0% (1/100), 0.5% (1/200), and 0.2% (1/500) ACE floodplains were obtained from the Sacramento and San Joaquin River Comprehensive Study modeling. The Comprehensive Study did not provide floodplains for the 20% (1/5) ACE event. The 20% (1/5) ACE floodplain was estimated by converting the UNET model developed for the San Joaquin River Comprehensive Study to HEC-RAS and running a steady flow rate associated with the 20% (1/5) ACE discharge. All floodplain data provided in the Comprehensive Study were based on the NGVD29 datum. These data were converted to the NAVD88 vertical datum using the 2.73 foot topographic data conversion described in the topographic data section of this report.

d. Orestimba Creek Channel Model. The one-dimensional U.S. Army Corps of Engineers HEC-RAS (version 4.0) program was used to evaluate Orestimba Creek channel hydraulics. HEC-RAS calculates steady, gradually varied flow in natural and manmade channels by performing step-backwater calculations of the 1-D flow energy equation through a series of input geometric cross-sections with empirically defined hydraulic roughness coefficients. HEC-RAS computes water surface elevations and flow velocity at each cross-section for user-defined discharges. This model is only valid for evaluating flood flows confined to the channel (flow less than 1,600cfs). A map showing the domain of the HEC-RAS model is provided as Plate 9.

(1) Geometry Data. Geometry data for the model were extracted from the Cartwright Aerial Digital Terrain Model using HEC-GEORAS. The resulting geo-referenced model contains 245 cross sections within the 16 mile study reach. Ineffective flow areas and reach average channel dimensions were considered during placement of model cross sections. The resulting cross sections are spaced approximately 300 feet apart. A map showing the cross section locations is presented in Plate 9. The cross section numbering was based on the stream channel distance in feet from the San Joaquin River. Ground survey cross section data were not available within the study reach.

(2) Bridges and Low Water Crossings. Bridges and low water crossings within the study reach are described in Table 7. Bridges were coded into the model from California Department of Transportation As-Built drawings, where available (Ayres, 2009). Where no bridge plans existed, such as private bridges, measurements were taken in the field (Ayres, 2009). All bridge plans and cross sections were verified with field visits (Ayres, 2009). Based on a review of historical flood conditions, bridge pier debris loading was estimated at the CNRR bridge. The dimensions of debris loading were based on a picture of recent flooding (Plate 8). The bridge pier debris loading was estimated at 6 feet tall and 7 feet wide (3ft either side of the 1ft wide pier). The three low water crossings within the study reach were modeled as in-line structures.

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Table 7
Orestimba HEC-RAS Model Bridges and Low Water Crossings

Bridge or Low Water Crossing (LWC) Name	Model Station (Feet)	Approximate Coordinates CCS Zone III – Survey Feet		Span (feet)	Width (feet)
		Northing	Easting		
California Aqueduct Bridge	70,645	1937950	6379839	197	21
Orestimba Creek Rd. Bridge	68,765	1939258	6381063	200	29
Southbound I-5 Bridge	63,994	1942795	6383952	240	42
Northbound I-5 Bridge	63,859	1942877	6384051	226	46
Bell Road LWC	61,418	1944007	6386084	NA	NA
Jorgenson Road LWC	50,649	1948851	6394097	NA	NA
Eastin Road LWC	43,758	1953455	6396793	NA	NA
Anderson Road Bridge	40,878	1954855	6398470	175	16
Private Bridge 1	35,559	1958250	6397937	70	15
CCID Bridge	35,192	1958617	6397934	60	15
State Route 33 Bridge	32,357	1960288	6399480	139	32
CN Railroad Bridge	32,257	1960293	6399574	135	16
Private Bridge 2	30,138	1961620	6400611	67	12
Morris Road Bridge	23,802	1964679	6404093	155	45
Kilburn Road Bridge	15,566	1968281	6406992	84	23
Private Bridge 3	13,390	1970085	6407885	86	16
Private Bridge 4	11,311	1970395	6409835	88	16
River Road Bridge	6,898	1973614	6412091	80	32.5

(3) Ineffective Flow Areas. The model was used to simulate channel flow only. Ineffective flow areas were defined at some bridge locations due to abrupt changes in conveyance area. However, most bridges span the channel with only small transitions in the cross sectional area at abutments. Ineffective flow areas were specified at these locations to simulate a general 2:1 contraction rate and 4:1 expansion rate.

(4) Manning's Roughness Values**.** Manning's roughness values of 0.04 through 0.05 were specified for the channel and over-banks respectively. Values were determined through a field visit and aerial photography. Measured water surface data were not available for calibration of the Manning's roughness values.

(5) Expansion and Contraction**.** Expansion and Contraction coefficients of 0.3 and 0.1 respectively were used for all reaches of the model. Expansion and contraction coefficients were increased to 0.3 and 0.5 respectively at bridge locations.

(6) Boundary Conditions. The downstream boundary condition for the HEC-RAS model was cross section 2894 located near the San Joaquin River. The lower portion of the model can be influenced by backwater from floods on the San Joaquin River. For each Orestimba Creek AEP steady flow simulation, a stage event with the same frequency was assumed for the San Joaquin River. This is a conservative assumption but only affects a small reach. In addition, as described in the FLO-2D model section, the HEC-RAS model is used to define hydraulic head losses at structures in the FLO-2D model.

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(7) Model Runs. The model was run for a suite of steady flows up to the 0.2% (1/500) ACE event. Profiles for flows greater than 1,500 cfs are not shown because this flow exceeds the bank-full capacity and the HEC-RAS model results are not valid. The results of these runs were used to define bridge rating curves (flow confined to bridge width) in the FLO-2D model described below. A computed water surface profile for 1,500 cfs in the channel is provided in Plate 10. This profile roughly corresponds to the 26 February 2005 annual peak of 1820 cfs at the Newman gage, 1850 cfs at the Hwy 33 gage, and 1280 cfs at the River Road gage.

e. Orestimba Creek Floodplain Model.

Floodplain hydraulics were evaluated using a FLO-2D (version 2009.06) hydraulic model. FLO-2D is a 2-dimensional, dynamic flood routing model that simulates movement of water across the ground surface while reporting volume conservation. It numerically routes flood hydrographs over a system of grid elements, and predicts the area of inundation and floodwave attenuation. A map showing the domain of the FLO-2D model (Floodplain Mapping Extent) is provided in Plates 1 and 3.

(1) Grid Element Size**.** A 200-foot grid element size was selected for construction of the model. USACE has no guidance for the selection grid element size relative to estimated uncertainty. The 200-foot element size was selected based on a review of models used for preliminary alternative analysis. The grid element size was reduced from 500 feet because it more accurately represented the water surface elevation and extent of flooding upstream of embankments on the sloping alluvial fan surface. The uncertainty of model results was estimated from simulations of the 1995 and 1998 floods.

Floodplain grid element elevations were obtained from a variety of sources including the 2008 DWR LIDAR data and Cartwright 1999 topographic DTM. Plate 3 shows the sources of topographic data used in the study.

(2) Channel Elements**.** Orestimba Creek channel cross-sections were extracted from the Orestimba Creek Channel HEC-RAS model described above. The 200-ft grid elements were found to adequately describe the larger hydraulic capacity of the reach upstream of Jorgenson Road, and no channel element was included in this reach. Channel elements were used from approximately Jorgenson Road to the San Joaquin River.

Crow Creek was not defined as a channel element in the FLO-2D model. Crow Creek is a tributary to Orestimba Creek within the project area. Downstream of Bell Road, the creek is conveyed by a series of ditches. The ditch capacity is negligible compared to flood flows. Therefore, the ditches were not included in the FLO-2D model.

A channel element was also added to simulate the channel along the Hearthstone housing development in the town of Newman. The dimensions of the channel element were based on 2008 DWR LIDAR data.

(3) Manning's Roughness Coefficients. Per the FLO-2D documentation, overland roughness coefficients are often significantly higher than standard open channel roughness coefficients. There was insufficient information available to vary the roughness values throughout the model domain. A recommended generic roughness coefficient for

overland flow is 0.07 (FLO-2D, 2004). A simulation of the 1998 flood hydrographs was compared to aerial photographs of the flood. A slightly higher value of 0.08 was found to better simulate the flood extents. This value was therefore selected as the final floodplain roughness value.

Within the channel, roughness values ranging from 0.040 to 0.050 were applied to Orestimba Creek channel elements. Estimates of Manning's roughness values were based on a site investigation and standard hydraulic reference texts (Chow, 1973). Uncertainty in computed water surface profiles due to the uncertainty in the Manning's roughness values was included in the model uncertainty.

(4) Width Reduction Factors. Width Reduction Factors (WRF) were applied to floodplain model elements in the towns of Newman and Crows Landing to represent the reduced conveyance area created by the concentration of urban structures. WRF values were based on building density observed in aerial photography and previously completed FLO-2D model studies (Corps, 2008). Width reduction factors ranged from 10% to 25%.

(5) Boundary Condition Inflows. Inflows were specified at fourteen grid elements in the FLO-2D model. Except for hydrologic index point ORES1, inflow grid element locations correspond to the hydrologic index points shown in Plate 2. The ORES 1 hydrologic index point is the main flow of Orestimba Creek at the Orestimba Creek at Newman Gage. This inflow was placed approximately 1 mile upstream of the gage at the upstream limit of the FLO-2D model. The translation is less than 1 hour and determined to be insignificant. Large inflows were divided into two adjacent grid elements in order to promote model stability.

To simulate the effects of the local drainage system through the CNRR embankment, only the hydrograph ordinates in excess of the 10-yr hydrograph ordinate were used in the hydraulic models for CNRR local sub-basin hydrology index points. The full hydrographs were used for the CCID hydrologic index points because there are no gravity drainage culverts through the CCID embankment.

Development of inflow hydrographs is summarized in the hydrology section above. Additional detail can be found in the hydrology appendix.

The March 2008 Hydrology Report provided 30-day event hydrographs in 1-hour increments. It was determined that shorter hydrographs, centered on the largest flood wave in the 30-day series, produced the same peak stages in the FLO-2D model with significantly less computer run time. Inflow hydrographs were therefore based on 120 hour durations. A sensitivity analysis was conducted by running a 240 hour long hydrograph. The maximum depth difference was 0.7 feet and only included a few grid elements. Almost all depth differences were less than 0.1 feet. These differences were considered negligible. Hydrographs for the five modeled inflow points described in Table 1 are shown in Plate 7.

(6) Boundary Condition Outflows. A channel outflow node was placed at the downstream end of Orestimba Creek, while floodplain outflow nodes were placed along the remainder of the downstream model grid element boundary. Each outflow node was set to discharge all inflow. This method approximates normal flow depth and was considered a reasonable downstream boundary assumption.

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(7) Hydraulic Structures**.** Hydraulic structures were represented in the FLO-2D model with rating curves obtained from HEC-RAS flow simulations. The HEC-RAS model only includes the main channel from bank to bank and flows confined to the structure width. This was done to be consistent with the FLO-2D model which simulates the overbank flow in the floodplain grid elements.

Fourteen structures were included along Orestimba Creek: California Aqueduct, Orestimba Road bridge, Southbound I-5 bridge, Northbound Interstate 5 bridge, Andersen Road bridge, Private Bridge 1, Main Canal siphon and bridge, Highway 33 bridge, California Northern railroad bridge, Private bridge 2, Morris Road bridge, Kilbourn Road bridge, Private bridge 3, Private Bridge 4, and River Road bridge. A single structure rating curve was used to simulate hydraulic losses at the CNRR and Highway 33 bridges due to their close proximity.

There are approximately 24 culverts that provide drainage through the Highway 33 and CNRR embankments. The culverts were estimated to be 36 inches in diameter by reviewing aerial photography and Google Earth Streetview. These culverts operate by gravity and were accounted for in the FLO-2D hydraulic model using a typical rating curve for each. The rating curve was developed from inlet control nomographs in the Federal Highway Administration design manual titled Hydraulic Design of Highway Culverts. It was assumed that local culverts and drainage systems could carry the runoff from a local 10% (1/10) ACE runoff event. Therefore, the local hydrographs just upstream from the culverts (not mainstem hydrographs) were reduced so they included only the excess above a 10% (1/10) ACE local event.

(8) Levee Elements. Significant linear topographic features on the Orestimba Creek floodplain were represented as levee elements in the FLO-2D model. Levee element input data defines the crest of the linear feature, which allows overtopping and movement of flow over the feature once water surface elevations reach the crest. The elevation of these features was determined from the 2008 LIDAR topographic data. Example features coded into the model include the CCID Main Canal embankment, CNRR railroad embankment, and Delta Mendota canal embankment.

Breaching and failure of the CCID Main Canal embankment was assumed if overtopped. The canal crosses the entire Orestimba Creek floodplain, and as a result impounds overland flow during large flood events. The most likely overtopping point appeared to be near Stuhr Road. This point was coded into the model to fail if overtopped.

(9) Other Elements**.** The FLO-2D infiltration option was not used in the model. The Orestimba Creek watershed must be saturated to produce runoff, which typically occurs late in the rainfall season. The ground in the project area was therefore assumed to be saturated from antecedent storms at the time of the peak inflows, and infiltration was assumed to be zero.

f. Model Validation. Peak flood depths for 1995 and 1998 events were simulated with the resulting FLO-2D model and compared to photographs, video, and anecdotal accounts of flooding. Inflow hydrographs for the Orestimba Creek at Newman gage were provided by the USGS in 15-minute increments for both floods. Coincident inflow hydrographs for the remaining model inflow boundaries were assumed to have a similar annual frequency as the Orestimba Creek at Newman gage. Levees were assumed to breach if overtopped. Several

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adjustments were made to levee heights and grid element elevations during initial simulations. These changes were incorporated into the existing conditions model.

A map of the peak modeled flood depths for the 1995 event is presented in Plate 11. A comparison of the measured and modeled flood hydrographs is presented in Plate 5. A map of photographs taken during the flood and the FLO-2D model results is presented as Plate 12. Pictures taken during the flood are provided in Plate 13 through 15. The map shows water entering the town of Newman. Within the City, the extent of flooding appears to be less than described by a map provided by City of Newman Public Works Director Ernie Garza. The CCID canal berm in the model is higher than at the time of the flood event and this may account for the difference.

A map of the peak modeled flood depths for the 1998 event is presented in Plate 16. A comparison of the measured and modeled flood hydrographs is presented in Plate 5. A map of aerial oblique photographs taken during the flood and the FLO-2D model results is presented as Plate 17. The pictures were compared to similar camera angles in Google Earth with an overlay of the model results. The comparisons are provided in Plate 18 through 23. Modeled flooding was also compared to video from the 1998 flood provided by the City of Newman Public Works Director Ernie Garza. The model agreed with the observations of shallow flood depths. The extent of flooding on the western side of the city appears less than observed. The observations indicate more overtopping of the CCID canal than the model simulated. The CCID canal berm in the model is higher than at the time of the flood event and this may account for the difference.

Although it is difficult to gage the flood depths in the 1995 and 1998 flood photographs they appear to compare within one foot of the model results. The comparison shows actual depths can vary significantly over a single 200 foot by 200 foot area modeled in FLO-2D. In some cases the actual depths appear to be 0.1 feet but the FLO-2D grid average in the same area is one foot deep.

g. Model Results. Existing condition floodplain maps for the 20% (1/5), 10% (1/10), 5% (1/20), 2% (1/50), 1% (1/100), 0.5% (1/200), and 0.2% (1/500) AEP events are provided in Plates 24 through 30. The floodplain maps were merged with the San Joaquin River UNET model results from the Sacramento-San Joaquin Comprehensive Study. Stage and flow estimates for nine economic index points throughout the area are provided in Table 8.

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Table 8
Hydraulic Characteristics, Existing Conditions

Economic Index Point Location and Parameter	Flood Event Annual Chance Exceedance							
	Invert	20% 1/5	10% 1/10	5% 1/20	2% 1/50	1% 1/100	0.5% 1/200	0.2% 1/500
7620 - California Aqueduct								
Flow (CFS)	-	3,630	5,660	7,900	11,100	13,700	16,400	20,300
Stage (FT-NAVD88)	206.00	209.43	210.68	211.97	213.58	214.78	215.97	217.53
Depth (FT)	-	3.43	4.68	5.97	7.58	8.78	9.97	11.53
26125 - Anderson Road Bridge								
Flow (CFS)	-	3150	3657	3880	4080	4200	4320	4440
Stage (FT-NAVD88)	107.72	119.74	120.44	120.75	120.98	121.08	121.18	121.27
Depth (FT)	-	12.02	12.72	13.03	13.26	13.36	13.46	13.55
Channel Velocity (FPS)	-	1.7	1.9	1.9	2.0	2.0	2.0	2.0
30196 - CCID Canal Bridge								
Flow (CFS)	-	2284	2600	2900	3350	3680	3980	4270
Stage (FT-NAVD88)	97.74	110.08	110.46	110.82	111.37	111.76	112.12	112.53
Depth (FT)	-	12.34	12.72	13.08	13.63	14.02	14.38	14.79
Channel Velocity (FPS)	-	3.4	3.7	4.0	4.4	4.8	5.0	5.0
31946 - CNRR Bridge								
Flow (CFS)	-	2163	2350	2670	2880	2990	3090	3210
Stage (FT-NAVD88)	96.41	107.11	107.45	108.03	108.41	108.60	108.78	108.99
Depth (FT)	-	10.7	11.04	11.62	12	12.19	12.37	12.58
Channel Velocity (FPS)	-	3.3	3.8	3.9	3.9	3.9	3.9	3.9
36912 - Morris Road Bridge								
Flow (CFS)	-	1950	2060	2160	2210	2220	2250	2250
Stage (FT-NAVD88)	80.84	89.87	90.08	90.22	90.28	90.30	90.33	90.33
Depth (FT)	-	9.03	9.24	9.38	9.44	9.46	9.49	9.49
Channel Velocity (FPS)	-	1.9	1.9	1.9	2.0	2.0	2.0	2.0
44416 - River Road Bridge								
Flow (CFS)	-	1930	2040	2150	2190	2210	2240	2240
Stage (FT-NAVD88)	51.27	61.96	62.28	62.51	62.61	62.65	62.71	62.72
Depth (FT)	-	10.69	11.01	11.24	11.34	11.38	11.44	11.45
Channel Velocity (FPS)	-	4.2	4.2	4.3	4.4	4.4	4.2	4.2
20771 - CCID at Lundy Rd								
Stage (FT-NAVD88)	107.55	109.84	110.86	111.19	111.40	111.53	111.61	111.68
Depth (FT)	-	2.29	3.31	3.64	3.85	3.98	4.06	4.13
Floodplain Velocity (FPS)	-	0.47	0.80	0.87	0.91	1.04	1.30	1.50
14933 - CCID at Stuhr Rd.								
Stage (FT-NAVD88)	108.61	108.61	109.01	110.54	111.12	111.33	111.37	111.47
Depth (FT)	-	0	0.4	1.93	2.51	2.72	2.76	2.86
Floodplain Velocity (FPS)	-	0	0.97	1.62	1.98	2.27	2.42	2.55
22247- CNRR at Lundy Road								
Stage (FT-NAVD88)	96.12	96.12	99.39	99.48	99.50	99.60	99.70	99.79
Depth (FT)	-	0	3.27	3.36	3.38	3.48	3.58	3.67
Floodplain Velocity (FPS)	-	0	1.53	1.76	1.80	2.01	2.21	2.37
23899- Villa Manucha Road								
Stage (FT-NAVD88)	85.56	85.56	86.09	86.30	86.40	86.54	86.71	86.89
Depth (FT)	-	0	0.53	0.74	0.84	0.98	1.15	1.33
Floodplain Velocity (FPS)	-	0	0.53	0.64	0.67	0.74	0.83	0.92
25356- Freitas Road								
Stage (FT-NAVD88)	78.18	78.18	78.58	79.48	79.95	80.16	80.40	80.63
Depth (FT)	-	0	0.40	1.30	1.77	1.98	2.22	2.45
Floodplain Velocity (FPS)	-	0	0.35	0.81	1.07	1.19	1.33	1.46
Note: All flows are through structure opening only and do not include overbank floodplain flow.								

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3.3 Sedimentation and Channel Stability.

A qualitative geomorphic and channel stability assessment of existing conditions was completed by Ayres and Associates 2 August 2007. A sedimentation and channel stability analysis of Orestimba Creek was completed by Tetra Tech Inc. 20 September 2000. The following were obtained from summaries in the reports.

The contours along and outward from the creek indicate that the creek has become perched above its surrounding alluvial fan and is bound by natural levees, which are likely the result of prehistoric mudflows and heavily sediment laden overbank stream flows. Relatively straight, braided reaches are indicative of the creek flowing over a steeper segment of the fan, whereas highly sinuous or meandering reaches are indicative of flow on flatter reaches perched on the fan surface. These flat, sinuous reaches, where they are not deeply entrenched into the topography, are the locus for potential avulsions as indicated by significant overbank flooding during relatively small flow events. However, permanent avulsions are unlikely given the degree of anthropogenic controls associated with infrastructure and agriculture along the creek and the surrounding floodplain.

Sand and gravel extraction activities between the Delta Mendota Canal siphon and Jorgensen road have increased the channel cross section and flood conveyance capacity of this reach. However, the gravel mining has locally reduced the channel slope, which slows the flow and encourages sediment deposition. The increased deposition that occurs in this reach has decreased sediment supply to points downstream, which has contributed to some lowering of the channel invert and exposure of bridge supports in the downstream reaches of the channel.

Flow velocities associated with a 50% (1/2) ACE event throughout the study reach are high enough to move the local bed material. While the channel appears somewhat seasoned and stable in the reaches downstream of the aggregate mining, some shifting of the planform is evident through comparisons of the 1952 and 1999 topographic maps. In addition, the relative stability of the channel is in part due to the fact that flows of significance overflow the channel - the channel reaches downstream of the overflow locations have not been subjected to the full effects of high magnitude flows. Improvement alternatives which involve increasing channel capacity (either through berms or channel enlargement) will subject the lower reaches to more extreme flow conditions (higher velocities, greater shear stresses) than has historically been the case. These alternatives will have to incorporate measures to ensure channel stability.

Average annual sediment loading to the upstream portion of the project reach is estimated at about 130,000 tons per year. Approximately half of this sediment load is expected to be of very fine sand size and larger. The remaining half is expected to be composed of silts and clays. Detention basin configurations may be expected to cause deposition of a significant fraction of this material and should be evaluated in consideration of the eventual storage loss or maintenance required to remove the accumulated material on a regular basis.

Based on the information described above, the channel appears to be relatively stable but has a trend towards long term degradation. The trend towards degradation could be increased by expanding channel capacity and raising associated velocities.

3.4 Interior Drainage. Local drainage within the study area was considered in the floodplain maps. Local interests operate several electric pumps to drain flood waters that collect on the

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west side of the CCID main canal near Anderson Road. These pumps are sometimes supplemented by portable pumps. The pumps discharge into the CCID main canal where they are conveyed north to a gated waste-way leading to Orestimba Creek. This gravity operated waste-way features manual gates and is referred to as the "finger". If required, the waste-way gates are opened when Orestimba Creek has receded below the canal level. These operations were assumed to occur after the flood event. Therefore, they were not included in the hydraulic modeling.

There are approximately 24 culverts that provide drainage through the Highway 33 and CNRR embankments. The culverts were estimated to be 36 inches in diameter by reviewing aerial photography and Google Earth Streetview. The capacity of these culverts is insufficient for conveying peak Orestimba Creek floodwaters. However, the culverts allow for drainage of floodwaters once the flood recedes. These culverts operate by gravity and were accounted for in the FLO-2D hydraulic model using a typical rating curve for each. The rating curve was developed from inlet control nomographs in the Federal Highway Administration design manual titled Hydraulic Design of Highway Culverts.

It was assumed that local culverts and drainage systems could carry the runoff from a local 10% (1/10) ACE runoff event. Therefore, the local hydrographs just upstream from the culverts (not mainstem hydrographs) were reduced so they included only the excess above a 10% (1/10) ACE event local event. During peak rainfall of the 1995 and 1998 flood events, the local storm drainage system was capable of conveying localized rainfall without damages. However, it was incapable of conveying excess floodwaters from Orestimba Creek. This indicates the drainage system is capable of conveying a 10-yr to 25-yr rainfall event without significant damages if Orestimba Creek overflows are not contributing to the system. This assessment of local drainage capacity was confirmed with the City of Newman Public Works Director.

3.5 Risk and Uncertainty Analysis. Within the study area, Orestimba Creek and Crow Creek are broad alluvial fans with shallow (1 to 3 feet deep) floodplains. The aerial distribution and depth of flooding can be significantly impacted by small changes to topography. Uncertainty related to the hydraulic stage-discharge relationship was evaluated following EM 1110-2-1619.

a. Channel Economic Index Points. Stage uncertainty at channel economic index points was based on natural and model uncertainty. The natural uncertainty standard deviation was estimated by reviewing discharge measurements at the Orestimba Creek near Newman Gage. USGS rating curve 22 was used as a base rating curve. Envelope curves were drawn to reflect the range of possible rating shifts around the rating curve. All discharge measurements were found to lie within bands 1.5 feet apart. This was assumed to represent 95% confidence of the natural uncertainty. The standard deviation was estimated to be 0.4 feet by assuming the 95% confidence value divided by four.

The model uncertainty standard deviation was estimated using Table 5-2 of EM 1110-2-1619. A model uncertainty standard deviation of 1.5 feet was determined for a Manning's Roughness reliability of "Poor" and cross sections based on a topographic map with 2-5' contours. This value was compared against the sensitivity of the 1% (1/100) ACE model to +/- 20% change in roughness. The +/-20% range is considered to be the 95% confidence in Manning's Roughness. For a 20% decrease in Manning's roughness, the maximum change in depth throughout the model domain was found to be +/-0.8 feet. For a 20% increase in Manning's roughness, the

maximum change in depth throughout the model domain was found to be + 5.0 feet to - 0.8 feet. The 5.0 feet increase was limited to the gravel pit area along Orestimba Creek and reflects inundation of isolated pits at the higher stages. These results are within the uncertainty range obtained from Table 5-2 of EM 1110-2-1619.

The total combined uncertainty standard deviation was estimated to be 1.5 feet using Equation 5-6 of EM 1110-2-1619. It is recommended that this uncertainty be applied to all annual exceedance frequency profiles.

b. Floodplain Economic Index Points. In shallow floodplains, the ratio of flood depth to the height of topographic features introduces significant uncertainty that can influence the direction and depth of flow. For example, a one foot high topographic feature common within agricultural fields can totally influence the direction of a 0.6 foot floodwater depth. Flood extents and depth were found to be highly influenced by the crest elevation of the CCID canal berm and CNRR railroad embankments which act as long weirs during flood events. The uncertainty in the crest elevation of these features is related to the topographic uncertainty. Therefore, the hydraulic uncertainty for floodplain economic index points was assumed to be based on 0.6 foot Root Mean Square Error (RMSE) of the Lidar based topographic data. This uncertainty value was confirmed through comparisons between actual flood depths photographed during the 1995 and 1998 floods and comparison to model validation runs of those floods. This comparison showed the model simulated flood depths within +/- 1 foot. Assuming this represents 95% confidence, the use of 0.6 feet for the standard deviation of stage uncertainty seems reasonable.

The uncertainty in the capacity of culverts which convey water under the CNRR embankment was also evaluated. The combined peak modeled flow of all culverts which pass water through the CNRR embankment was found to be approximately 5% of the Orestimba Creek inflow. Assuming the culverts had a 50% reduction in capacity would reduce the percentage to 2.5%. A portion of these restricted floodwaters would overtop the embankment rather than increase flooding upstream of the culvert. Therefore, the estimated culvert capacity is not a significant contribution of uncertainty.

3.6 Flood Warning Time. Flood warning time varies throughout the study area. The total estimated warning time for the town of Newman is 8 to 16 hours. Warning times were estimated from simulations of the 1995 and 1998 floods. The 1995 flood is the largest peak flood event and the 1998 flood is the third largest peak flood event since records began in 1932. These floods are assumed to be reasonable indicators of warning time. The warning time was estimated as the elapsed time from the peak occurring at the upstream stream gage to the time when depths in the town of Newman exceeded 1-foot. The elapsed time was estimated to be 8 and 10 hours for the 1998 and 1995 floods respectively. The warning time from issuance of a NWS flash flood warning is probably 4 to 8 hours earlier than the peak flow at the gage due to the time it takes rainfall runoff to accumulate at the gage.

4.0 FUTURE WITHOUT-PROJECT CONDITIONS

The following describes future without-project condition assumptions within the study area.

4.1 Hydrology. The most likely future without project condition is assumed to be similar to the existing condition. The watershed above the study area is extremely remote. Future development in the watershed is assumed to be minor and have little to no impact on hydrologic

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frequency. No adjustments were made to account for climate change in the hydraulic analysis. The sensitivity of project alternatives to climate change is discussed in the economics and risk analysis appendix.

4.2 Hydraulics. There are no planned activities that would alter the hydraulic conditions. Therefore, the future-without project conditions are assumed to be identical to existing conditions.

4.3 Sedimentation and Channel Stability. There are no planned activities that would alter the sedimentation and channel stability conditions. The sedimentation analysis conducted by Tetra Tech for this study indicated relative stability of the channel. The future-without project conditions are assumed to be identical to existing conditions.

4.4 Interior Drainage. There are no planned activities that would alter the interior drainage conditions. Therefore, the future-without project conditions are assumed to be identical to existing conditions.

4.5 Risk and Uncertainty Analysis. The stage-discharge uncertainty for future conditions is estimated to be similar to the existing conditions.

4.6 Flood Warning Time. Flood warning time is expected to remain the same in the future without project condition.

5.0 CHEVRON LEVEE ALTERNATIVE

5.1 Design. A map of the chevron levee alternative is provided in the floodplain maps (Plate 32). This alternative would involve constructing project levees along the east side of the Central California Irrigation District (CCID) Main Canal from the Newman Wasteway north to the latitude of Lundy Road, a distance of approximately 4 miles. The levee would then turn easterly and cross the California Northern Railroad (CNRR) embankment near Lundy Road, a distance of approximately 0.7 miles. The levee would extend an additional 35 feet east of the CNRR embankment to insure that floodwaters do not outflank the proposed levee. All levee segments would meet current USACE design standards with 16 foot wide top width and 3:1 side slopes. Drawings reflecting the 30% design for the Tentative National Economic Development Plan (NED) and Tentative Locally Preferred Plan (LPP) are provided as Attachment A.

Over the course of the feasibility study, two possible alignments along the CCID canal embankment were evaluated. The east side alignment was selected as the final alternative. The west side alignment was eliminated due to under-seepage caused by the proximity of the unlined canal.

a. Profile Assumptions. Three levee height profiles (A, B, and C) representing increasing levels of Flood Risk Management (FRM) performance were evaluated. The profiles and planning assumptions were based on a 31 August 2011 conference call with members of the PDT and Mike Deering at the USACE Hydrologic Engineering Center.

(1) <u>Profile A</u>**.** This profile represents the lowest size increment of an FRM project. The profile was based on the assumption that the CCID canal berms do not provide flood risk management with any certainty. The proposed levee would extend along the east side of the canal berm from the Newman Wasteway to the CNRR railroad. The levee segment along the CCID canal would be constructed to the 1/50 AEP median hydrologic event height

(approximate existing height of CCID canal embankment). The Lundy road segment of the levee would be based on 1/50 AEP median hydrologic event and an assumed breach of the CCID canal levee north of the segment. Economic damages/benefits would be based on the assumption that the canal berm would not fail unless overtopped, based on past performance of this feature.

(2) Profile B. This profile represents the height which optimizes the net Flood Risk Management benefits of the chevron levee and is described as the Tentative NED Plan in Attachment A. The height was defined as being greater than Profile A and providing similar FRM performance along its entire length. This profile is based on an economic performance optimization using profile and cost information from Profile A and Profile C (described below). The profile was based on the assumption that the CCID canal does not provide flood risk management with any certainty. The levee length would be identical to Profile A. The profile would be an interpolation between Profiles A and C. Economic damages/benefits would be based on assumption the canal berm would not fail unless overtopped, based on past performance of this feature.

(3) Profile C**.** This profile represents that highest reasonable size increment of Flood Risk Management for the chevron levee. Based on preliminary analysis presented at the F4 conference, this profile was based on meeting the local sponsors' design criteria of a 0.5% (1/200) ACE median hydrologic event with 3 feet of freeboard. The freeboard must be sufficient to prevent overtopping from wind wave runup and setup from a 1/72.6 AEP wind speed The sponsors' design criteria are described in the State of California Urban Levee Design Criteria, 15 November 2011. The profile is described as the LPP in Attachment A. The profile was based on the assumption that the CCID canal does not provide flood risk management with any certainty. A levee would be required from the Newman Wasteway to the CNRR railroad. A levee along the CCID canal would be constructed to the 0.5% (1/200) ACE median hydrologic event height plus an additional 3 feet of freeboard. The Lundy road segment of the levee would be based on the 0.5% (1/200) ACE median hydrologic event and an assumed breach of the CCID canal levee north of the segment. Economic damages/benefits would be based on assumption the canal berm would not fail unless overtopped, based on past performance of this feature.

b. Profile Results. The existing (without-project) conditions FLO-2D model was modified to incorporate infinitely tall levees along the proposed chevron levee alignment. The model was then run for a suite of hydrologic events ranging from 20% (1/5) ACE through 0.2% (1/500) ACE to compute water surface elevations along the levee. The model was also run for the range of hydrologic events assuming a failure of the CCID canal berm just north of the alignment. These runs were used to define the levee profile along the Lundy Road levee segment.

Each design levee profile was smoothed along the segment to eliminate minor changes in grade along the levee. Levee design elevations were specified at nine locations along the reach with constant grades assumed between. The economically optimized design height (Profile B) was based on an extrapolation of the 1% (1/100) ACE and 0.2% (1/500) yr median hydrologic events. The final design profiles are provided on Plate 31.

c. Closure Structures. Stop log type closure structures would be constructed at Shields Road, Draper Road, Orestimba Creek Road, and Stuhr Roads. At each of these road crossings, the proposed levee would be higher than the bridge deck and approach. In order to meet highway safety standards for vertical curves, a gap in the top portion of the levee is required for the bridge

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approach. A slotted abutment would be constructed in the levee on each side of the roadway. During a flood event, stop logs would be placed into the slotted abutments, across the roadway. When installed, the stop log structure would be approximately 2-3 feet high and will prevent floodwaters from flowing through the gap. This will not interfere with traffic because the roadway to the west of the structure would already be flooded when the stop logs were in place. These locations are the lowest points along the chevron levee and the performance of project depends on these structures operating correctly. Therefore, these locations will be made more resistant to overtopping.

A gate type closure structure would be constructed where the levee crosses the CNRR railroad embankment. The proposed levee is higher than the railway and a gap in the top portion of the levee is required to prevent interference with the railroad grade. It is important to note that the railroad grade can not be changed because the height of the levee segment is dependent on floodwaters overtopping this grade. An abutment would be constructed in the levee on each side of the railway. During a flood event, floodgates hinged on the abutment would be closed across the railway. When installed, the floodgate structure would be approximately 2-3 feet high and will prevent floodwaters from flowing through the gap. This will not interfere with railway traffic because the railway north of the levee would already be flooded when the stop log structure was in place. This location is a lowest point along the chevron levee and the performance of project depends on the structure operating correctly. Therefore, this location will be made more resistant to overtopping.

d. Interior Drainage. Construction of the levee will create approximately 41 acres of isolated drainage area between the CCID berm and the proposed levee toe. This area would have no upstream contributing drainage area and very low ground slope. Rainfall would infiltrate naturally without drainage pumps or culverts. In the case of a breach or overtopping of the CCID canal berm, this area would be rapidly inundated by floodwaters. Most of the floodwaters would drain by gravity following the flood event. However, it is anticipated that some floodwaters would be trapped in low isolated areas. Since this would only occur during rare events and may vary by event, portable pumps are recommended to drain the isolated areas. It is anticipated that this minor volume of floodwater would be pumped into the CCID canal where it would drained back to Orestimba Creek through CCID's outlet structure. Pumping would occur as hydrologic/hydraulic conditions permitted.

e. Erosion Protection. Erosion protection was specified at two locations. Erosion protection designed for energy dissipation will be constructed at the intersection of the CCID canal levee and the Lundy road canal segments. Erosion protection is necessary to address high water velocities expected at this location. The high velocities would occur if a breach in the CCID canal levee were to occur adjacent to the proposed levee segment. The breach floodwaters would fill the area between the two levees and flow north. The floodwaters would expand once they reach the open area north of the Lundy road levee. This expansion will result in a large amount of head loss over a short distance.

Construction of the levee will block floodwaters from Orestimba Creek from moving south along the Highway 33 and CNRR railroad embankments. During small flood events and localized rainfall events, Orestimba Creek floodwaters or local runoff would be conveyed to the east side of the railroad embankment through existing drainage culverts. During large floods, these additional floodwaters (beyond what would occur under existing conditions) would overtop the CNRR embankment. To mitigate for this condition, the west side of the railroad embankment

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will be buttressed to minimize seepage and the east side of the railroad embankment will be lined with rock revetment to prevent erosion. Culverts under the CNRR embankment will be extended to accommodate the seepage embankment and erosion protection. New upstream and downstream headwalls will be constructed at each culvert. The railroad embankment protection plan begins where the proposed levee crosses the railroad and ends where the railroad crosses Orestimba Creek. The erosion protection is shown in Attachment A.

f. Design Summary. A summary of pertinent information for the Profile A, B, and C designs is provided in Table 9. General Profiles A, B, and C are provided as Plate 31. Detailed design profiles of B and C are provided in Attachment A.

Table 9
Chevron Levee Design Summary

Project Feature	Design Profile		
	A 2% 1/50 ACE H&H Median	**B Tentative NED Optimized Economics**	**C LPP 0.5% 1/200 ACE H&H Median Plus 3 ft Freeboard1/**
CCID Main Canal Levee			
Levee Length (miles)	4.2	4.2	4.2
Design El. at Newman Wasteway (ft NAVD88)	111.4	112.8	114.8
Design El. at Shells Road (ft NAVD88)	111.4	112.8	114.8
Design El. at Draper Road (ft NAVD88)	111.4	112.8	114.8
Design El. at Stuhr Road (ft NAVD88)	111.4	112.8	114.8
Design El. at Latitude of Lundy Road (ft NAVD88)	111.4	112.8	114.8
Farm Road Levee			
Levee Length (miles)	0.6	0.6	0.6
Design El. at Main Canal (ft NAVD88)	111.4	112.8	114.8
Design El at CNRR (ft NAVD88)	100.0	100.5	103.1
California Northern Railroad Erosion Mitigation			
Length of Revetment (Miles)	2	2	2
Note: 1/ California Department of Water Resource urban levee design criteria.			

5.2 With-Project Floodplains. Floodplains for profiles B and C are provided in Plates 32 through 38. The floodplains represent the chevron levee performance for the median hydrologic and hydraulic conditions, and are the same for both levee profiles. The levee crest of Profiles B and C are higher than the median 0.2% (1/500) ACE median water surface. Therefore residual floodplains east of the proposed levee are not shown. Hydraulic characteristics at economic index points are described in Table 10 for Profiles B and C. As described above, the hydraulic characteristics are the same for profiles B and C because the levee crest of Profiles B and C are higher than the median 0.2% (1/500) ACE median water surface.

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Profile A was only used in the economic optimization of levee height. Floodplains and hydraulic characteristics for Profile A were not developed. However, they would be similar to profiles B and C for the 20% (1/5) ACE through 2% (1/50) ACE events. The method of economic optimization is described in the Economic Appendix to the main feasibility report.

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Table 10
Hydraulic Charachteristics, Chevron Levee Profiles B and C

Economic Index Point Location and Parameter	Flood Event Annual Chance Exceedance							
	Invert	20% 1/5	10% 1/10	5% 1/20	2% 1/50	1% 1/100	0.5% 1/200	0.2% 1/500
7620 - California Aqueduct								
Flow (CFS)	-	3,630	5,660	7,900	11,100	13,700	16,400	20,300
Stage (FT-NAVD88)	206.00	209.43	210.68	211.97	213.58	214.78	215.97	217.53
Depth (FT)	-	3.43	4.68	5.97	7.58	8.78	9.97	11.53
26125 - Anderson Road Bridge								
Flow (CFS)	-	3420	4038	4308	4529	4657	4978	5089
Stage (FT-NAVD88)	107.72	119.74	120.45	120.75	120.98	121.08	121.18	121.27
Depth (FT)	-	12.02	12.73	13.03	13.26	13.36	13.46	13.55
Channel Velocity (FPS)	-	1.7	1.9	1.9	1.9	2.0	2.0	2.0
30196 - CCID Canal Bridge								
Flow (CFS)	-	2288	2601	2920	3349	3676	3976	4288
Stage (FT-NAVD88)	97.74	110.08	110.46	110.81	111.37	111.76	112.12	112.53
Depth (FT)	-	12.34	12.72	13.07	13.63	14.02	14.38	14.79
Channel Velocity (FPS)	-	3.4	3.7	4.0	4.5	4.7	5.0	5.2
31946 - CNRR Bridge								
Flow (CFS)	-	2165	2354	2670	2881	2990	3087	3205
Stage (FT-NAVD88)	96.41	107.11	107.44	108.03	108.41	108.60	108.78	108.99
Depth (FT)	-	10.70	11.03	11.62	12.00	12.19	12.37	12.58
Channel Velocity (FPS)	-	3.5	3.8	3.9	4.0	4.0	3.9	4.0
36912 - Morris Road Bridge								
Flow (CFS)	-	1959	2058	2167	2210	2223	2254	2258
Stage (FT-NAVD88)	80.84	89.87	90.08	90.22	90.28	90.30	90.33	90.33
Depth (FT)	-	9.03	9.24	9.38	9.44	9.46	9.49	9.49
Channel Velocity (FPS)	-	1.9	1.9	1.9	2.0	2.0	2.0	2.0
44416 - River Road Bridge								
Flow (CFS)	-	1929	2049	2146	2194	2210	2245	2248
Stage (FT-NAVD88)	51.27	61.96	62.30	62.51	62.61	62.65	62.71	62.73
Depth (FT)	-	10.69	11.03	11.24	11.34	11.38	11.44	11.46
Channel Velocity (FPS)	-	4.2	4.2	4.3	4.4	4.4	4.2	4.3
20771 - CCID at Lundy Rd								
Stage (FT-NAVD88)	107.55	109.84	110.86	111.19	111.4	111.58	111.75	111.89
Depth (FT)	-	2.29	3.31	3.64	3.85	4.03	4.2	4.34
Floodplain Velocity (FPS)	-	0.47	0.80	0.87	0.91	1.20	1.68	2.00
14933 - CCID at Stuhr Rd.								
Stage (FT-NAVD88)	108.61	108.61	109.01	110.54	111.21	111.43	111.62	112.03
Depth (FT)	-	0	0.4	1.93	2.6	2.82	3.01	3.42
Floodplain Velocity (FPS)	-	0	0.97	1.62	2.03	2.43	2.73	3.29
22247- CNRR at Lundy Road								
Stage (FT-NAVD88)	96.12	96.12	99.75	99.83	99.84	99.97	100.1	100.23
Depth (FT)	-	0	3.63	3.71	3.72	3.85	3.98	4.11
Floodplain Velocity (FPS)	-	0	2.30	2.43	2.45	2.66	2.84	3.03
23899- Villa Manucha Road								
Stage (FT-NAVD88)	85.56	85.56	86.29	86.49	86.53	86.66	86.83	87.00
Depth (FT)	-	0	0.73	0.93	0.97	1.10	1.27	1.44
Floodplain Velocity (FPS)	-	0	0.67	0.79	0.82	0.84	0.90	0.99
25356- Freitas Road								
Stage (FT-NAVD88)	78.18	78.18	78.87	79.65	80.05	80.28	80.52	80.56
Depth (FT)	-	0	0.69	1.47	1.87	2.10	2.34	2.38
Floodplain Velocity (FPS)	-	0	0.49	0.90	1.12	1.25	1.40	1.54
Note: All flows are through structure opening only and do not include overbank floodplain flow.								

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5.3 Sedimentation and Channel Stability. The chevron levee alternative would have no impact on channel sedimentation or stability because it is set well back from Orestimba Creek. Long term deposition of fine suspended sediments on the west side of the CCID berm may change flow or storage patterns along the CCID berm. However this is not an impact of the project levee, which would be located on the east side of the CCID berm. This would likely result in future floods being conveyed further and increasing flood stages south along the west side of the CCID canal levee. Floodplain velocities within areas of potentially induced flooding (see section below) were examined. Velocities at Villa Manucha Road and Freitas Road are shown in Table 10 and were found to be less than 1.5 feet per second. Floodplain velocities at this magnitude are unlikely to result in erosion.

5.4 Wind Wave and Wind Setup. A wind wave analysis was conducted for the alignment presented at the F4 conference (along the west side of the CCID canal). The analysis is described in a memo dated 18 May 2010. The alignment was subsequently moved to the east side of the canal to address seepage concerns. As a result, the proposed Chevron Levee alignment would be sheltered from wind waves by the existing CCID berm.

The analysis showed there was no apparent correlation between wind speed and flood events and evaluated wave runup and wind setup for three wind scenarios representing likely low, most likely, and probable high wind speeds.

Application of the results to the Lundy road segment for Profiles B and C indicated the significant wind wave runup plus setup would range from 0.5 feet to 1.5 feet for design wind speeds of 12 mph (likely low) to 41mph (probable high).

Wind wave runup and setup were not used to optimize the economic performance of Profile B. There are no USACE requirements to optimize economics based on wind waves and the wind wave module of the USACE FDA program does not function. Therefore, wind wave data were not accounted for in the economic analysis.

Wind wave runup for Profile C was found to be less than the freeboard required by the State of California interim levee design requirements.

5.5 Risk and Uncertainty. Within the town of Newman, the source of flooding in the without project condition is highly uncertain in comparison to the chevron levee conditions. In the without project condition, the town is at risk from floodwaters overtopping or breaching the CCID canal or being conveyed into town by the CNRR railroad berm. The probability of these floodwaters entering the town of Newman is substantially reduced by the proposed project.

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The stage uncertainty values computed for existing conditions are suitable for the project condition. The sensitivity of stage estimates along the proposed chevron levee was evaluated by modeling several scenarios likely to influence the flood stage along the levee. A breach in the CCID canal on the water side of the east-west Lundy road segment was evaluated for one scenario. Mannings Roughness values were increased and decreased by 20% in two scenarios. A final scenario evaluated topographic uncertainty by increasing the CCID canal and CNRR embankments by 1.2 feet. The resulting stage differences are presented in Table 11. Stages along the chevron levee were found to be most sensitive to embankment elevation and found to be within the range of the existing conditions uncertainty. Project performance is described in the F4 Economics Appendix. It is recommended that more refined hydraulic analysis be conducted to confirm or reduce the stage uncertainty where the levee intersects the Newman waste way and CNRR railroad.

Table 11
Stage Sensitivity, Chevron Levee Profiles B and C

Economic Index Point Location and Parameter	Stage (FT-NAVD88)		
	5% 1/20	1% 1/100	0.5% 1/200
20771 - CCID at Lundy Rd			
Mean Estimate	111.2	111.6	111.8
Increase Manning's Roughness 20%	111.1	111.6	111.7
Decrease Manning's Roughness 20%	111.3	111.6	111.8
Increase Embankment Height 1.2 feet	112.5	112.8	111.9
Assume Failure of CCID Canal	109.3	110.5	111.2
22247- CNRR at Lundy Road			
Mean Estimate	99.8	100.0	100.1
Increase Manning's Roughness 20%	99.8	100.0	100.0
Decrease Manning's Roughness 20%	99.9	100.0	100.2
Increase Embankment Height 1.2 feet	101.0	101.5	101.7
Assume Failure of CCID Canal	100.0	100.1	100.2

5.6 Design Capacity Exceedance. When the design capacity of the alternative is exceeded, the project levees could be overtopped. There is a chance that the levees could breach during overtopping. A breach of the project levee along the main canal could result in the release of the impounded water. This water would flow east until it reached the CNRR embankment where it would be directed to the south and into the town of Newman. The resulting inundation would be similar to the existing (without-project) conditions shown in Plates 24 through 30 .

5.7 Levee Superiority. The definition of levee superiority per EC 1110-2-6066 (*Design of I-Walls*, 31 October 2010) is the increment of additional height added to a flood risk management system to increase the likelihood that when the design event is exceeded, controlled flooding will occur at the design overtopping section. Profile A does not provide levee superiority because it is nearly the same height as the existing CCID canal berm. Profiles B and C provide levee superiority because they are higher than the CCID canal berm. The 4-5 foot high CCID canal berm north of the Lundy Road project levee reach would most likely overtop first. Overtopping waters would likely breach the CCID canal berm, but floodwater would be prevented from entering the Town of Newman by the proposed Lundy Road project levee reach. Once the CCID

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canal berm breached and stages were reduced, it would be extremely unlikely the proposed project levee would be overtopped.

5.8 Induced Flooding.

Modeled differences in flood depths within the model domain are provided in Plates 39 through 45. The area shown in the maps as having potential flood depth increases for the 0.2% (1/500) ACE flood were evaluated as a potential maximum extent of induced flooding. The area includes approximately 2,850 acres.

Within this area all depths were found to be less than 6 feet for both the existing (without project) and alternative conditions. A depth of 2 feet is used as the limit of the leathality zone in the USACE FIA program. For any structure: if the event maximum depth is 2 feet or less, or less than the first floor height (fh) of structure, then no flood lethality zone assignment is made (USACE,2010). Approximately 1,850 and 1,790 acres were found to be less than 2 feet deep in the existing and alternative conditions respectively. It was estimated that 600 acres would be increased less than 0.5 feet above the criteria, 190 acres would be increased 0.5 to 1.0 feet above the criteria. None of the depths in the area were found to increase more than 2.0 feet above the criteria.

The average and maximum velocities within the area for both the existing (without project) and alternative conditions were found to be approximately 1foot per second and 4 feet per second respectively. Only five acres were found to increase from 3 feet per second in the existing (without project) condition to 4 feet per second in the alternative condition.

ER 1105-2-100, E-18f indicates that mitigation is justified if there are overriding reasons for safety. The increases in depth and velocity within the area of potential induced flooding do not appear to present a significant safety issue.

5.9 Flood Warning Time. Flood warning time is expected to remain the same as existing conditions. Continued operation of the three stream gages on Orestimba creek would be a requirement of the operations and management of the plan.

5.10 Operations and Maintenance. O&M requirements would include maintenance of the project levees and periodic operation of roadway and railroad closure structures. The project performance described in this feasibility study is dependent on the operation of the closure structures. If these structures are not operated, flow escaping through the structure could erode the levee embankment and lead to failure.

6.0 CHEVRON LEVEE WITH CHANNEL IMPROVEMENTS

6.1 Design. This alternative includes channel modifications as an additional increment to the tentative NED sized chevron levee or LPP sized levee described above (Profiles B and C). The preliminary version of this alternative was designed by Ayres and Associates under AE task order W91238-07-D-0038-0004 and is described in the F4 report. The alternative was further refined as a potential final alternative.

The alternative would increase Orestimba Creek channel capacity between Anderson Road and Morris Road to a capacity similar to the downstream reach. The project would involve excavating a larger channel cross section and constructing berms along several reaches. The

preliminary version presented at the F4 conference required only replacement of the CNRR railroad trestle. Further analysis of this alternative determined that two local bridges and the CNRR railroad trestle would require replacement. The project was designed to convey a median design discharge of 3,500 cfs at bankfull capacity. The preliminary version of this alternative was originally reported to have a design capacity of 4,000cfs, but further analysis indicated that this capacity was overestimated. Drawings reflecting the design are provided as Attachment B.

The existing conditions HEC-RAS model was used to design the alternative through an iterative process. To determine the proposed levee locations, results of the HEC-RAS hydraulic model were used to show low points along the banks and where overtopping occurred. If the area was being overtopped and the surrounding ground was lower than the ground elevation upstream and downstream of the reach, then a berm was placed. If a section was being overtopped, but the ground elevation was consistent with the ground level in adjacent reaches, then channel widening was proposed.

a. Chevron Levee Components. The details of the Chevron Levee components are the same as identified for the Chevron Levee alternative for the Tentative NED Plan and LPP plan (Profiles B and C).

b. Berms. Berms to contain the design flow were specified along portions of the project reach. These berms would be overtopped frequently due to the low design capacity of the channel improvements (design exceeded for a 20% (1/5) ACE median event). The berms were armored to reduce the probability of erosion during an overtopping event. If this alternative is selected, further analysis should be conducted to determine the tradeoff between the cost of armoring the berms face and conducting repairs. Proposed berm reaches are described in plans provided in Attachment B.

c. Channel Widening. The general design of the channel widening was a compound channel with a low flow channel inset into the larger channel. These minor low flow channel details were not included in the model. The channel bottom width was varied throughout the reach based on the hydraulic conditions. To accommodate features adjacent to the channel, the floodplain bench was restricted to one side of the channel where possible. The channel widening sections would be transitioned back to the normal bank line at a 4:1 change in conveyance area. Reaches where channel excavation was proposed and typical cross section details are shown in Attachment B.

d. Channel Rock Armor. Models showed increased flows and velocities throughout the proposed channel modification reach. The reach may experience hydraulic instabilities leading to local bank erosion or scour. As noted in the existing conditions, the channel appears to have a long term degradation trend. Additional bank erosion and degradation may result from the more frequent higher flows resulting from the increased upstream capacity. The Ayres and Associates preliminary plan called for channel rock armor to be placed 100 ft upstream and downstream of transitions from the native channel to the excavated channel. In addition, they recommend that rock protection be placed at the upstream and downstream sides of bridges as protection from increased velocity (Ayres, 2009). Similar recommendations were made for the final alternative. It was recommended that the protection extend 100 feet upstream of the bridge

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to 100 feet downstream of each bridge. Recommended rock armor locations are shown in Attachment B.

e. Grade Control Structures. It was assumed that five rock hydraulic structures at the bridges would be designed for grade control. The structures would approximate a trapezoidal channel and be approximately 250 feet long. More detailed surveys and modeling of the channel would be needed to refine the location and detail of these structures during PED. Additional structures may be needed downstream of the channel improvement reach to account for increases in the flow and velocities.

f. Flood Easements. Several areas were designated as flood easements along the reach. Easements were designated where inundation would drain back to the channel at the design flow and annualized construction costs were likely to exceed the annualized damages. Areas where flood easements were specified are shown in Attachment B and described below.

A flood easement was designated on the right bank between Highway 33 and the Main Canal. It was estimated an additional 0.7 miles of berm would be required to prevent the 3,500cfs design flow from inundating 22 acres and four structures. Construction of a berm in this area would also be costly due to the close proximity of the structures to the channel.

A flood easement was designated for an area along the right bank of Orestimba Creek approximately 2000 feet upstream from Morris Road. It was estimated an additional 0.3 miles of berm would be required to prevent the 3,500 cfs flow from inundating 6 acres of undeveloped area. Construction of a levee would also have to address local drainage inflow through the berm.

A flood easement was designated for a floodplain terrace area near Morris Road. The floodplain terrace would contain the 3,500 cfs design flow without modification. An additional 0.6 miles of berm would be required to prevent the 3,500 cfs design flow from inundating this 40 acre area.

Ayres and Associates noted that there are some existing areas of high ground adjacent to the river that will need to be maintained to ensure water would remain within the channel (Ayres, 2009). As mentioned earlier in this report, these areas are actively farmed and land leveling is common. Therefore, it is recommended that an easement be maintained along the entire project reach in order to prevent land leveling and adverse impacts to the project capacity. The easement would also provide for maintenance access.

g. Bridge Replacements. The CNRR trestle would be replaced with a three span bridge for this alternative. The CNRR trestle has historically collected debris resulting in reduced capacity during floods. This is expected to have more significant hydraulic impacts for the increased flow frequency of the design condition. Ayres and Associates tested a scenario where 25% of the flow area was assumed obstructed with debris. The model indicated a 1.6 foot increase in the upstream water surface for the design flow. A picture of CNRR trestle is provided in Plate 4.

Two additional local bridges would require replacement to span the channel improvements. These are described as Private Bridge 1 and Private Bridge 2 in Table 7. The bridge replacements are described in Attachment B.

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h. Vegetation. It was assumed the channel modification reach would be maintained to a Manning's roughness value of 0.040 to 0.050 in the channel and 0.060 in the overbanks. This is similar to existing conditions.

i. Interior Drainage. Most of the surrounding land drains away from the creek channel due to the general slope of the alluvial fan. Therefore, interior drainage facilities were not specified for this alternative. However, local drainage needs may be discovered during more detailed topographic surveys conducted for PED.

j. Design Summary. A summary of pertinent information for the 3,500 cfs channel modification design is provided in Table 12.

Table 12
Chevron Levee Profile B and C with 3,500 cfs Channel Modification Design Summary

Feature	3,500 cfs Design
Channel Improvement	
Channel Excavation and Berms (Miles)	3.4
Grade Control Structures	5
Bridge Replacements	3

6.2 With-Project Floodplains. With-project floodplains were estimated by modifying the FLO-2D model used for the Chevron Levee project design. This required first incorporating the channel modification features into the HEC-RAS model. Then the HEC-RAS model cross sections were incorporated into the FLO-2D model. The next step was to incorporate the structure rating curves for structures impacted by the channel modification. The FLO-2D model was then run for the full suite of ACE events to determine the residual floodplains. Floodplain plots for the design are presented in Plates 46 through 52. The chevron levee crest is higher than the 0.2% (1/500) ACE median water surface. Therefore residual floodplains east of the proposed levee are not shown. Hydraulic characteristics at economic index points are described in Table 13. Induced inundation depths are shown in Plates 53 through 59.

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Table 13
Hydraulic Charachteristics, Chevron Levee with Channel Improvements

Economic Index Point Location and Parameter	Flood Event Annual Chance Exceedance							
	Invert	20% 1/5	10% 1/10	5% 1/20	2% 1/50	1% 1/100	0.5% 1/200	0.2% 1/500
7620 - California Aqueduct								
Flow (CFS)	-	3,630	5,660	7,900	11,100	13,700	16,400	20,300
Stage (FT-NAVD88)	206.00	209.43	210.68	211.97	213.58	214.78	215.97	217.53
Depth (FT)	-	3.43	4.68	5.97	7.58	8.78	9.97	11.53
26125 - Anderson Road Bridge								
Flow (CFS)	-	3567	4918	5390	5687	5850	5988	6130
Stage (FT-NAVD88)	107.72	118.90	120.61	121.03	121.26	121.38	121.48	121.58
Depth (FT)	-	11.18	12.89	13.31	13.54	13.66	13.76	13.86
Channel Velocity (FPS)	-	2.1	2.1	2.2	2.2	2.2	2.2	2.3
30196 - CCID Canal Bridge								
Flow (CFS)	-	3516	4239	4345	4421	4492	4585	4757
Stage (FT-NAVD88)	97.74	111.66	112.48	112.57	112.63	112.68	112.76	112.90
Depth (FT)	-	13.92	14.74	14.83	14.89	14.94	15.02	15.16
Channel Velocity (FPS)	-	4.8	5.2	5.3	5.3	5.4	5.5	5.6
31946 - CNRR Bridge								
Flow (CFS)	-	3403	4580	4316	4456	4529	4606	4710
Stage (FT-NAVD88)	96.41	106.17	107.42	107.80	108.13	108.30	108.48	108.73
Depth (FT)	-	9.76	11.01	11.39	11.72	11.89	12.07	12.32
Channel Velocity (FPS)	-	5.7	5.7	5.8	5.8	5.8	5.8	5.8
36912 - Morris Road Bridge								
Flow (CFS)	-	3288	4116	4297	4408	4475	4576	4661
Stage (FT-NAVD88)	80.84	91.50	92.61	92.91	93.12	93.22	93.36	93.53
Depth (FT)	-	10.66	11.77	12.07	12.28	12.38	12.52	12.69
Channel Velocity (FPS)	-	2.4	2.6	2.6	2.7	2.7	2.7	2.7
44416 - River Road Bridge								
Flow (CFS)	-	3125	4005	4043	4095	4098	4127	4120
Stage (FT-NAVD88)	51.27	64.71	66.55	66.61	66.69	66.69	66.74	66.73
Depth (FT)	-	13.44	15.28	15.34	15.42	15.42	15.47	15.46
Channel Velocity (FPS)	-	4.9	5.1	5.2	5.2	5.2	5.1	5.2
20771 - CCID at Lundy Rd								
Stage (FT-NAVD88)	107.55	108.76	109.32	110.6	111.26	111.53	111.71	111.87
Depth (FT)	-	1.21	1.77	3.05	3.71	3.98	4.16	4.32
Floodplain Velocity (FPS)	-	0.28	0.17	0.72	0.87	1.02	1.59	1.94
14933 - CCID at Stuhr Rd.								
Stage (FT-NAVD88)	108.61	108.61	108.61	108.89	110.83	111.31	111.54	111.92
Depth (FT)	-	0	0	0.28	2.22	2.7	2.93	3.31
Floodplain Velocity (FPS)	-	0	0	0	1.71	2.25	2.61	3.16
22247- CNRR at Lundy Road								
Stage (FT-NAVD88)	96.12	96.12	96.12	96.12	99.35	99.82	99.91	100.05
Depth (FT)	-	0.00	0.00	0.00	3.23	3.70	3.79	3.93
Floodplain Velocity (FPS)	-	0	0	1.41	2.43	2.56	2.77	2.97
23899- Villa Manucha Road								
Stage (FT-NAVD88)	85.56	85.56	85.56	85.77	86.48	86.53	86.73	86.92
Depth (FT)	-	0	0	0.21	0.92	0.97	1.17	1.36
Floodplain Velocity (FPS)	-	0	0	0.29	0.78	0.82	0.85	0.95
25356- Freitas Road								
Stage (FT-NAVD88)	78.18	78.18	78.18	78.45	79.53	79.91	80.27	80.56
Depth (FT)	-	0	0	0.27	1.35	1.73	2.09	2.38
Floodplain Velocity (FPS)	-	0	0	0.26	0.84	1.05	1.25	1.42
Note: All flows are through structure opening and do not include overbank floodplain flow.								

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6.3 Sedimentation and Channel Stability. This alternative increases the capacity of Orestimba Creek between Morris Road and Anderson Road. The increase in flow and velocity at economic index points is described in Table 14 and 15 respectively. The increased flow and velocity could impact sediment transport and channel stability within the project reach as well as the downstream reach.

Within the overall project reach, the channel may experience sediment deposition, bed degradation/aggradation, and bank erosion. Specifically within excavation reaches, the channel may experience sediment deposition due to reduction in velocity. Between excavation reaches, the channel may experience bed and bank erosion due to increased velocities. Ayres and Associates incorporated rock armor along the banks at transition reaches and bridge locations. Additional grade control structures were specified at five locations.

Within the reach downstream of the improvements (below Morris Road), the channel may experience increased degradation and bank erosion due to changes in flow regime and sediment transport within the upstream reach. If this alternative is selected, further analysis is recommended during PED to evaluate if bed stabilization or bank protection measures are warranted within the project reach or downstream reach.

Table 14
Channel Flow Increase, Chevron Levee with Channel Improvements

Economic Index Point Location and Parameter	Flood Event Annual Chance Exceedance							
	Invert	20% 1/5	10% 1/10	5% 1/20	2% 1/50	1% 1/100	0.5% 1/200	0.2% 1/500
26125 - Anderson Road Bridge								
W/O Project Flow (CFS)	0	3150	3657	3880	4080	4200	4320	4440
With Project Flow (CFS)	0	3567	4918	5390	5687	5850	5988	6130
30196 - CCID Canal Bridge								
W/O Project Flow (CFS)	0	2284	2600	2900	3350	3680	3980	4270
With Project Flow (CFS)	0	3516	4239	4345	4421	4492	4585	4757
31946 - CNRR Bridge								
W/O Project Flow (CFS)	0	2163	2350	2670	2880	2990	3090	3210
With Project Flow (CFS)	0	3403	4580	4316	4456	4529	4606	4710
36912 - Morris Road Bridge								
W/O Project Flow (CFS)	0	1950	2060	2160	2210	2220	2250	2250
With Project Flow (CFS)	0	3288	4116	4297	4408	4475	4576	4661
44416 - River Road Bridge								
W/O Project Flow (CFS)	0	1930	2040	2150	2190	2210	2240	2240
With Project Flow (CFS)	0	3125	4005	4043	4095	4098	4127	4120
Note: All flows are through structure opening and do not include overbank floodplain flow.								

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Table 15
Channel Velocity Increase, Chevron Levee with Channel Improvements

Economic Index Point Location and Parameter	Flood Event Annual Chance Exceedance							
	Invert	20% 1/5	10% 1/10	5% 1/20	2% 1/50	1% 1/100	0.5% 1/200	0.2% 1/500
26125 - Anderson Road Bridge								
W/O Project Velocity (FPS)	0	1.7	1.9	1.9	2.0	2.0	2.0	2.0
With Project Velocity (FPS)	0	2.1	2.1	2.2	2.2	2.2	2.2	2.3
30196 - CCID Canal Bridge								
W/O Project Velocity (FPS)	0	3.4	3.7	4.0	4.4	4.8	5.0	5.0
With Project Velocity (FPS)	0	4.8	5.2	5.3	5.3	5.4	5.5	5.6
31946 - CNRR Bridge								
W/O Project Velocity (FPS)	0	3.3	3.8	3.9	3.9	3.9	3.9	3.9
With Project Velocity (FPS)	0	5.7	5.7	5.8	5.8	5.8	5.8	5.8
36912 - Morris Road Bridge								
W/O Project Velocity (FPS)	0	1.9	1.9	1.9	2.0	2.0	2.0	2.0
With Project Velocity (FPS)	0	2.4	2.6	2.6	2.7	2.7	2.7	2.7
44416 - River Road Bridge								
W/O Project Velocity (FPS)	0	4.2	4.2	4.3	4.4	4.4	4.2	4.2
With Project Velocity (FPS)	0	4.9	5.1	5.2	5.2	5.2	5.1	5.2
Note: All flows are through structure opening and do not include overbank floodplain flow.								

Floodplain velocities within areas of potentially induced flooding (see section below) were examined. Velocities at Villa Manucha Road and Freitas Road are shown in Table 15 and were found to be less than 1.5 feet per second. Floodplain velocities at this magnitude are unlikely to result in erosion.

6.4 Risk and Uncertainty. Uncertainty of modeled flood depths and flood extents associated with shallow flooding is discussed in the existing conditions and chevron levee sections. Similar considerations should be given to floodplain mapping associated with this alternative. The design is based on a mean estimate of the bankfull capacity and not a specific flood frequency. Stage uncertainty for the design condition is the same as existing conditions. Project performance of this alternative is discussed in the economics appendix.

6.5 Design Capacity Exceedance. When the design capacity of the alternative is exceeded, the channel banks and levees would be overtopped. There is a risk that the berms along the channel could breach during overtopping. Under this scenario, the pattern of downstream flooding would be similar to the existing (without-project) conditions.

6.6 Levee Superiority. Levee superiority is the same as the Chevron Levee Alternative.

6.7 Induced Flood Depths. Increases and decreases to flood depths within the model domain are provided in Plates 53 through 59.

6.8 Flood Warning Time. Flood warning time is expected to remain the same as existing conditions. Continued operation of the three stream gages on Orestimba creek would be a requirement of the operations and management of the plan.

6.9 Operations and Maintenance. It is likely that project berms would require repair following each overtopping flood event. Annual maintenance costs would need to account for the project capacity being exceeded at approximately a 20% (1/5) ACE event. Periodic vegetation

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maintenance would be required to maintain the Manning's roughness values to conditions similar to the existing (without-project conditions). Sediment removal may be required in excavated reaches and channel bank erosion may require repair following flood events. The project performance described in this feasibility study is dependent on the operation of the closure structures. If these structures are not operated, flow escaping through the structure could erode the levee embankment and lead to failure.

7.0 SUMMARY

This report describes hydraulic, sedimentation, and operations and maintenance analyses performed for the final alternatives of the Orestimba Feasibility Study. Analyses were performed for existing (without-project) and two project alternative conditions. The report provides an update of the previous analysis of the without-project conditions.

The study is focused on Orestimba and Crow Creek flood sources. Floodplain delineations are provided for 20% (1/5), 10% (1/10), 5% (1/20), 2% (1/50), 1% (1/100), 0.5% (1/200), and 0.2% (1/500) Annual Chance Exceedance (n-ACE) events for the existing and alternative conditions.

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22. USGS, 2008, National Water Information System, Data Retrieval, March 1995 15 minute Hydrograph data, Gage No. 11274500, Orestimba Creek near Newman

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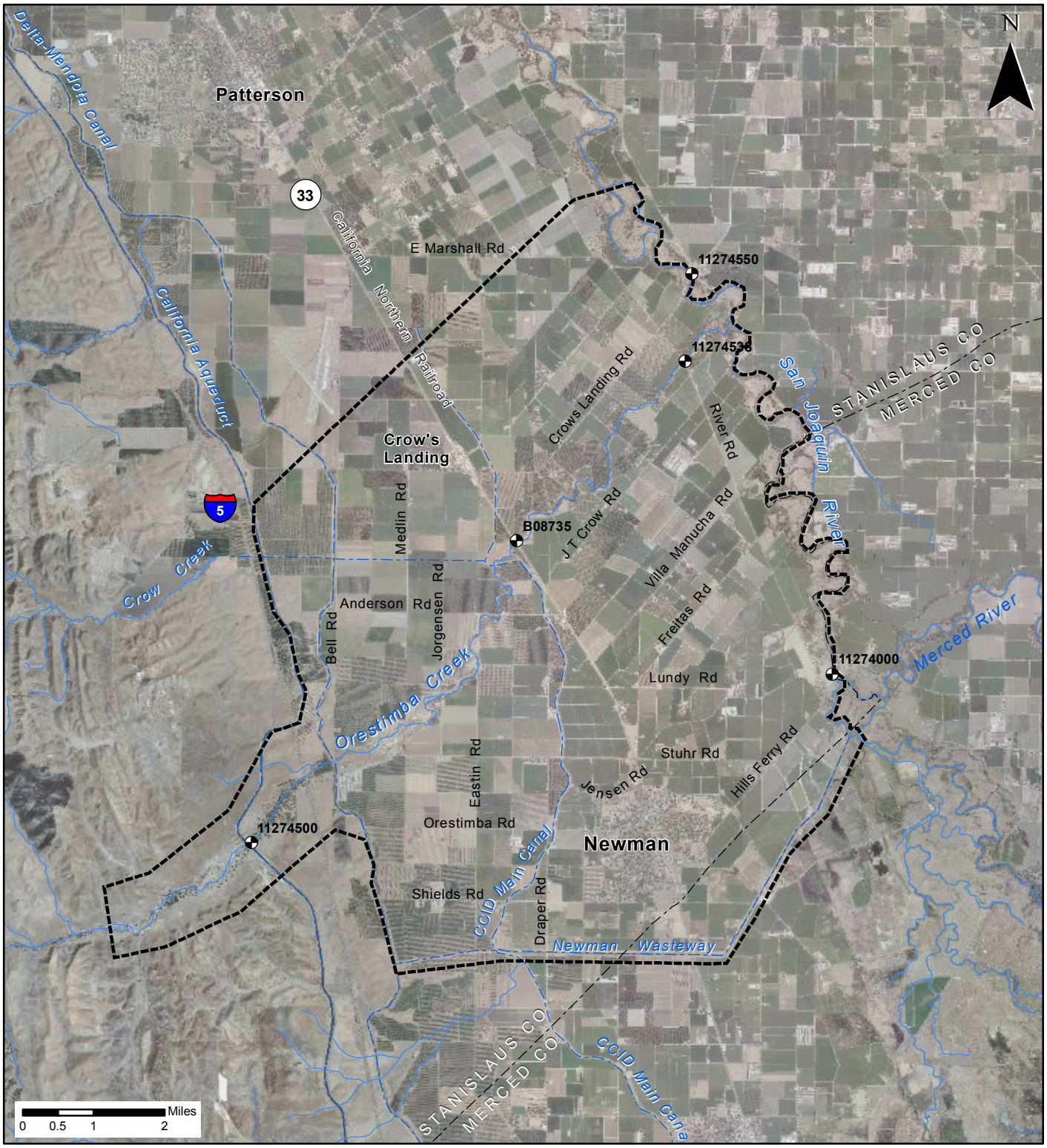


Legend

- Stream Gage
- Floodplain Mapping Extent

2010 Aerial Photography, http://imaps.dfg.ca.gov/arcgis/services

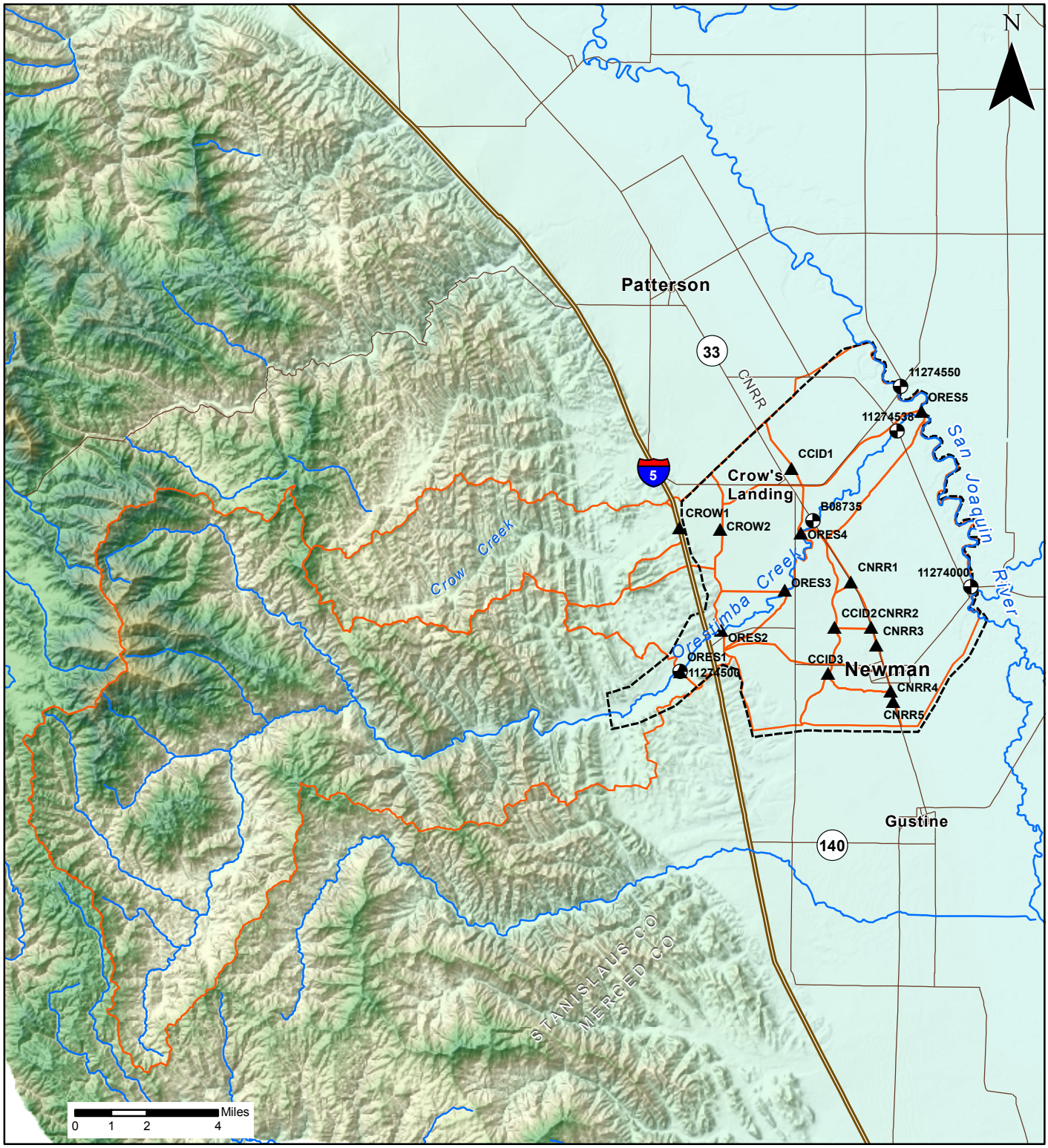
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

STUDY AREA

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

JUL 2012

PLATE 1



Legend

- ▲ Hydrologic Index Points
- Stream Gages
- Sub-Basin Boundary
- Floodplain Mapping Extent

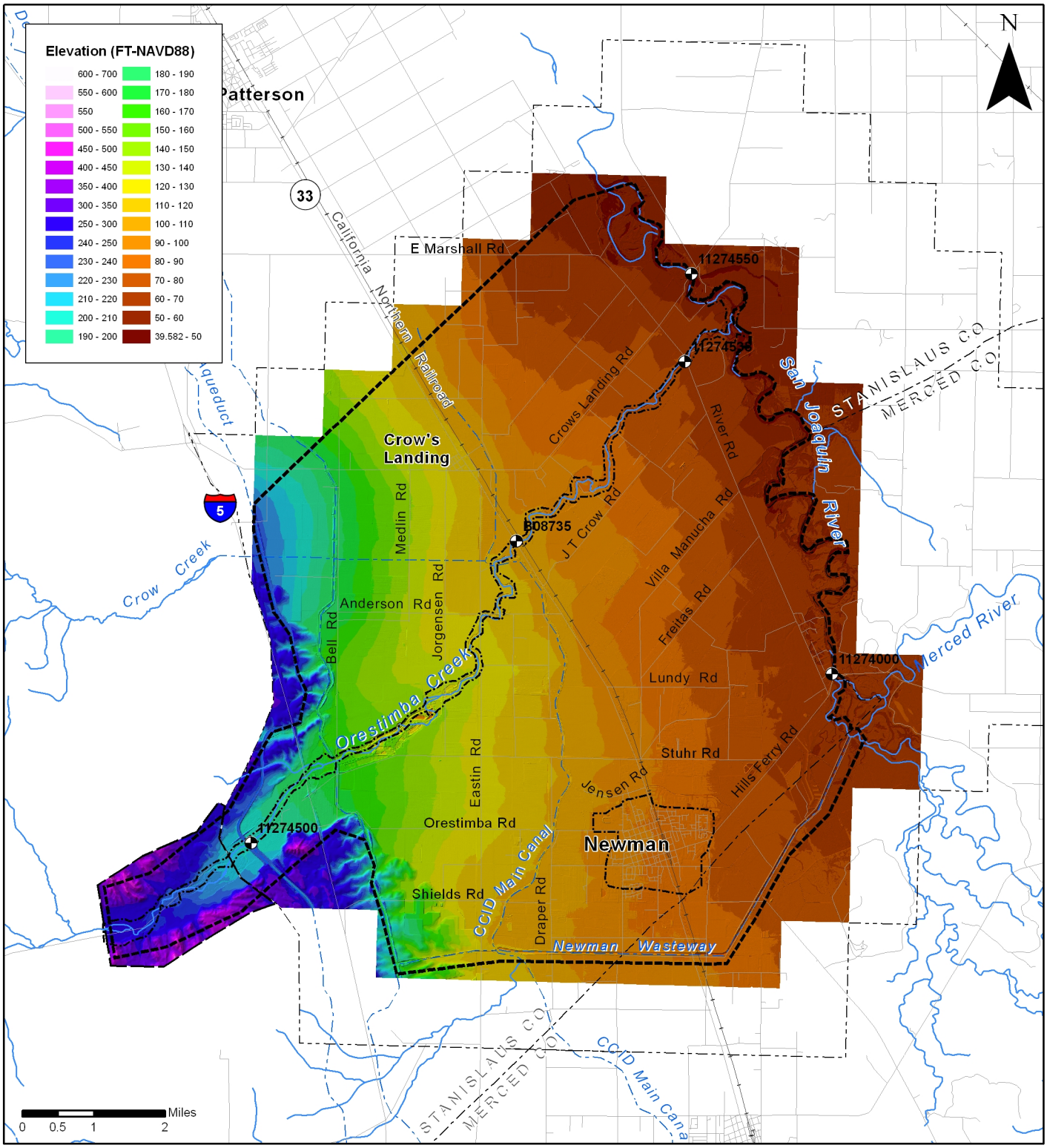
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

WATERSHED

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

JUL 2012

PLATE 2



Legend

- Stream Gage
- Floodplain Mapping Extent
- DWR 2008 LIDAR
- Cartwright 1999 Aerial Topo 5ft CI
- Cartwright 1999 Aeiral Topo 2 ft CI

2010 Aerial Photography, http://imaps.dfg.ca.gov/arcgis/services

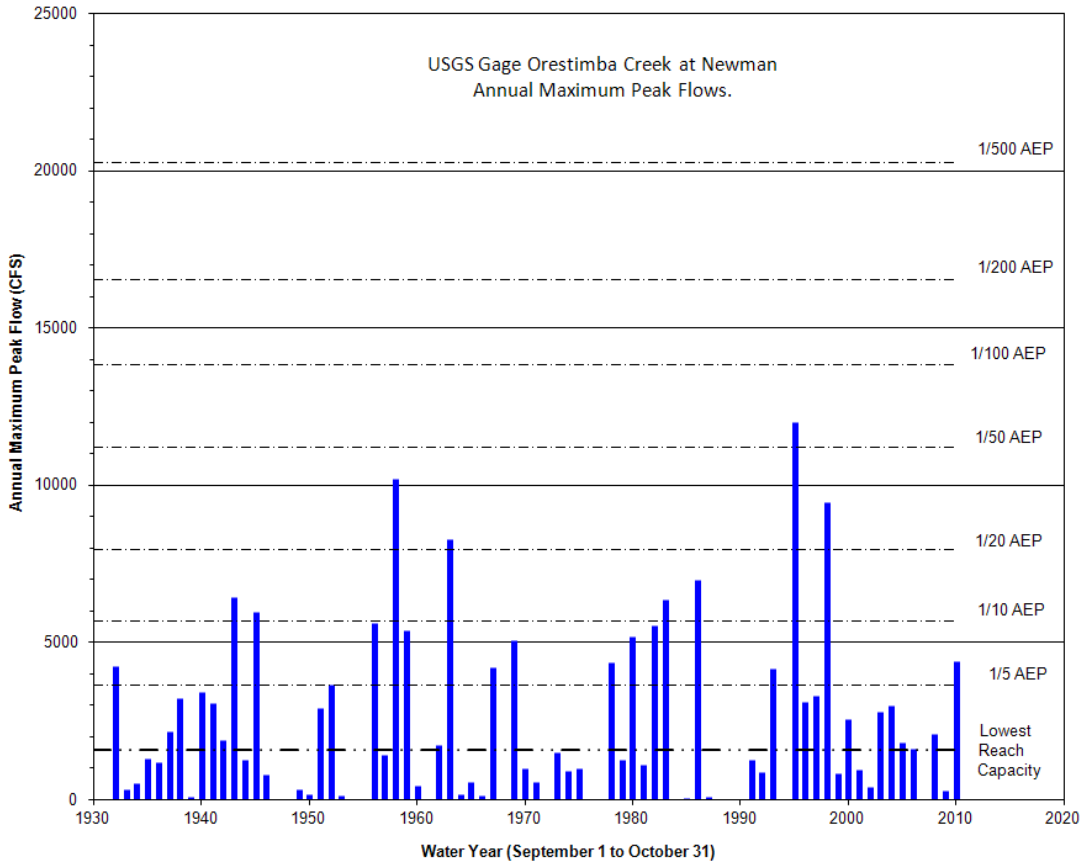
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

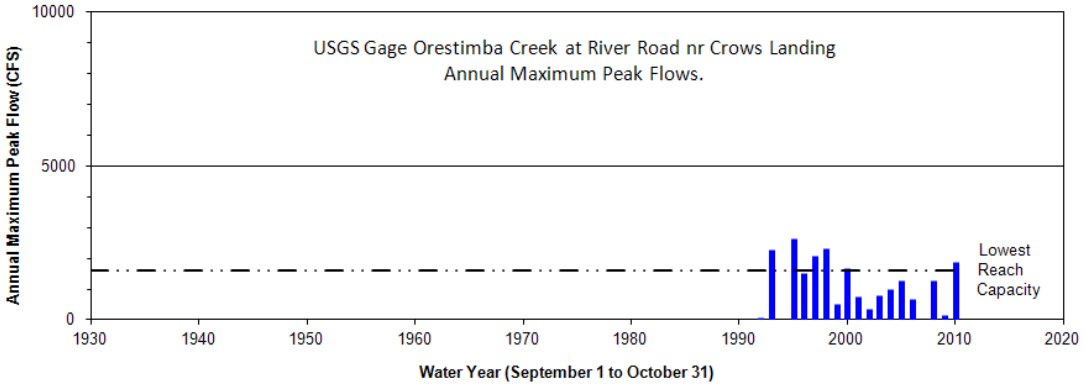
TOPOGRAPHY

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

JUL 2012

PLATE 3





ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNA
FEASIBILITY STUDY

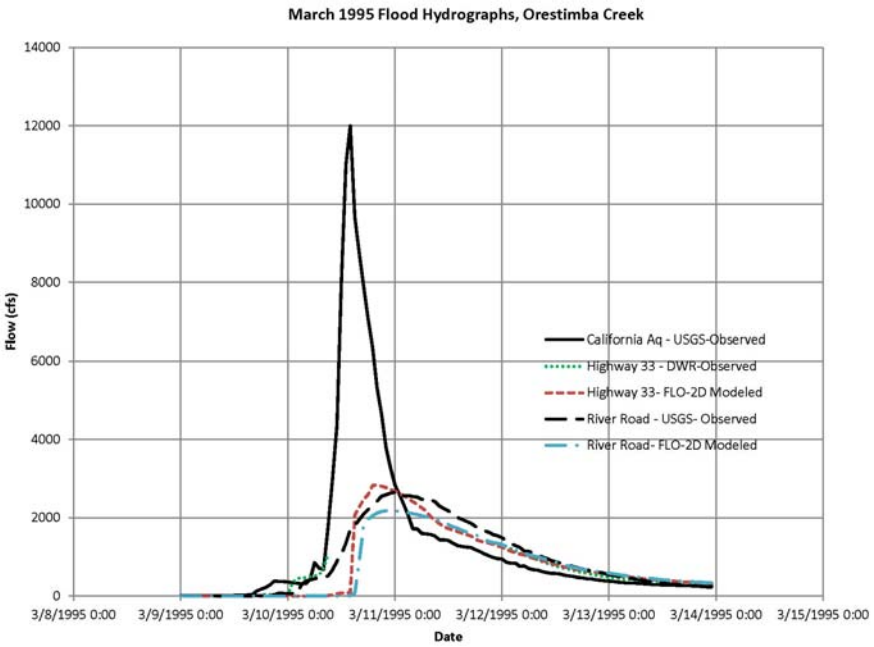
ANNUAL MAXIMUM PEAK FLOW
ORESTIMBA CREEK NEAR NEWMAN
ORESTIMBA CREEK AT RIVER ROAD

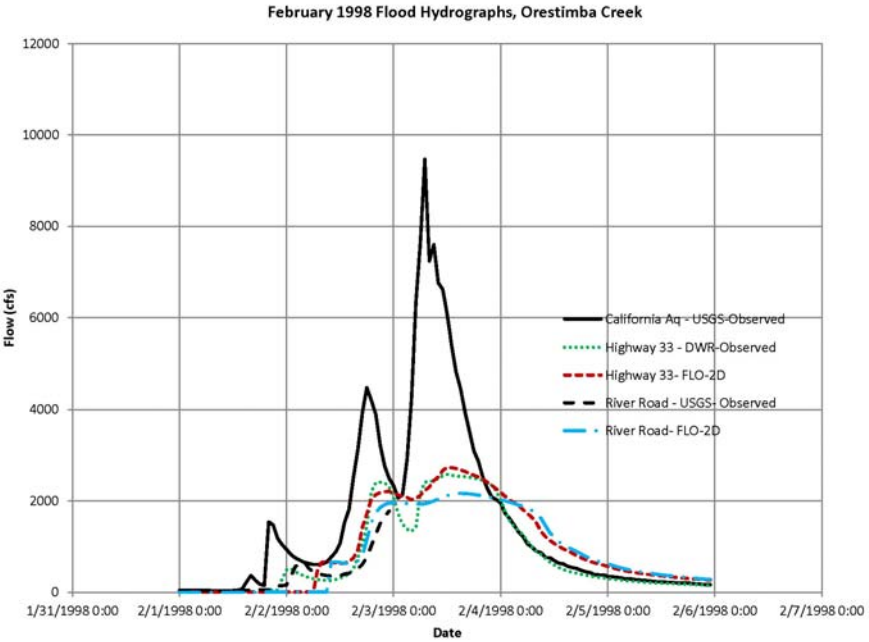
U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by PJB

JUL 2012

PLATE 4





Notes:

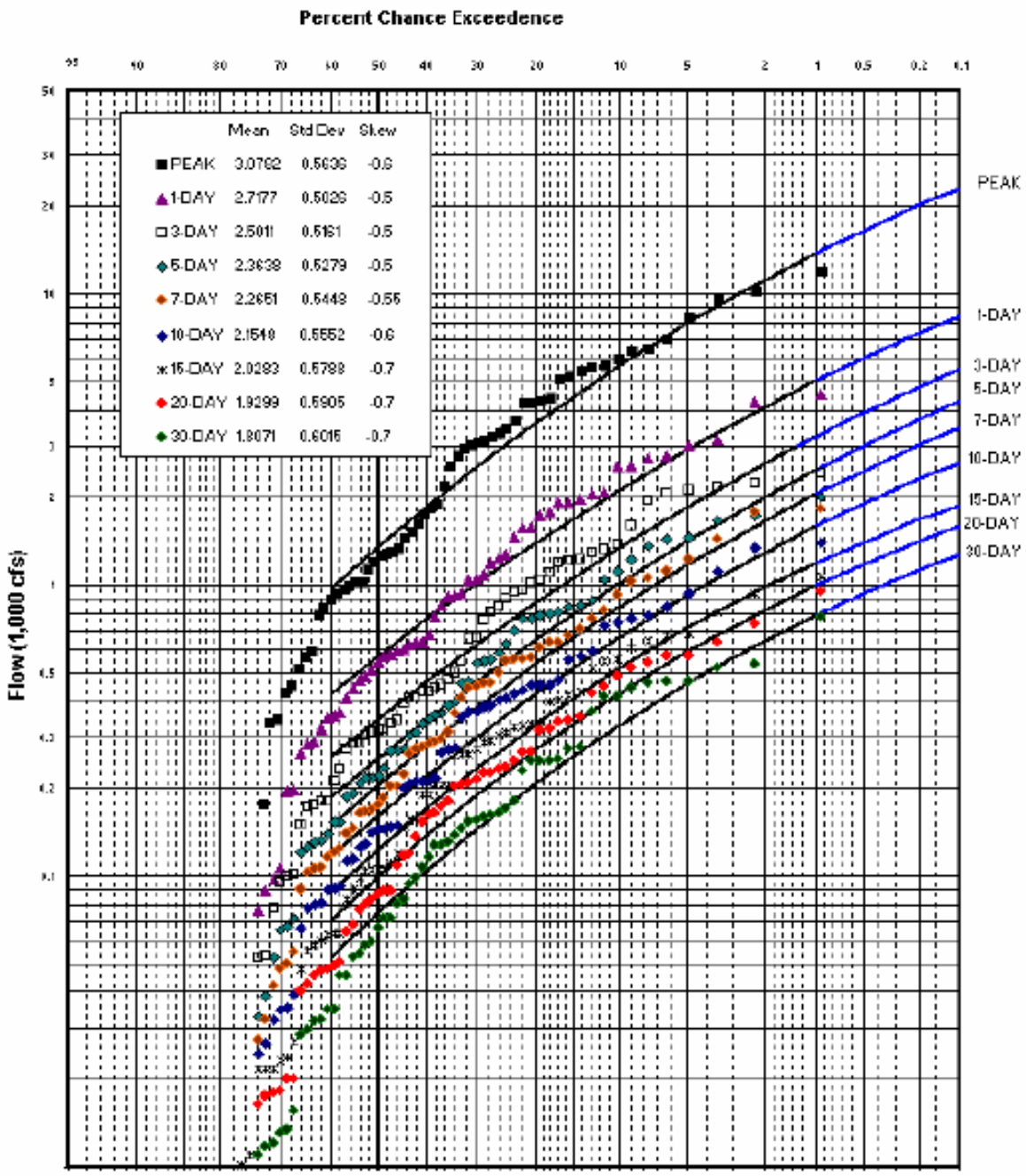
March 1995 Flood Data unavailable for DWR gage at Hwy 33 from 3/10/1995 10:00 to 3/12/1995 2:00

February 1998 Flood Data unavailable for USGS gage at River Road after 2/2/1998 0:00 Hours.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MARCH 1995 AND FEBRUARY1998
FLOOD HYDROGRAPHS
ORESTIMBA CREEK

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



NOTES:

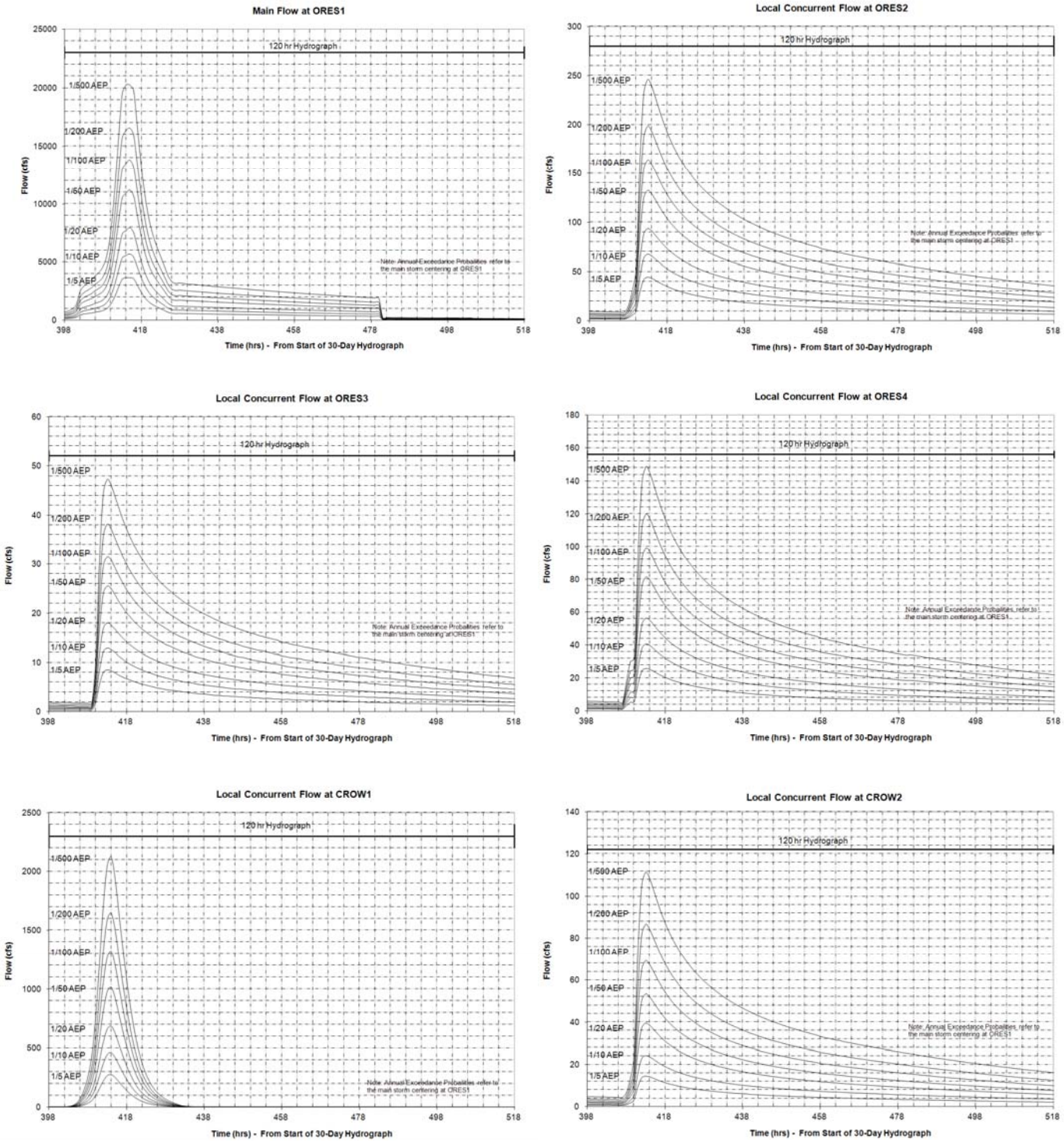
1. Period of record: water years1932-2006
2. Peak flow 76 years, daily flows 75 years of record
3. Median plotting positions used to plot flows.
4. Drainage area 134 sq.mi.
5. USGS Station 11274500

Source: March 2008 Orestimba Creek Hydrology Report

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

ORESTIMBA CREEK NEAR NEWMAN
FLOOD FREQUENCY CURVES

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

120-HOUR HYDROGRAPHS
EXISTING (WITHOUT-PROJECT)

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Source: March 2008 Hydrology Report

California Northern Railroad Bridge at Orestimba Creek
Source: Ayres and Associates

CCID Main Canal at Anderson Road

Local Levee Upstream of Anderson Road

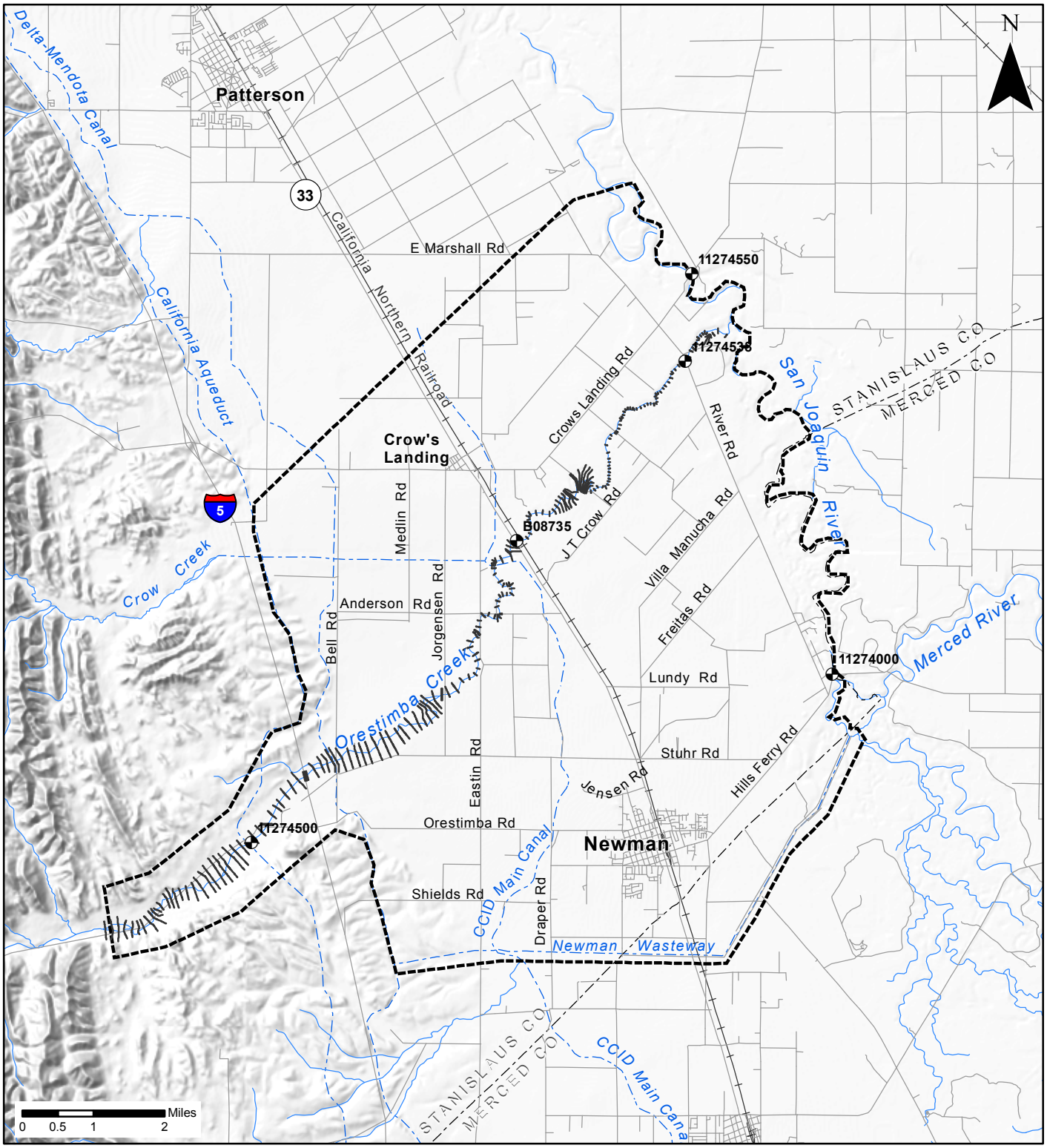
USGS gage, Orestimba Creek near Newman

California Northern Railroad Embankment

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

ORESTIMBA CREEK
FLOODPLAIN FEATURES

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

- Stream Gage
- Floodplain Mapping Extent
- HEC RAS Cross Sections

2010 Aerial Photography, http://imaps.dfg.ca.gov/arcgis/services

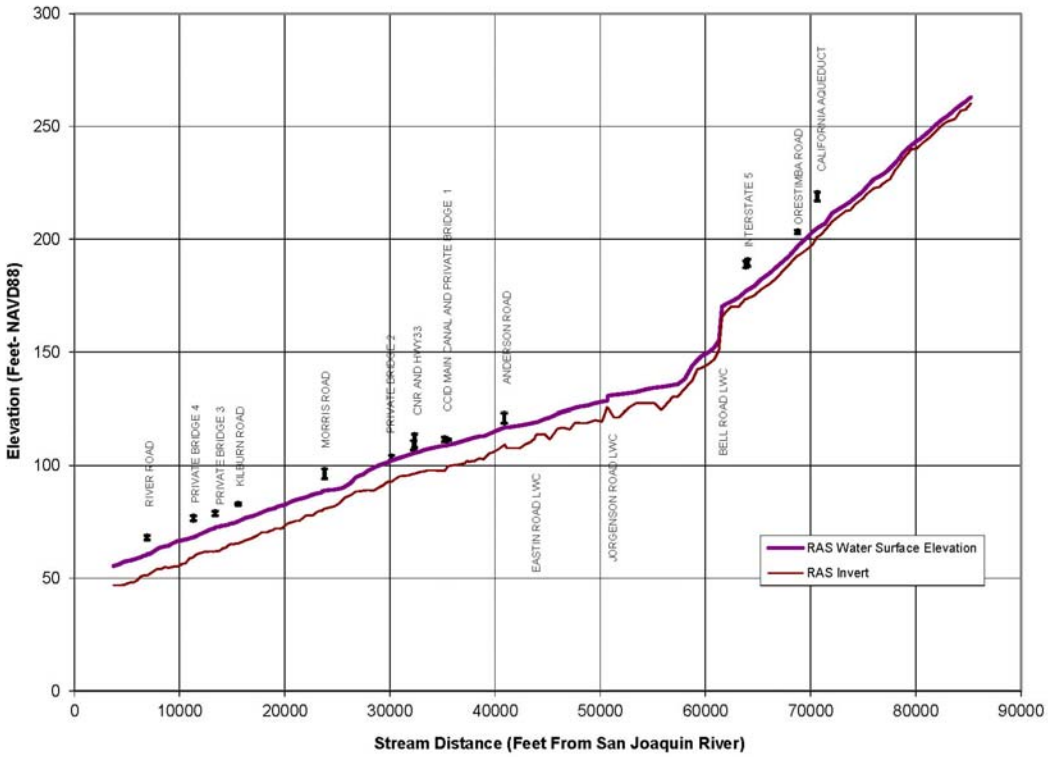
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

HEC-RAS MODEL

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

JUL 2012

PLATE 9

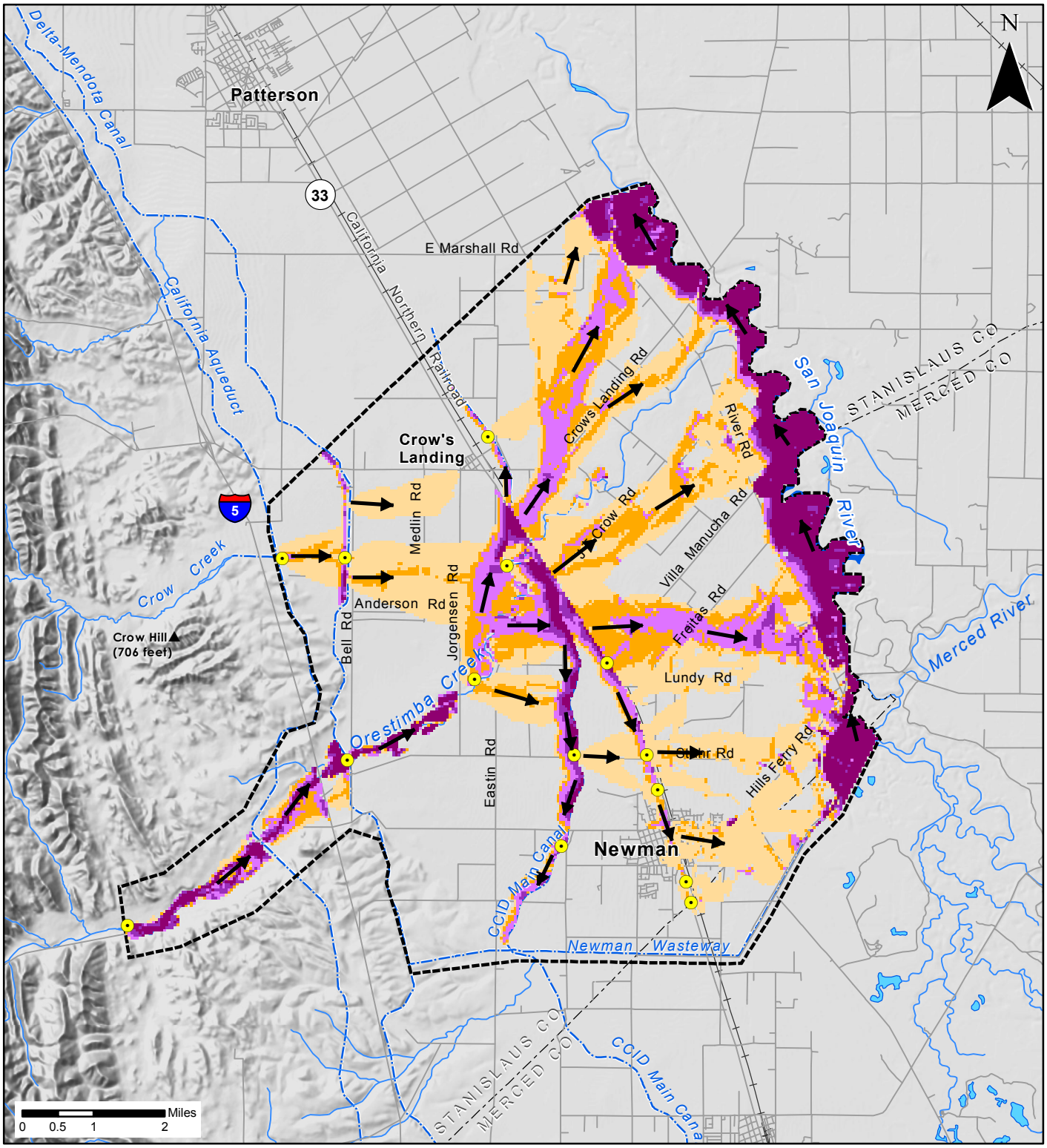


ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

ORISTIMBA CREEK
MODELED WATER SURFACE PROFILE
EXISTING (WITHOUT-PROJECT)
1,500 CFS

Prepared by PJB

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

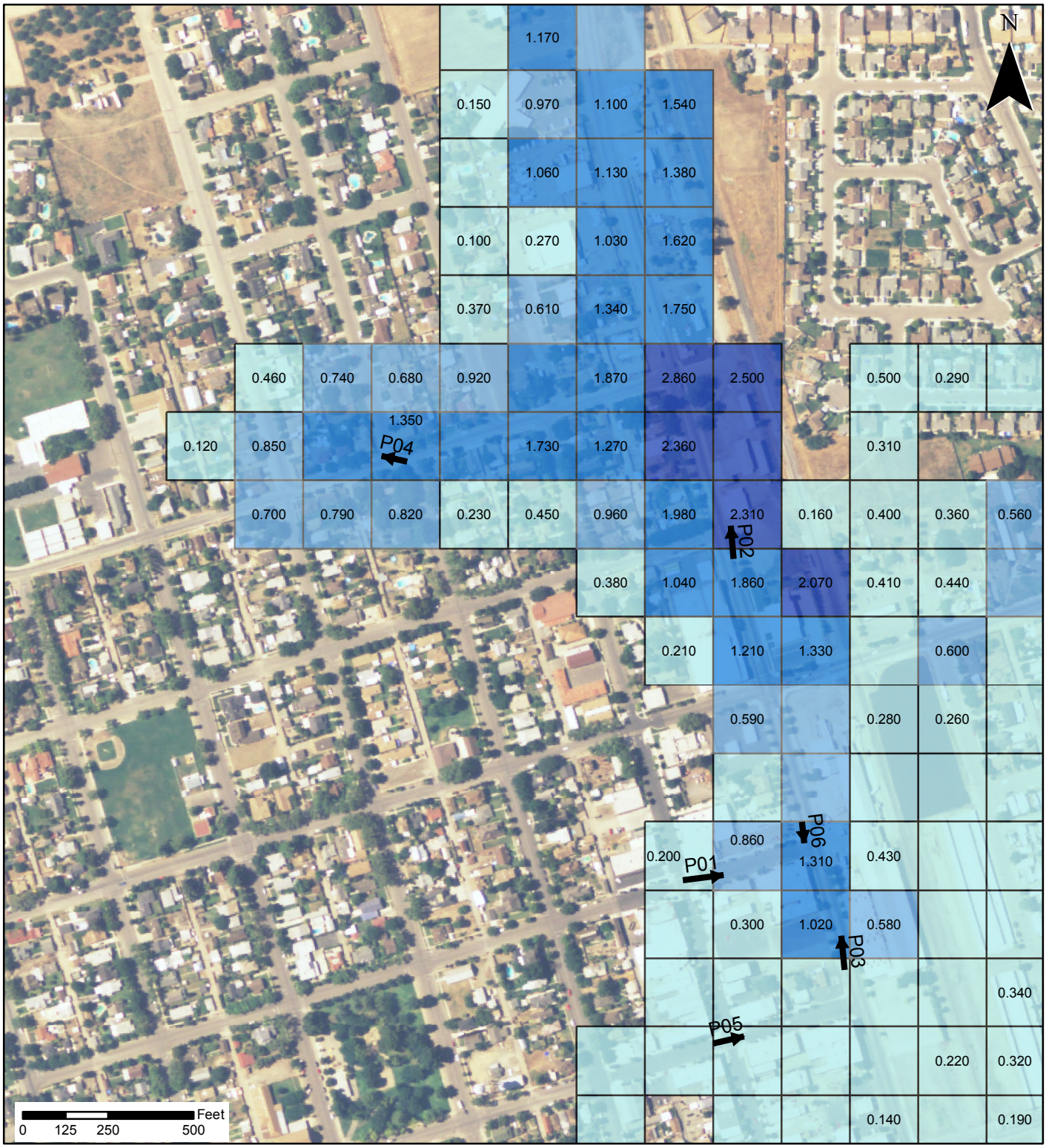
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
MARCH 1995 FLOOD

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

SEP 2012

PLATE 11



Legend

Depth (feet)

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
MARCH 1995 FLOOD
PHOTOGRAPH LOCATIONS
AND FLO2D MODEL DEPTHS

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Photo 1, Main and Tulare Streets Looking East

Photo 2, Highway 33 and Mariposa Ave Looking North

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
MARCH 1995 FLOOD
PHOTOGRAPHS 1 AND 2

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Photo 3, Highway 33 and Fresno Street Looking North

Photo 4, Yolo and P Street Looking West

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
MARCH 1995 FLOOD
PHOTOGRAPHS 3 AND 4

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

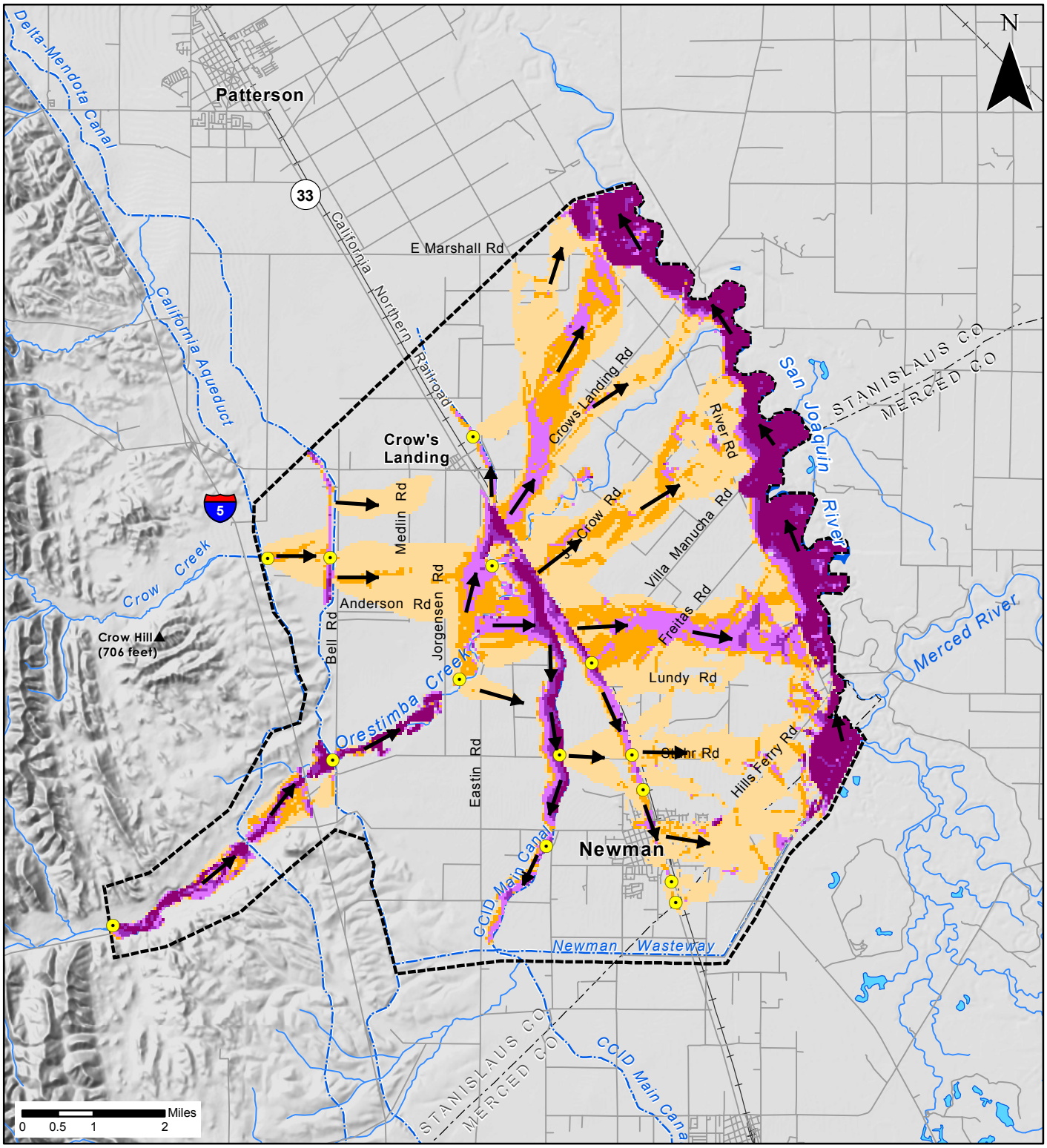
Photo 5, Main and Fresno Street Looking East

Photo 6, Highway 33 and Tulare Street Looking South

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
MARCH 1995 FLOOD
PHOTOGRAPHS 5 AND 6

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

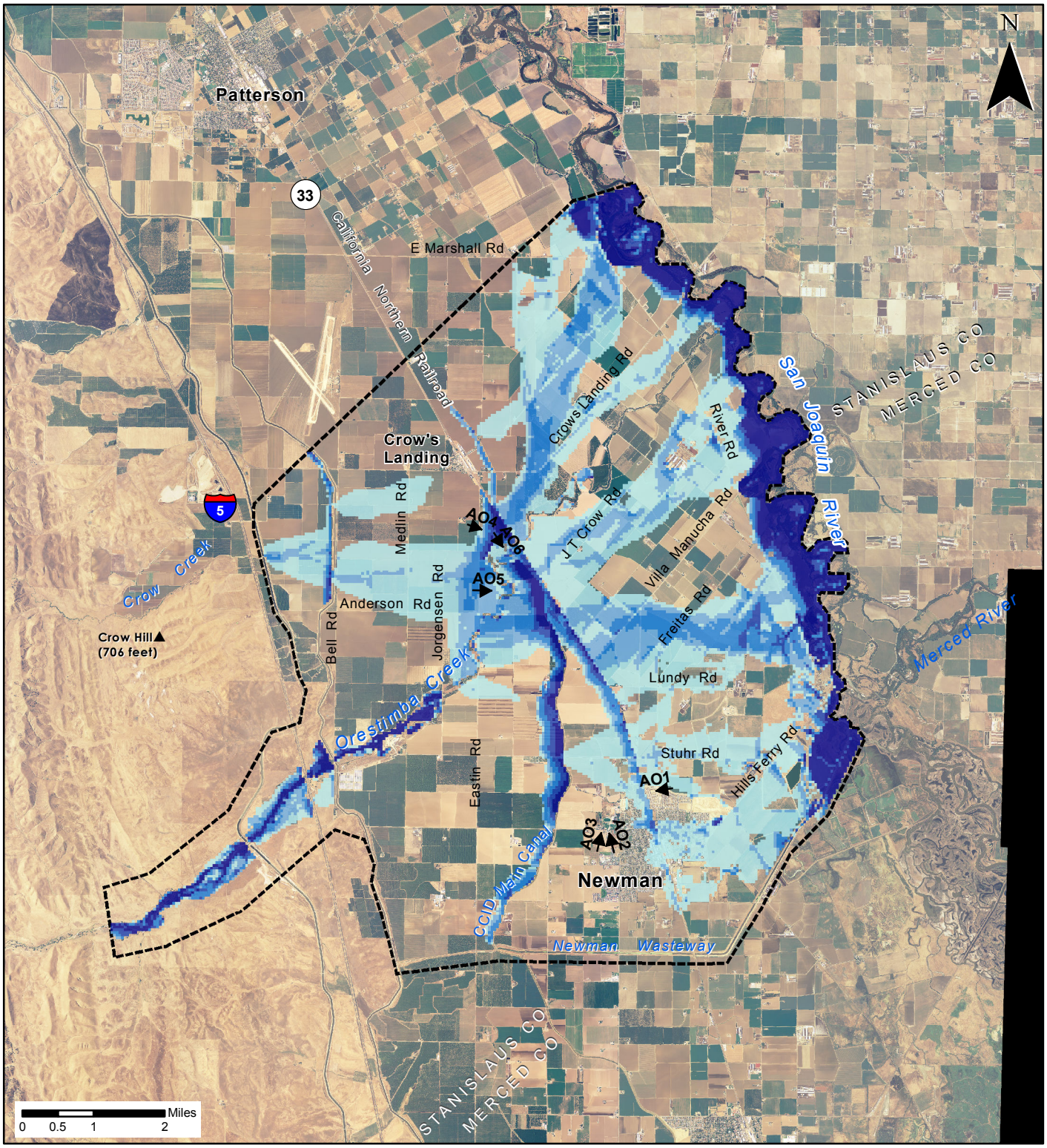
- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
FEBRUARY 1998 FLOOD

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Depth (feet)

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

Canal

Floodplain Mapping Extent

Aerial Oblique

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
FEBRUARY 1998 FLOOD
FLOOD PHOTOGRAPHY LOCATIONS

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Notes:

Modeled elevation of CCID canal embankment is higher than existed at time of flood. Less canal overtopping is expected in model simulation.

Only model depths greater than 0.5 feet shown. Depths less than 0.5 feet assumed to be transparent in observed flooding.

Source: Google Earth with FLO-2D depth overlay.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
FEBRUARY 1998 FLOOD
AERIAL OBLIQUE 1

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Notes:

Modeled elevation of CCID canal embankment is higher than existed at time of flood. Less canal overtopping is expected in model simulation.

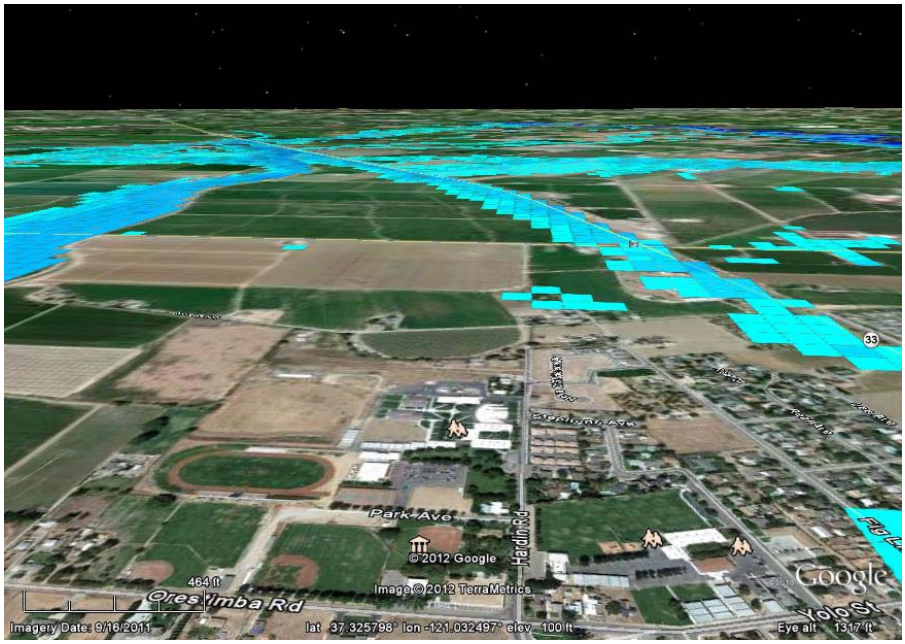
Only model depths greater than 0.5 feet shown. Depths less than 0.5 feet assumed to be transparent in observed flooding.

Source: Google Earth with FLO-2D depth overlay.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
FEBRUARY 1998 FLOOD
AERIAL OBLIQUE 2

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Notes:

Modeled elevation of CCID canal embankment is higher than existed at time of flood. Less canal overtopping is expected in model simulation.

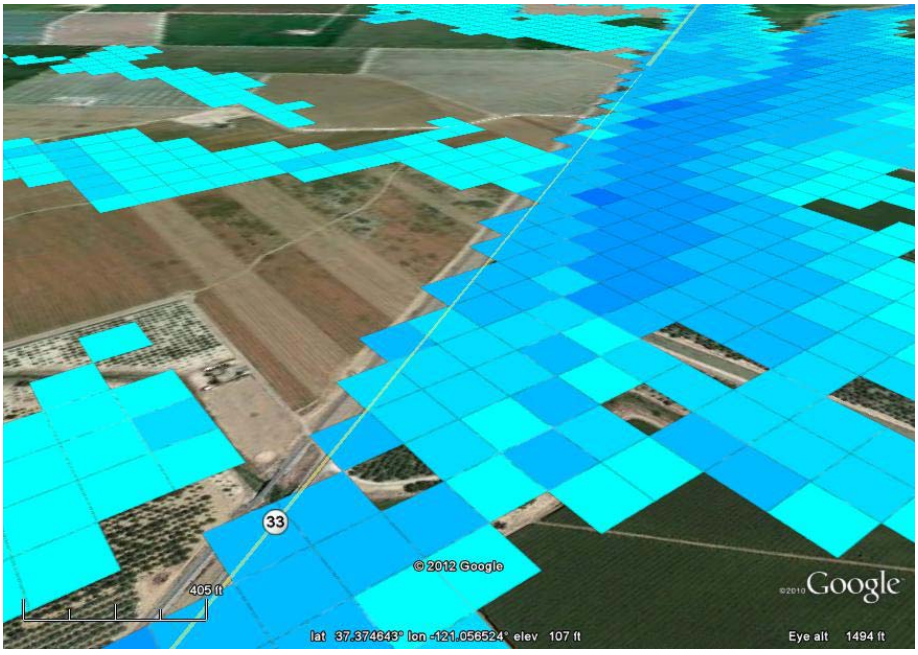
Only model depths greater than 0.5 feet shown. Depths less than 0.5 feet assumed to be transparent in observed flooding.

Source: Google Earth with FLO-2D depth overlay.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
FEBRUARY 1998 FLOOD
AERIAL OBLIQUE 3

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Notes:

Modeled elevation of CCID canal embankment is higher than existed at time of flood. Less canal overtopping is expected in model simulation.

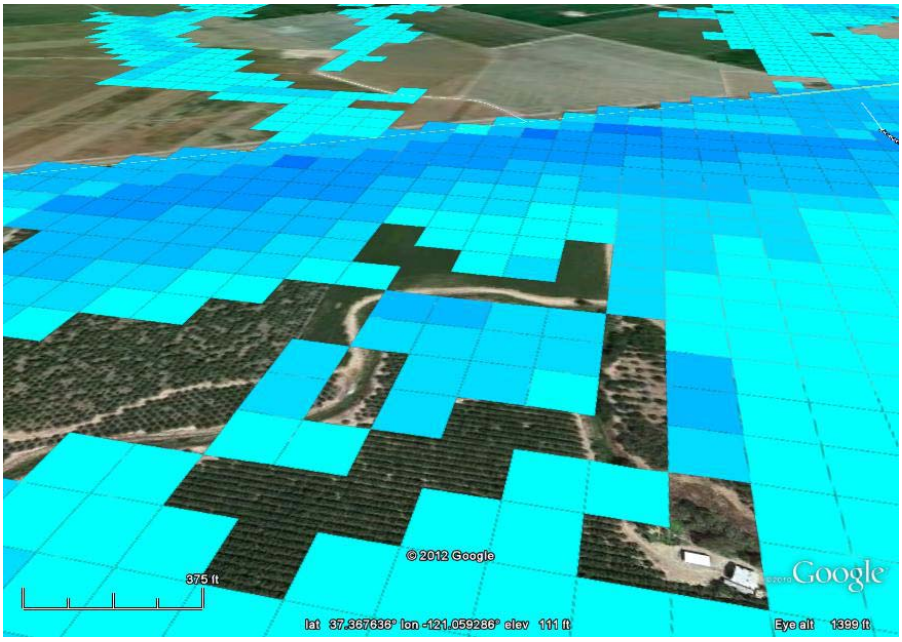
Only model depths greater than 0.5 feet shown. Depths less than 0.5 feet assumed to be transparent in observed flooding.

Source: Google Earth with FLO-2D depth overlay.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
FEBRUARY 1998 FLOOD
AERIAL OBLIQUE 4

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Notes:

Modeled elevation of CCID canal embankment is higher than existed at time of flood. Less canal overtopping is expected in model simulation.

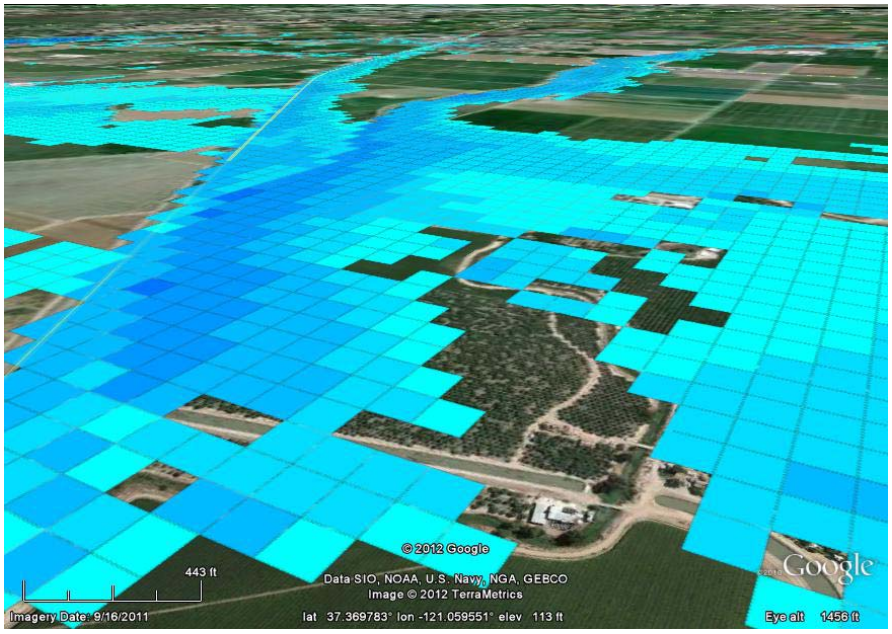
Only model depths greater than 0.5 feet shown. Depths less than 0.5 feet assumed to be transparent in observed flooding.

Source: Google Earth with FLO-2D depth overlay.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
FEBRUARY 1998 FLOOD
AERIAL OBLIQUE 5

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Notes:

Modeled elevation of CCID canal embankment is higher than existed at time of flood. Less canal overtopping is expected in model simulation.

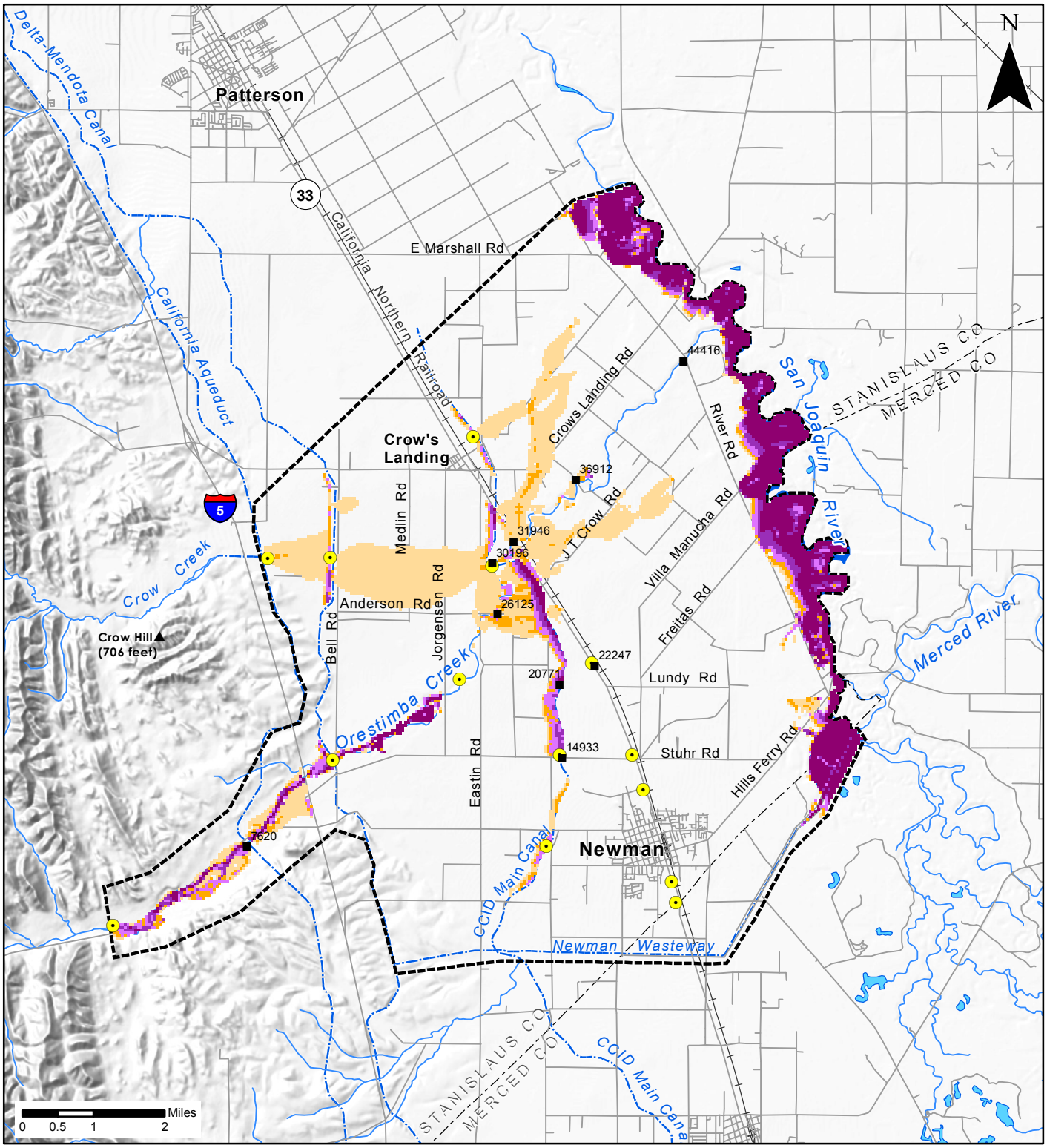
Only model depths greater than 0.5 feet shown. Depths less than 0.5 feet assumed to be transparent in observed flooding.

Source: Google Earth with FLO-2D depth overlay.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

MODEL VERIFICATION
FEBRUARY 1998 FLOOD
AERIAL OBLIQUE 6

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

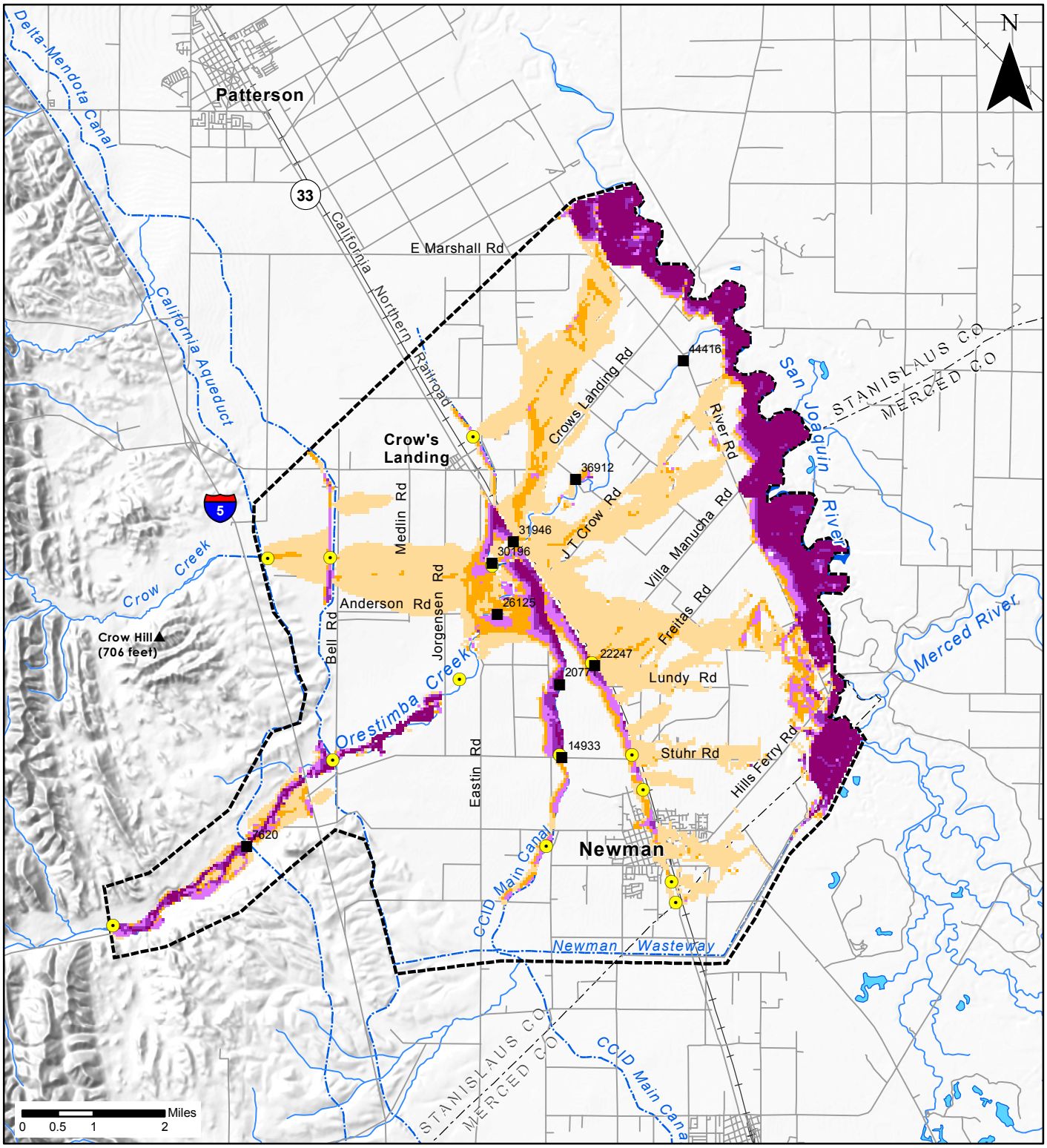
Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

EXISTING (WITHOUT-PROJECT) CONDITIONS

20% (1/5) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

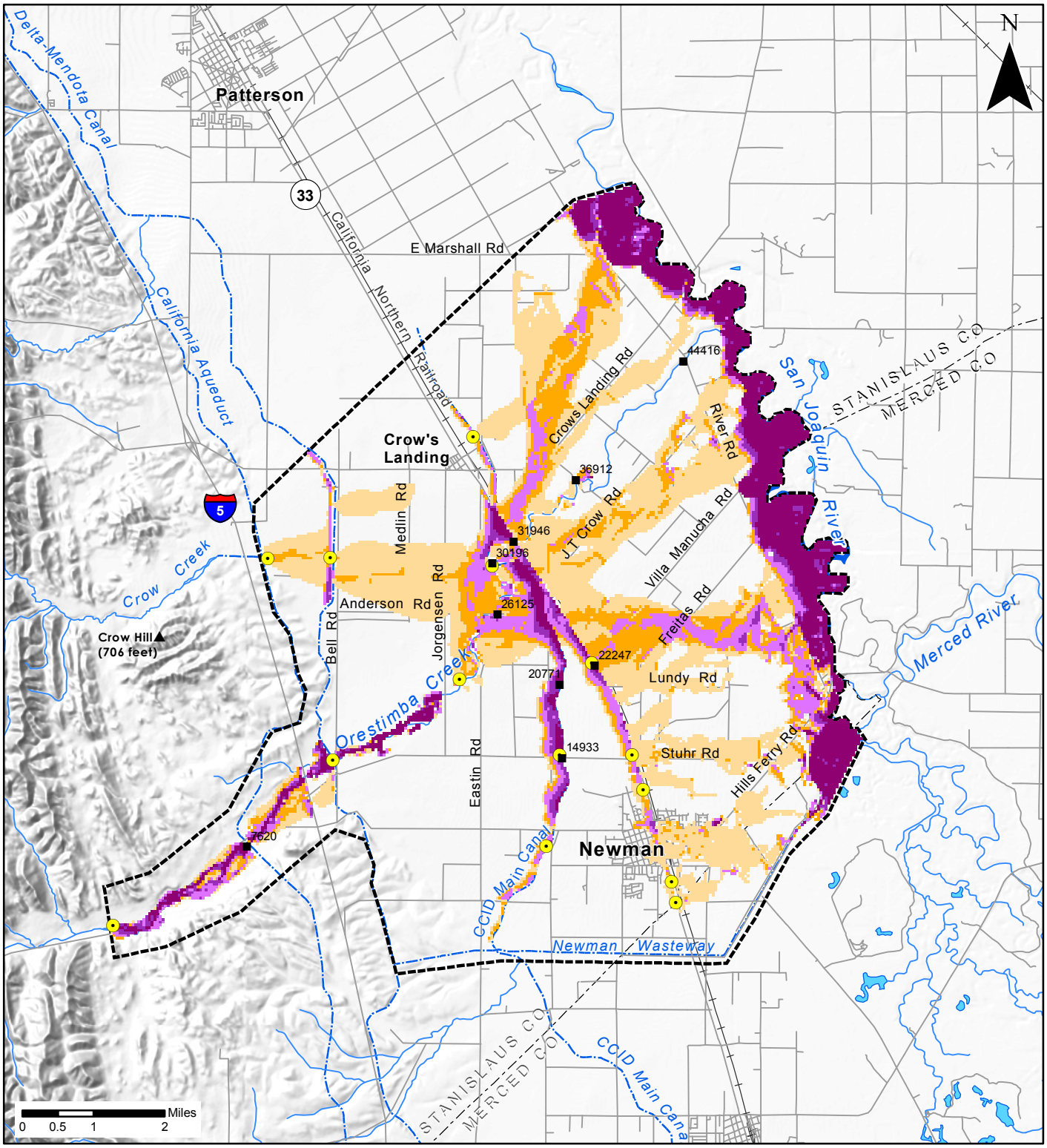
Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

EXISTING (WITHOUT-PROJECT) CONDITIONS

10% (1/10) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

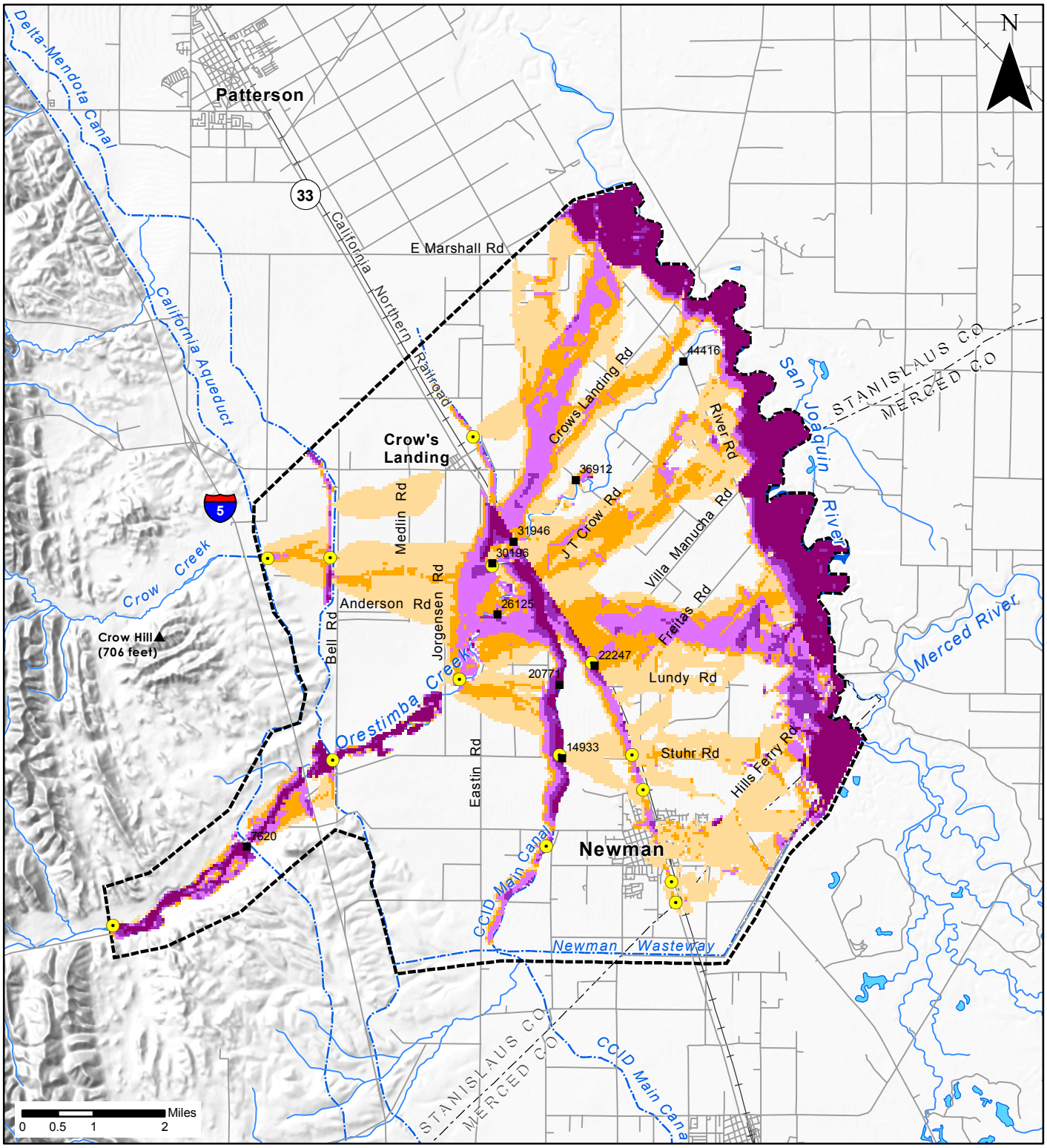
Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

EXISTING (WITHOUT-PROJECT) CONDITIONS

5% (1/20) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

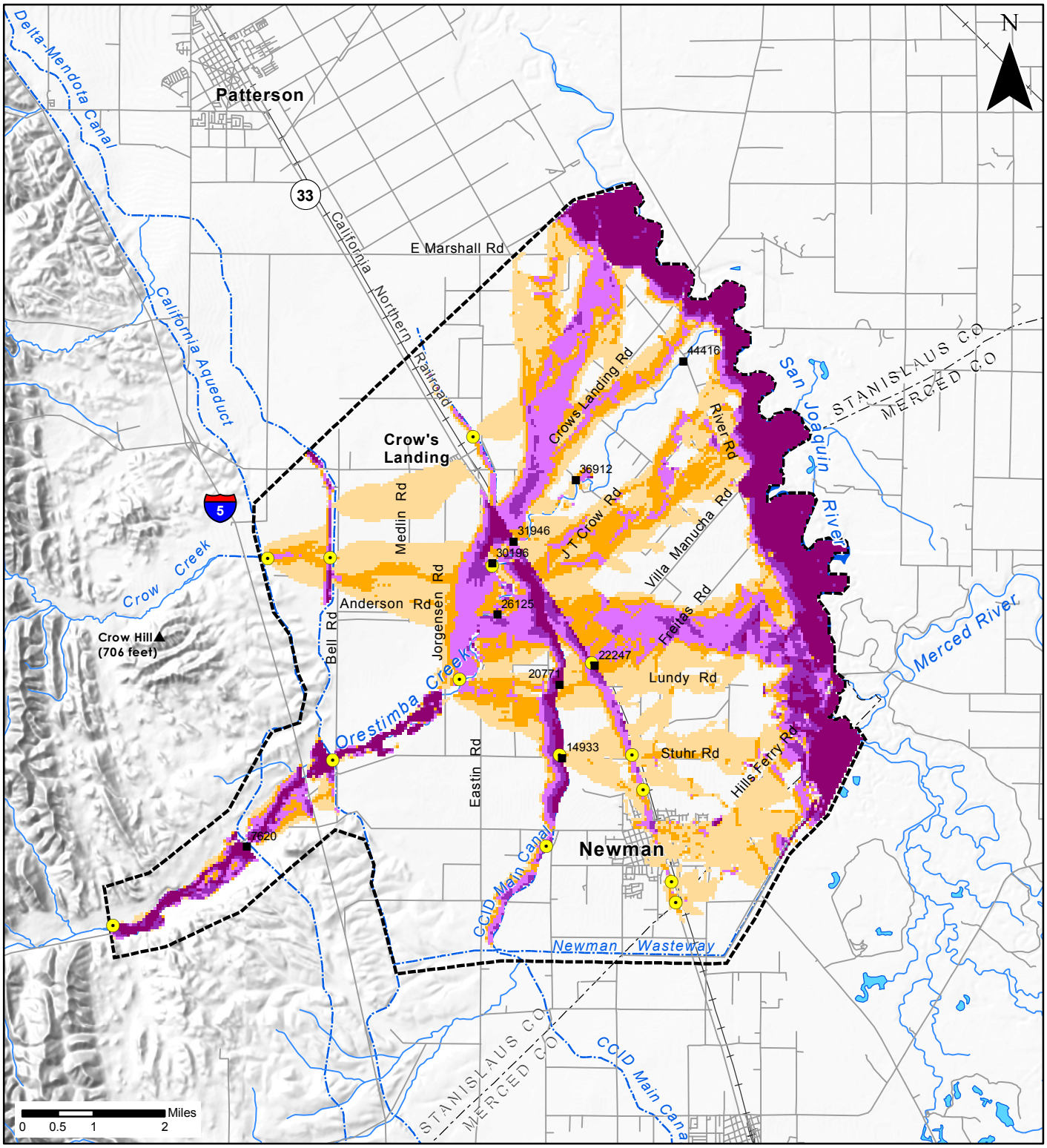
Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

EXISTING (WITHOUT-PROJECT) CONDITIONS

2% (1/50) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

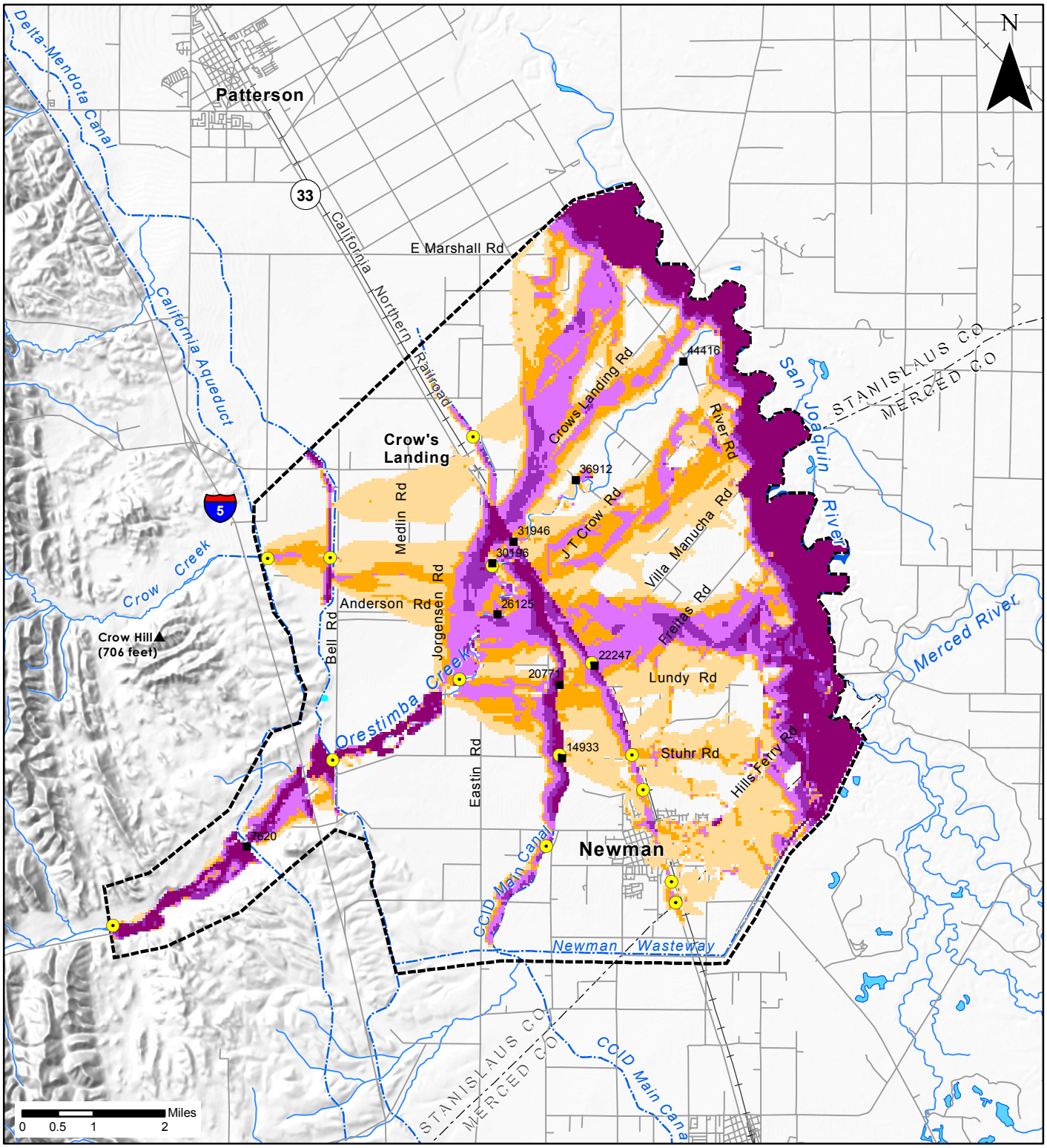
Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

EXISTING (WITHOUT-PROJECT) CONDITIONS

1% (1/100) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

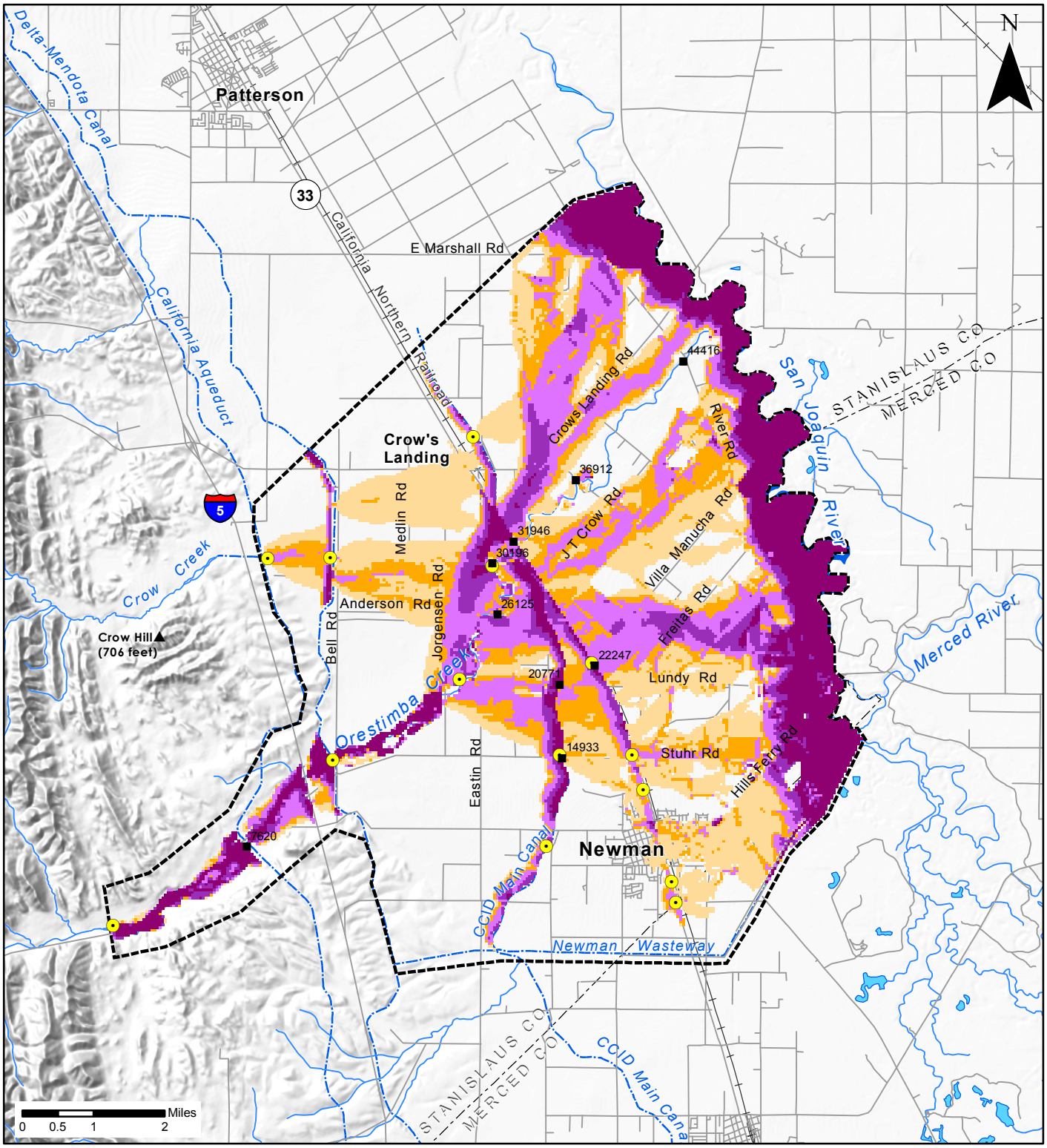
Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

EXISTING (WITHOUT-PROJECT) CONDITIONS

0.5% (1/200) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

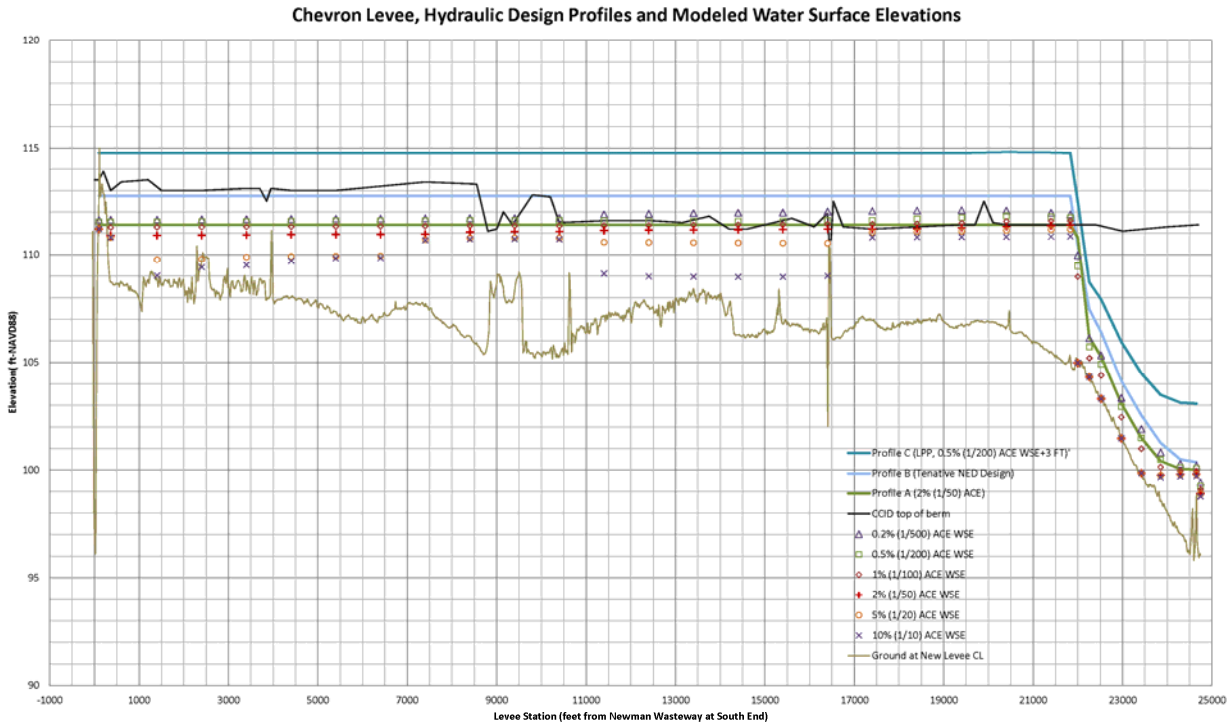
Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

EXISTING (WITHOUT-PROJECT) CONDITIONS

0.2% (1/500) ACE FLOOD EVENT

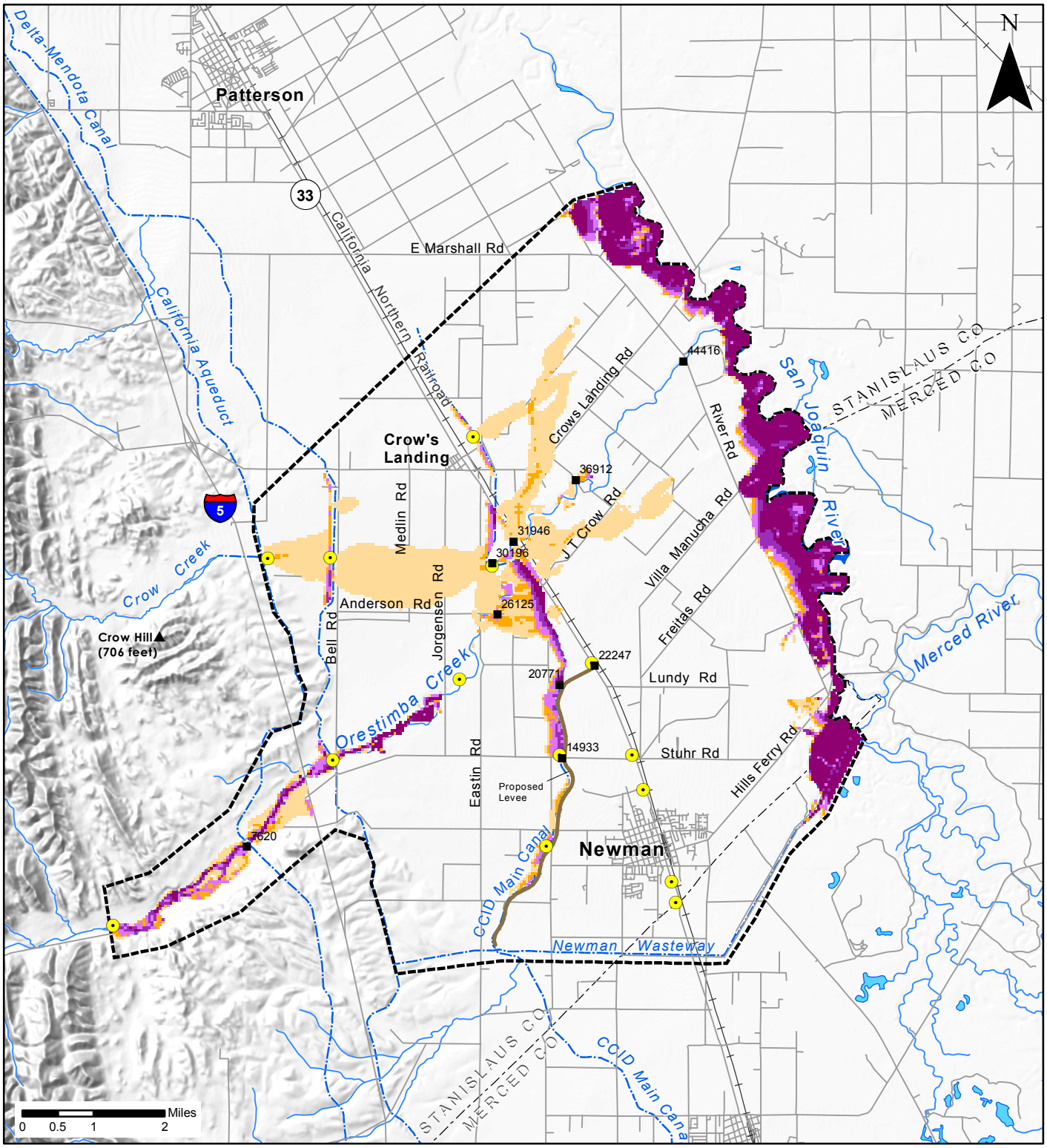
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE
HYDRAULIC DESIGN PROFILES

U.S ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

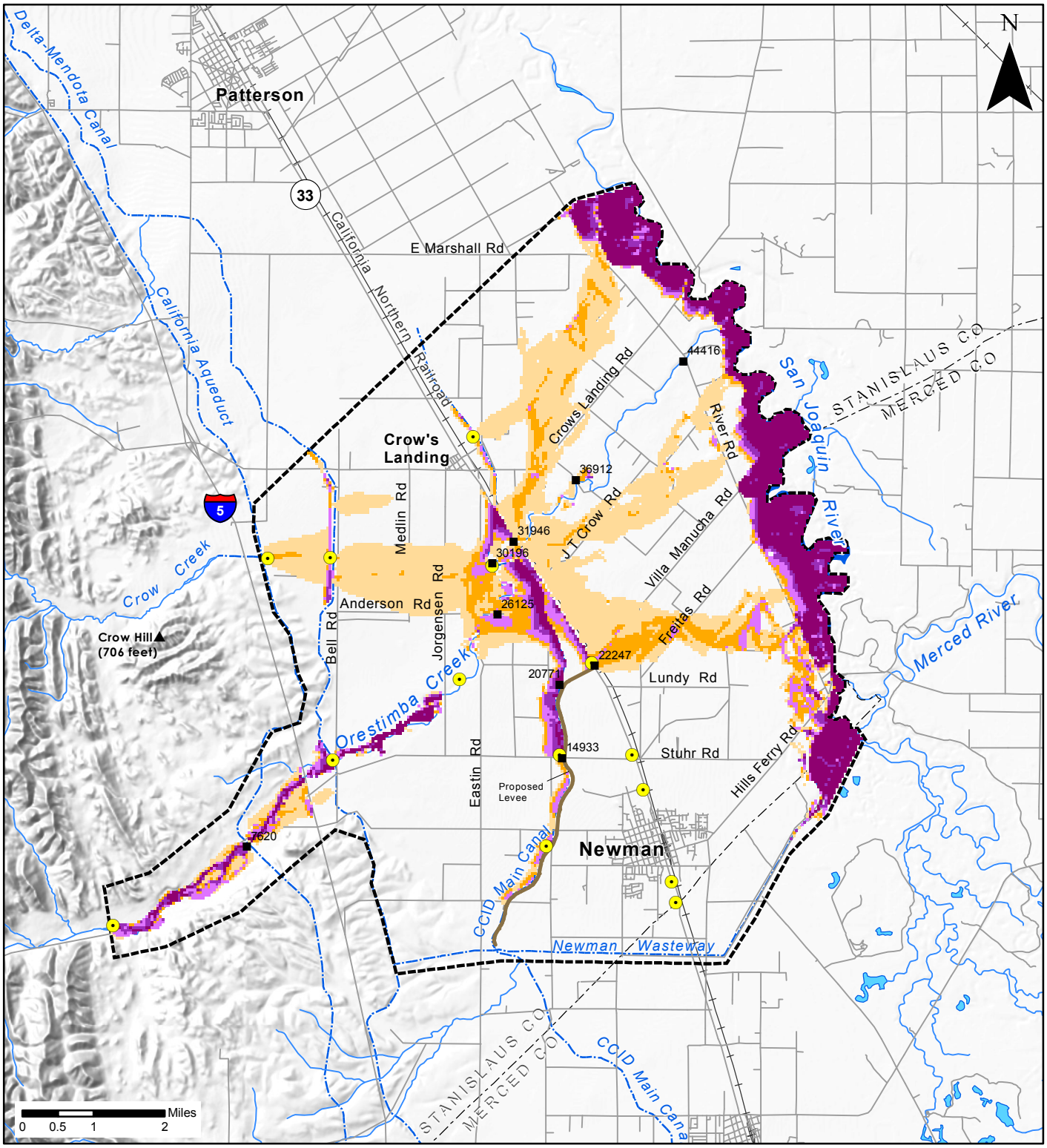
- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE
PROFILES B AND C
20% (1/5) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

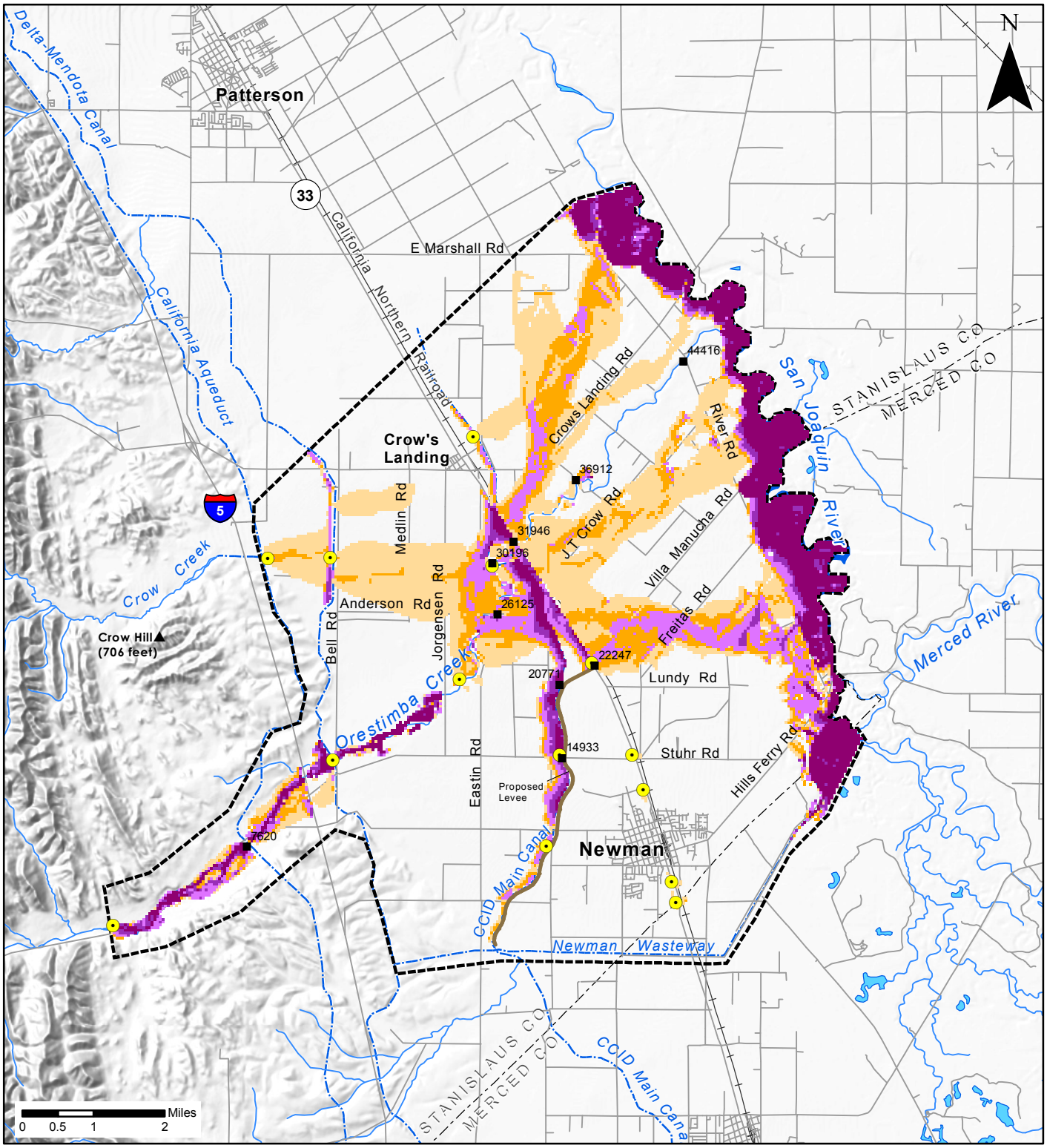
- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE
PROFILES B AND C
10% (1/10) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

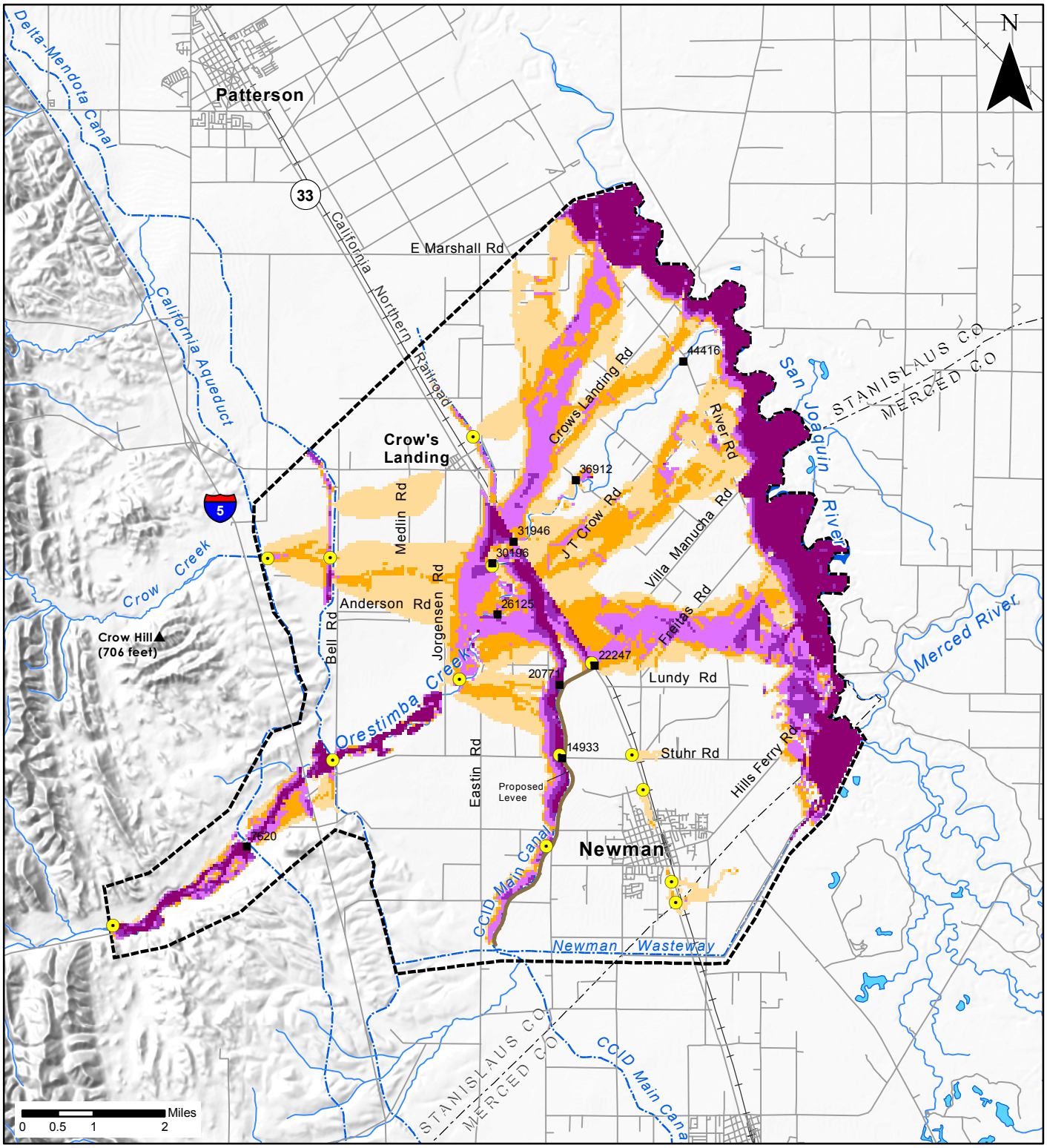
- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE
PROFILES B AND C
5% (1/20) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

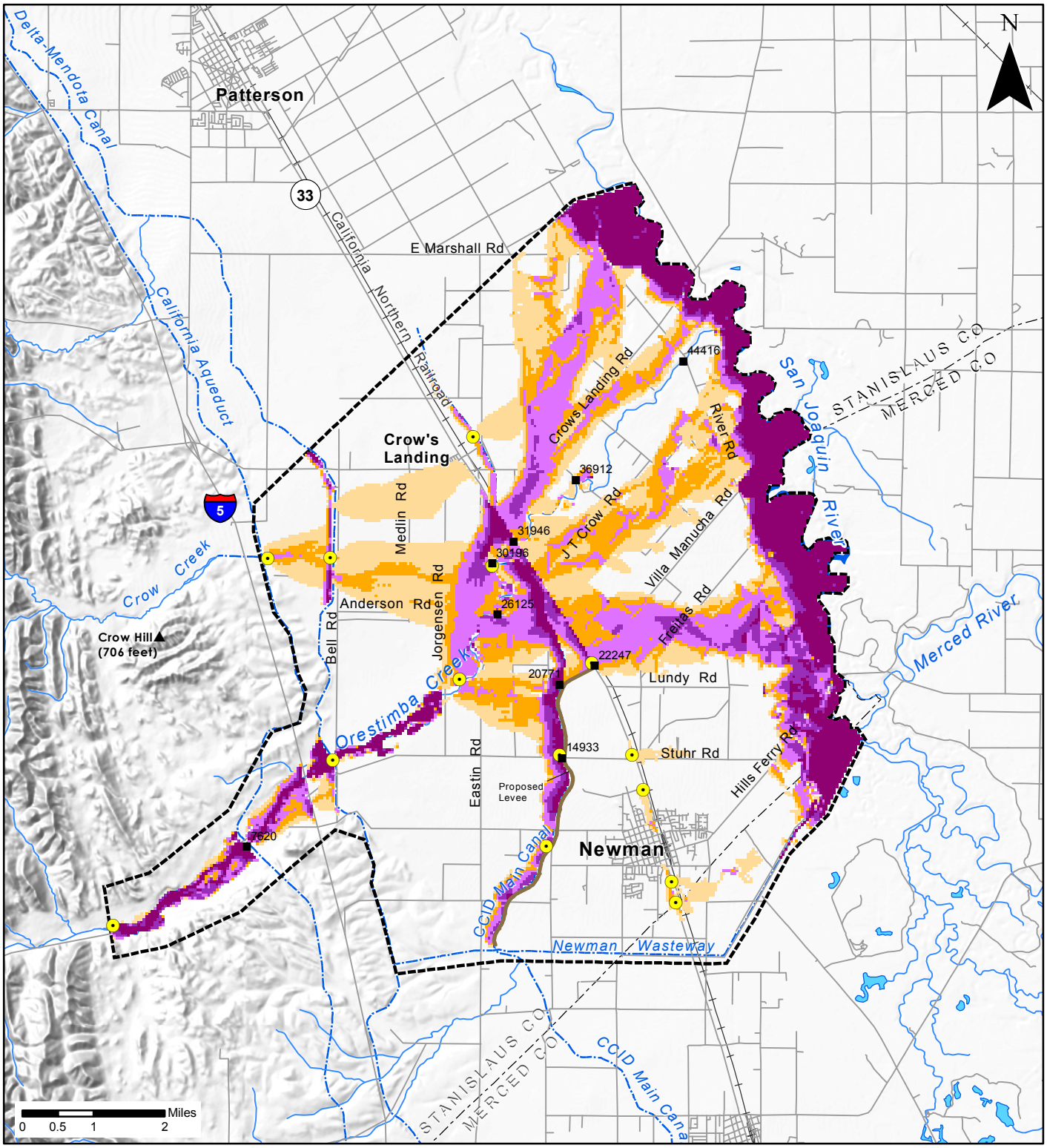
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE
PROFILES B AND C
2% (1/50) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

SEP 2012

PLATE 35



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

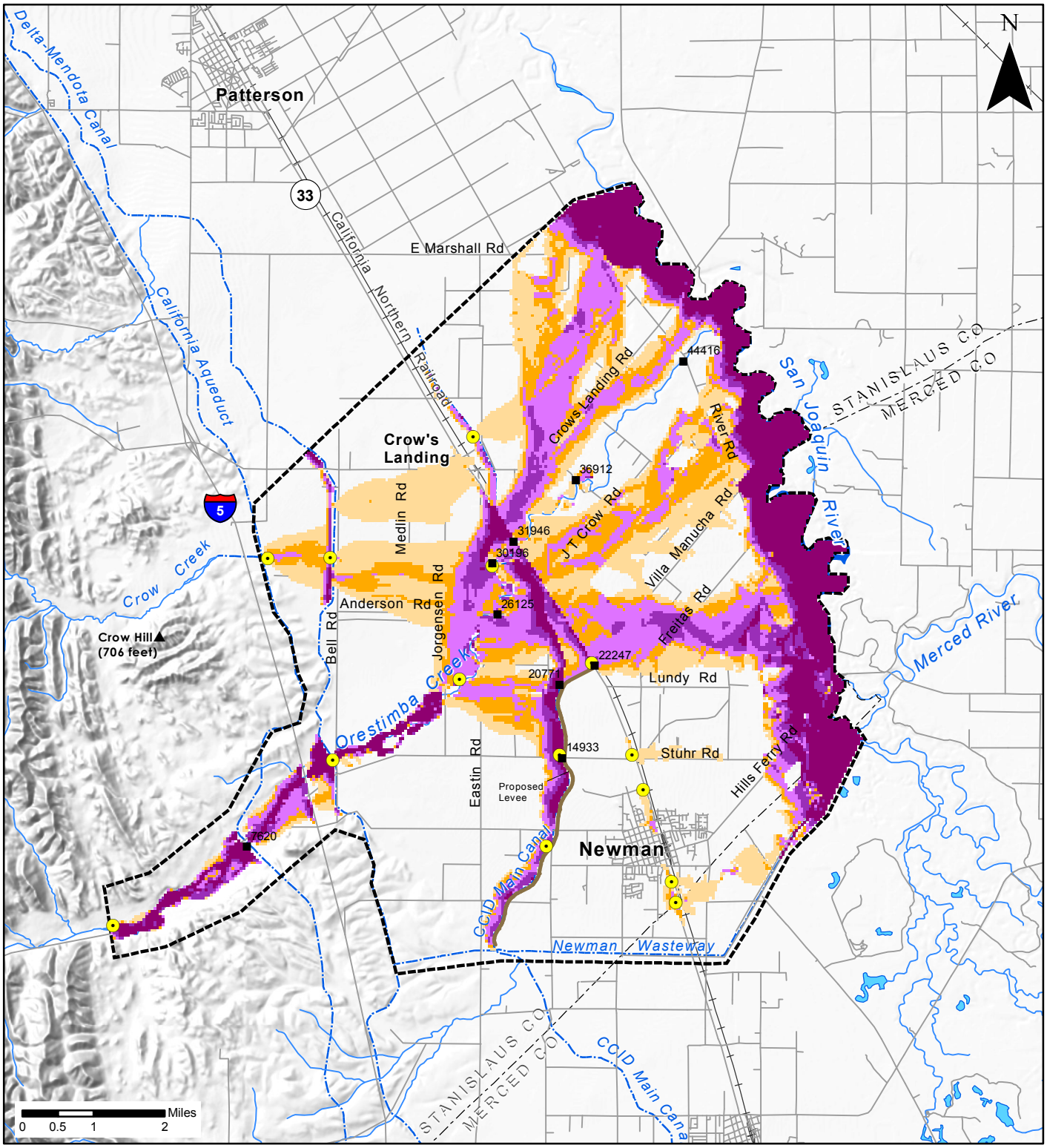
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE
PROFILES B AND C
1% (1/100) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

SEP 2012

PLATE 36



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

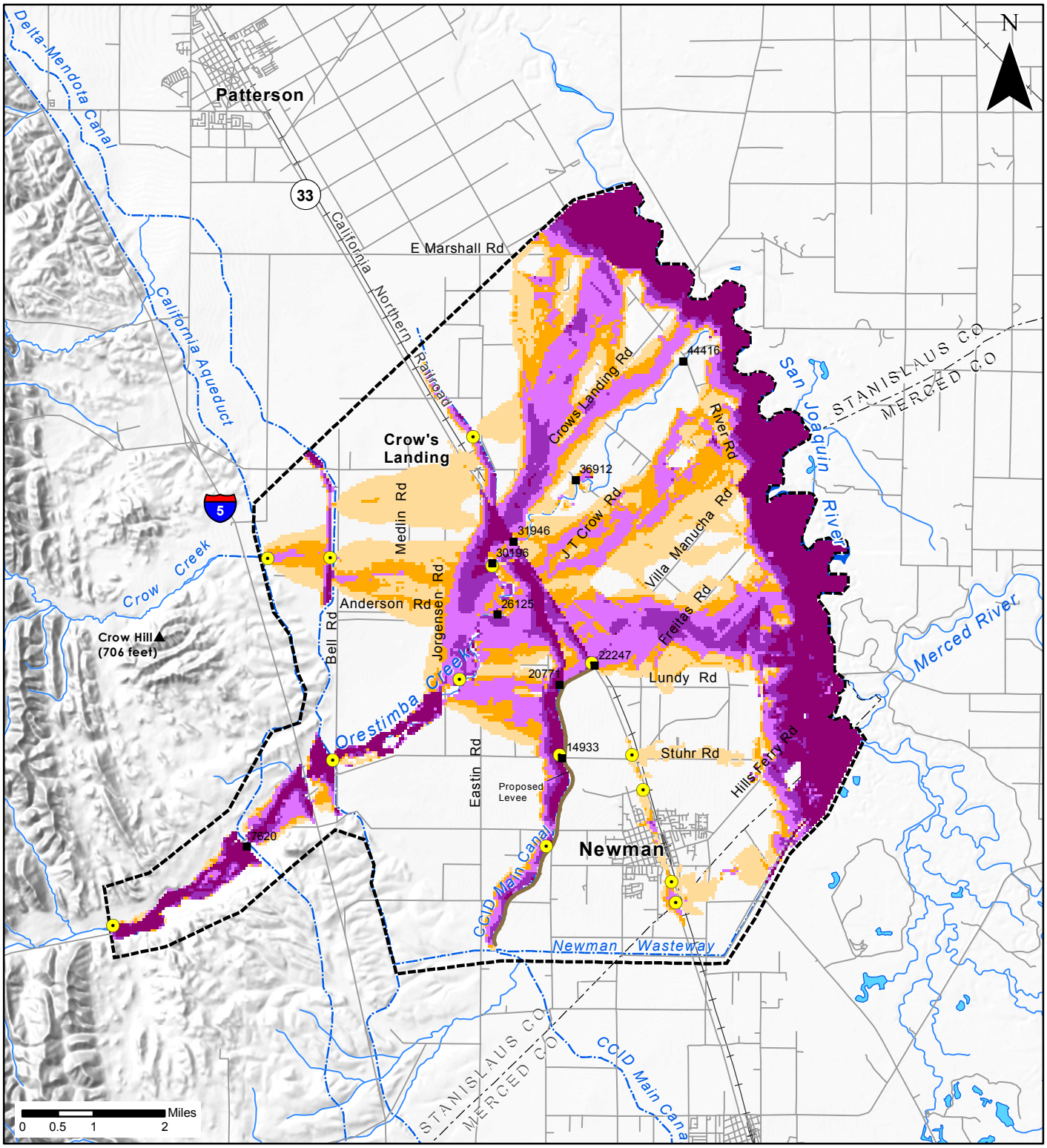
- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE
PROFILES B AND C
0.5% (1/200) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

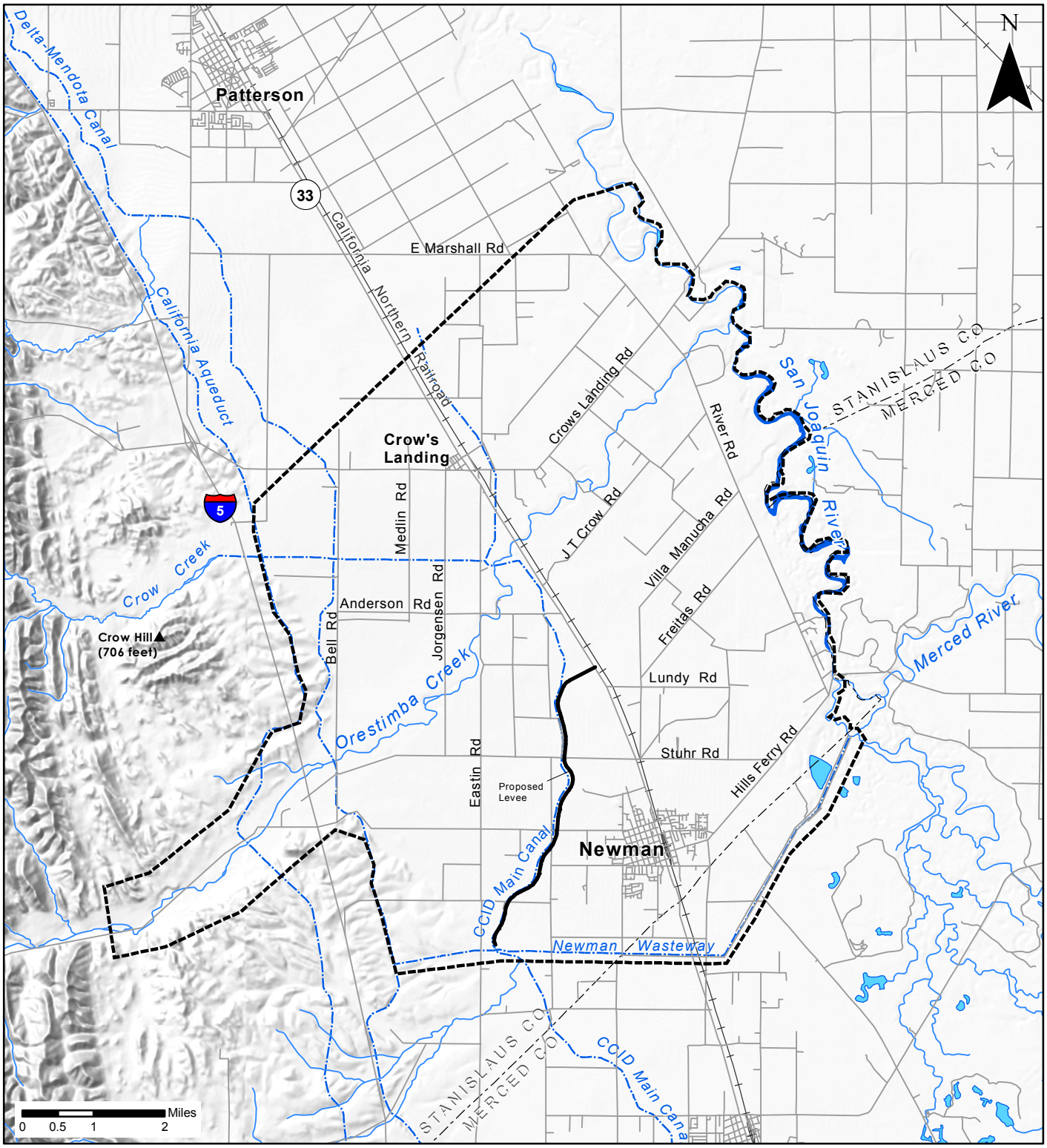
- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE
PROFILES B AND C
0.2% (1/500) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Avg Change (feet)

- -6 to -4
- -4 to -2
- -2 to -1
- -1 to -0.1
- no change
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0

Canal

Floodplain Mapping Extent

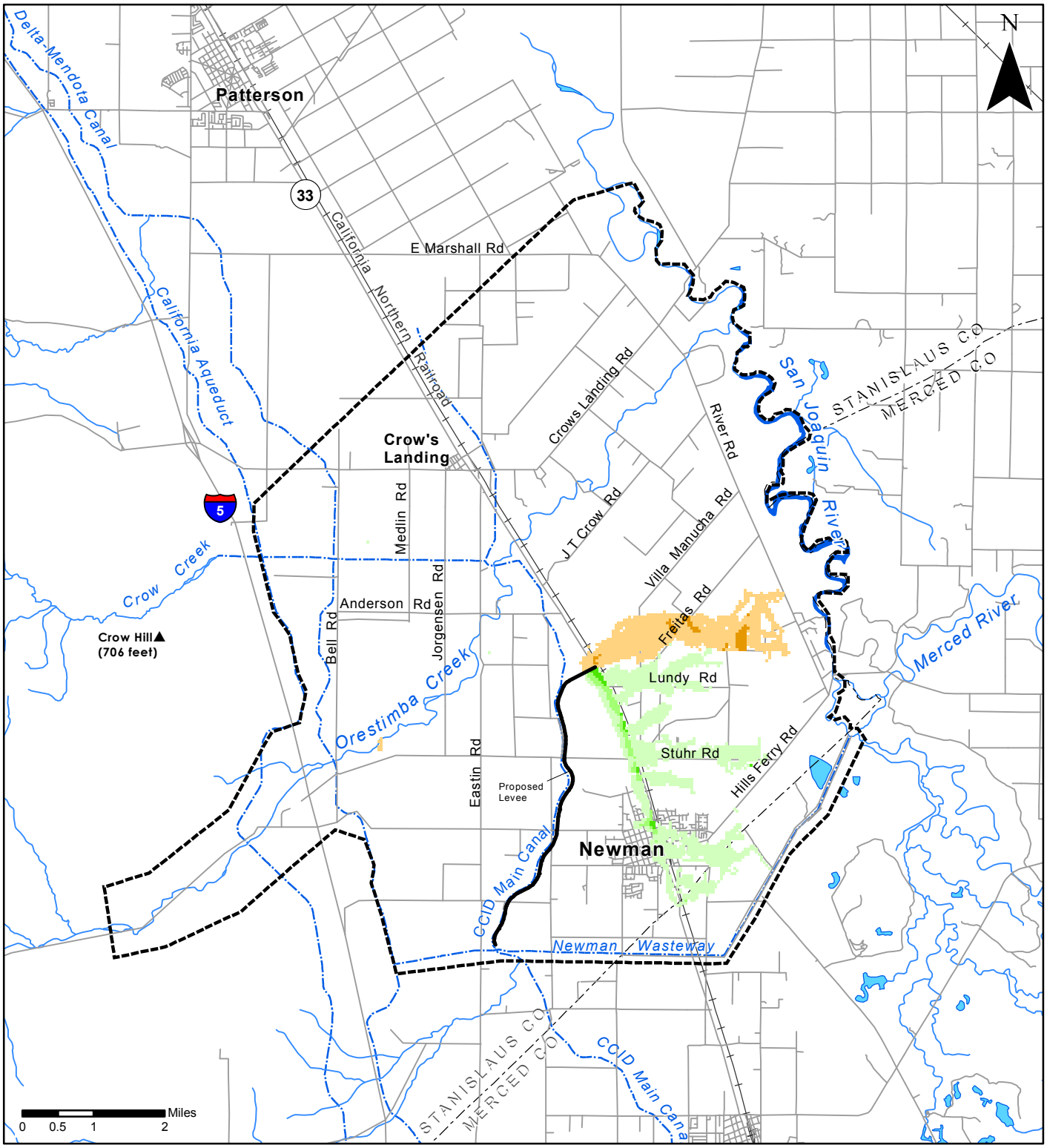
Chevron_Levee

Note: Impacts near Orestimba Creek are due to model instability.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
AVERAGE CHANGE IN FLOOD DEPTH
20% (1/5) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Avg Change (feet)

- -6 to -4
- -4 to -2
- -2 to -1
- -1 to -0.1
- no change
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0

Canal

Floodplain Mapping Extent

Chevron_Levee

Note: Impacts near Orestimba Creek are due to model instability.

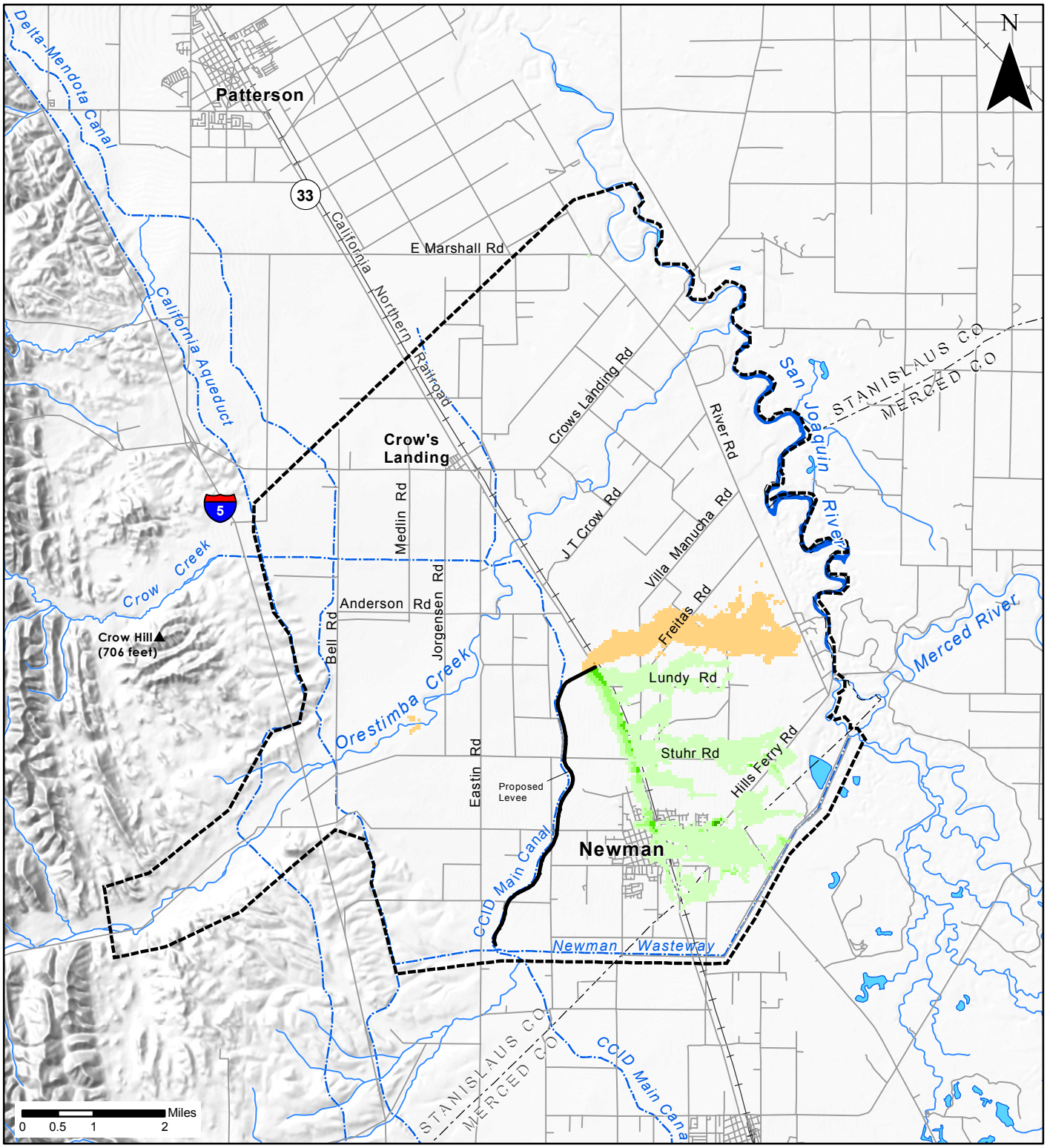
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILE B AND C
AVERAGE CHANGE IN FLOOD DEPTH
10% (1/10) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

SEP 2012

PLATE 40



Legend

Avg Change (feet)

- -6 to -4
- -4 to -2
- -2 to -1
- -1 to -0.1
- no change
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0

Canal

Floodplain Mapping Extent

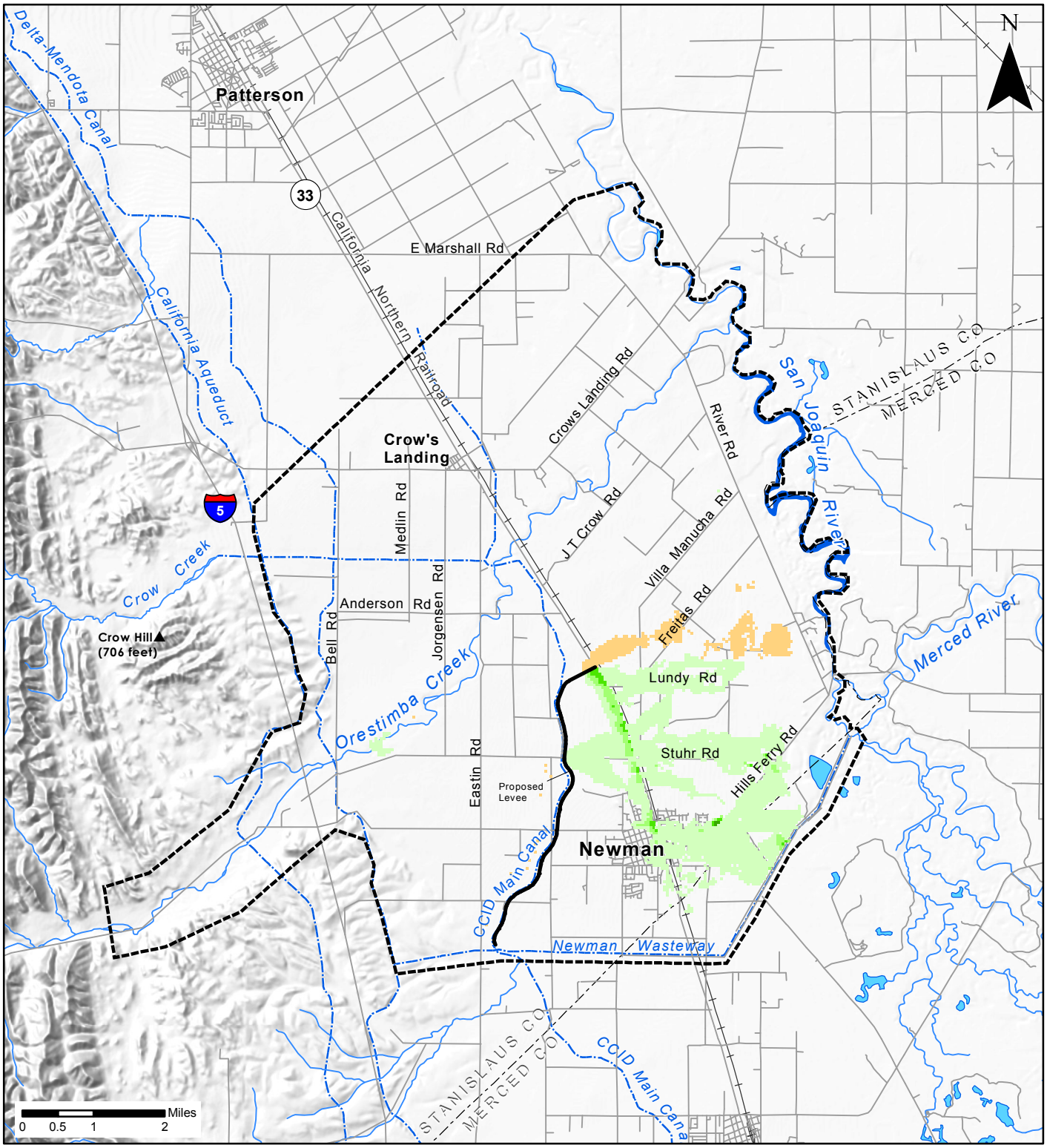
Chevron_Levee

Note: Impacts near Orestimba Creek are due to model instability.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
AVERAGE CHANGE IN FLOOD DEPTH
5% (1/20) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Avg Change (feet)

- -6 to -4
- -4 to -2
- -2 to -1
- -1 to -0.1
- no change
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0

Canal

Floodplain Mapping Extent

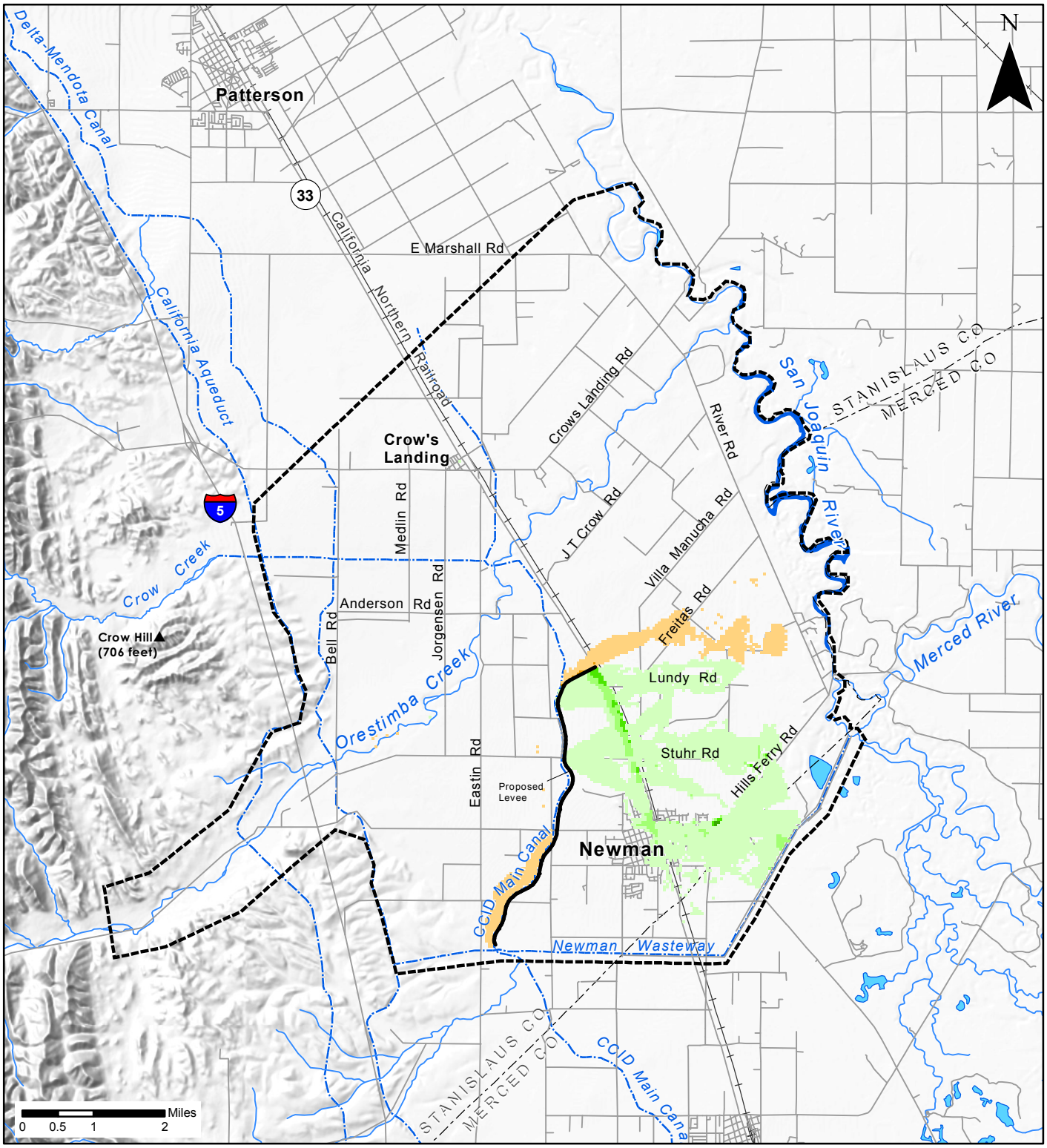
Chevron_Levee

Note: Impacts near Orestimba Creek are due to model instability.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
AVERAGE CHANGE IN FLOOD DEPTH
2% (1/50) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



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- Canal
- Floodplain Mapping Extent
- Chevron_Levee

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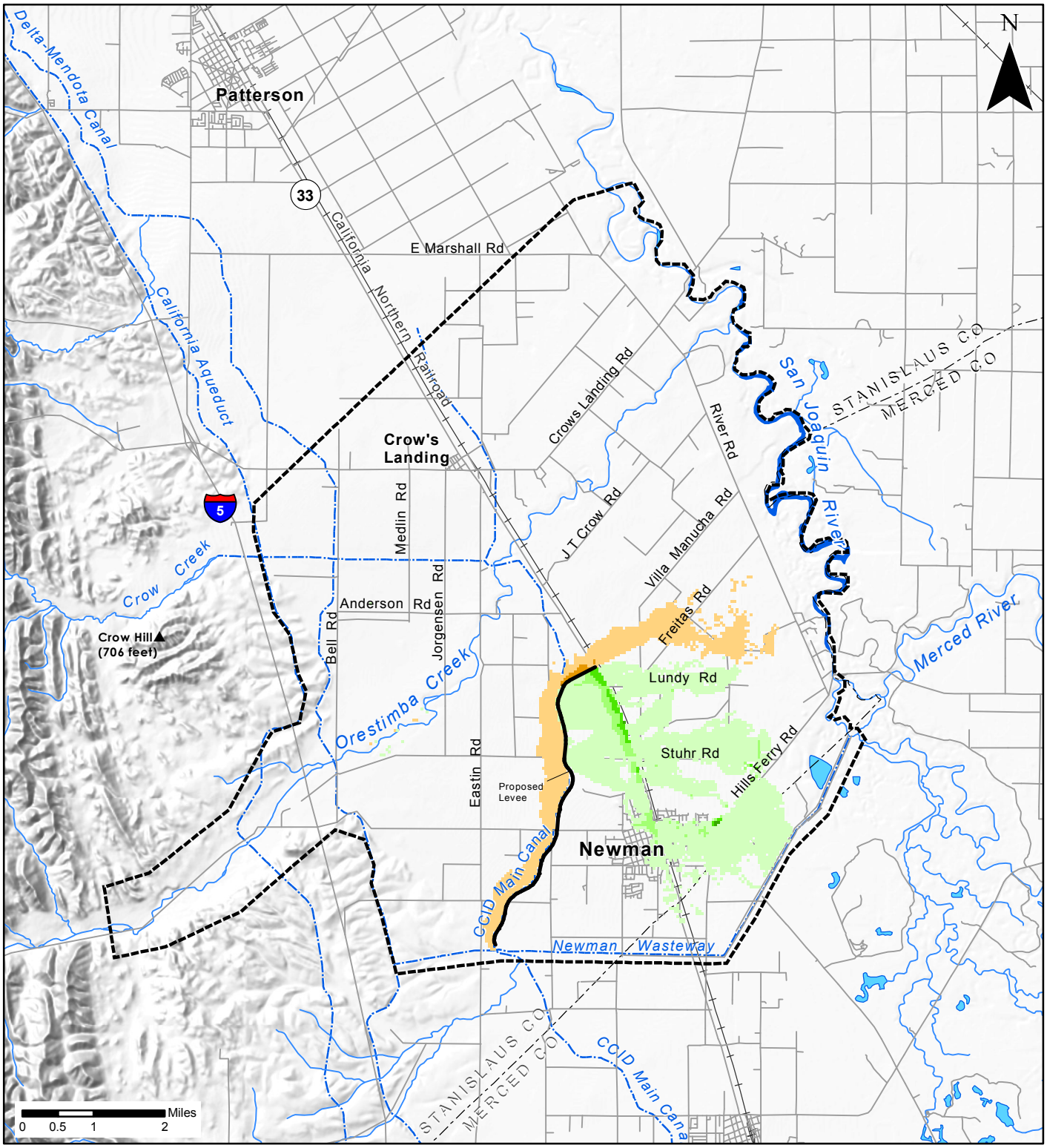
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
AVERAGE CHANGE IN FLOOD DEPTH
1% (1/100) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



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Canal

Floodplain Mapping Extent

Chevron_Levee

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ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
AVERAGE CHANGE IN FLOOD DEPTH
0.5% (1/200) ACE FLOOD EVENT

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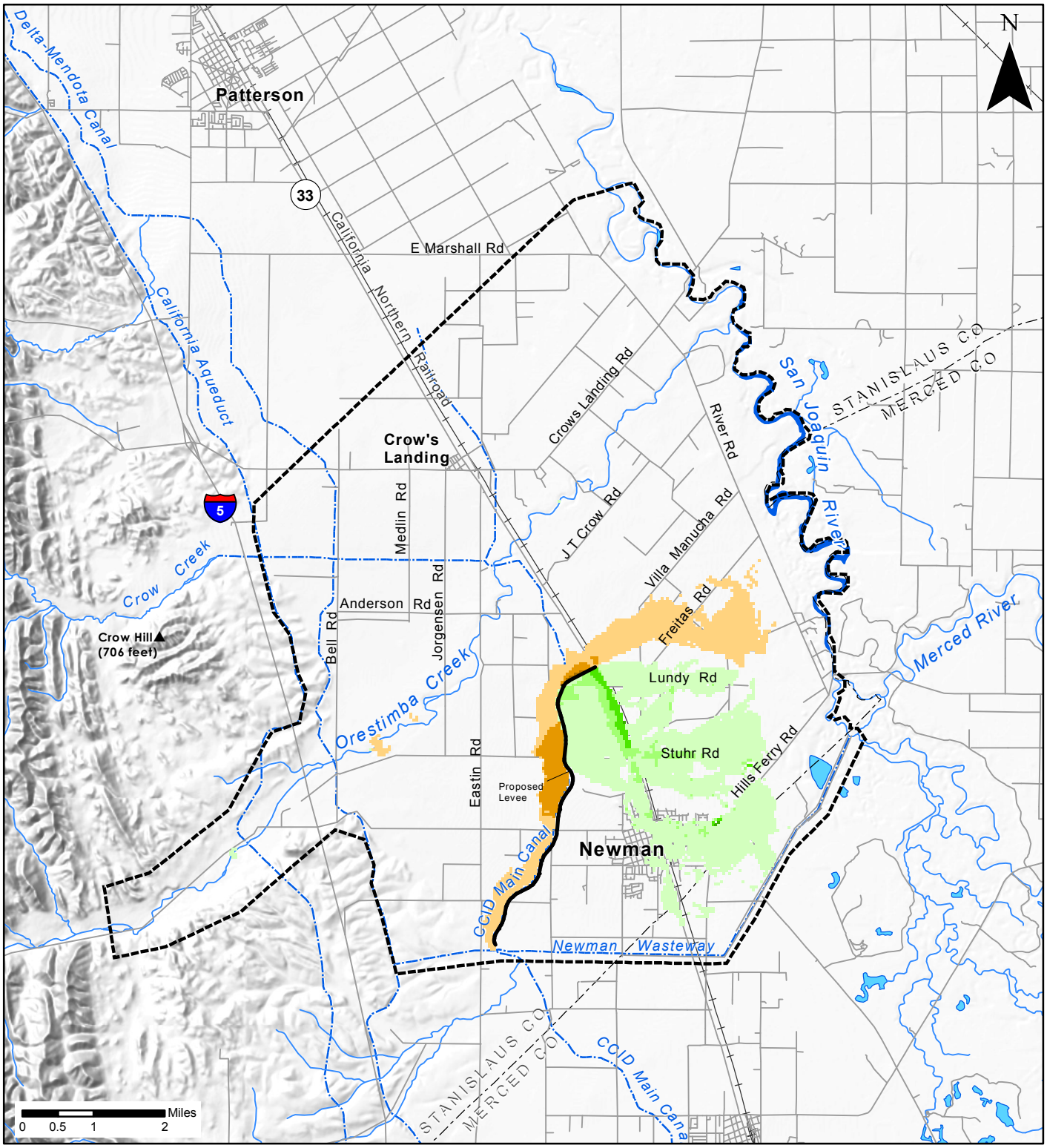

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Canal

Floodplain Mapping Extent

Chevron_Levee

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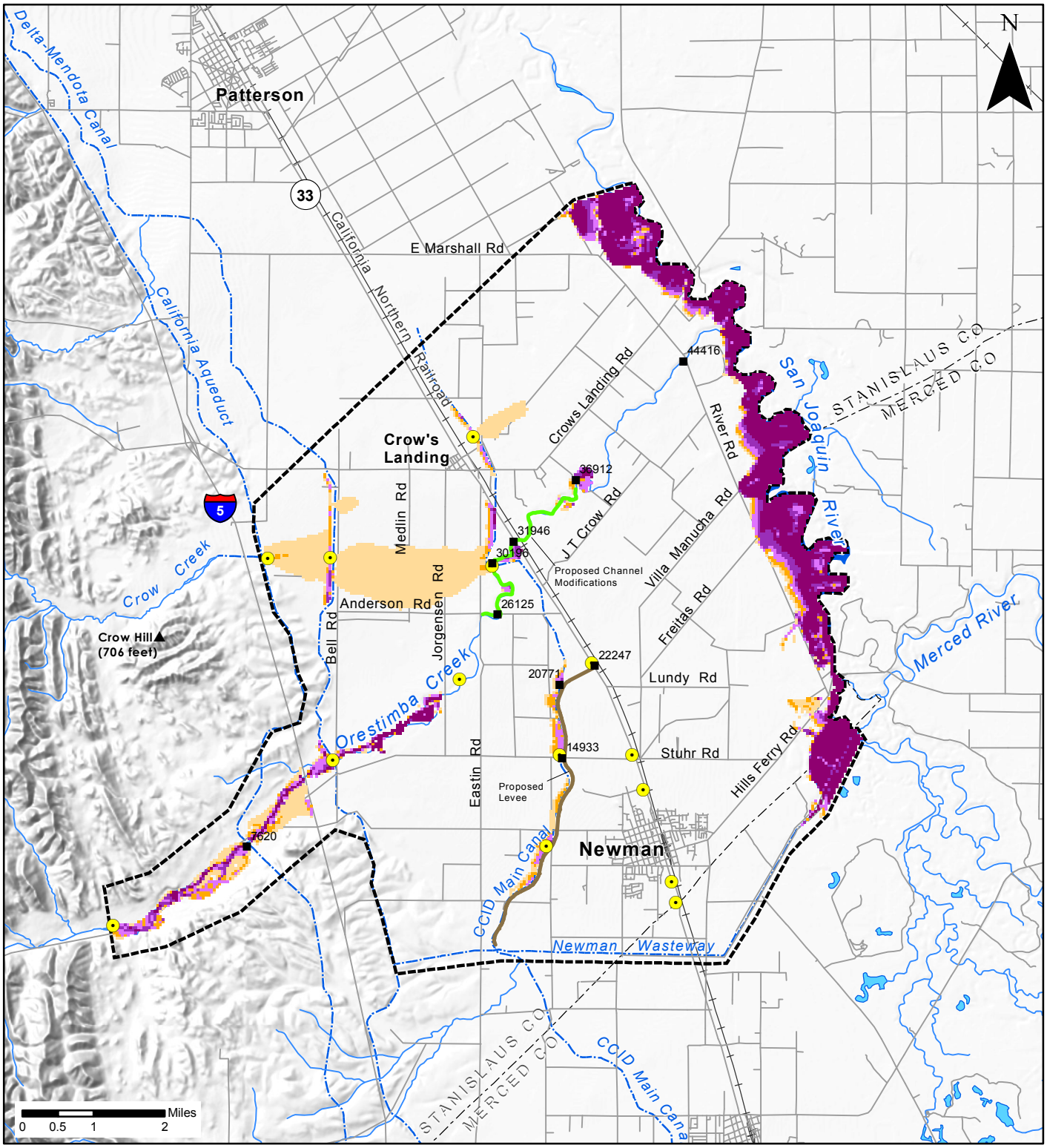
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
CHANGE IN FLOOD DEPTH
0.2% (1/500) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



Legend

Inundation Depth (feet):

- 0.100 - 0.500
- 0.501 - 1.000
- 1.001 - 2.000
- 2.001 - 3.000
- Greater than 3

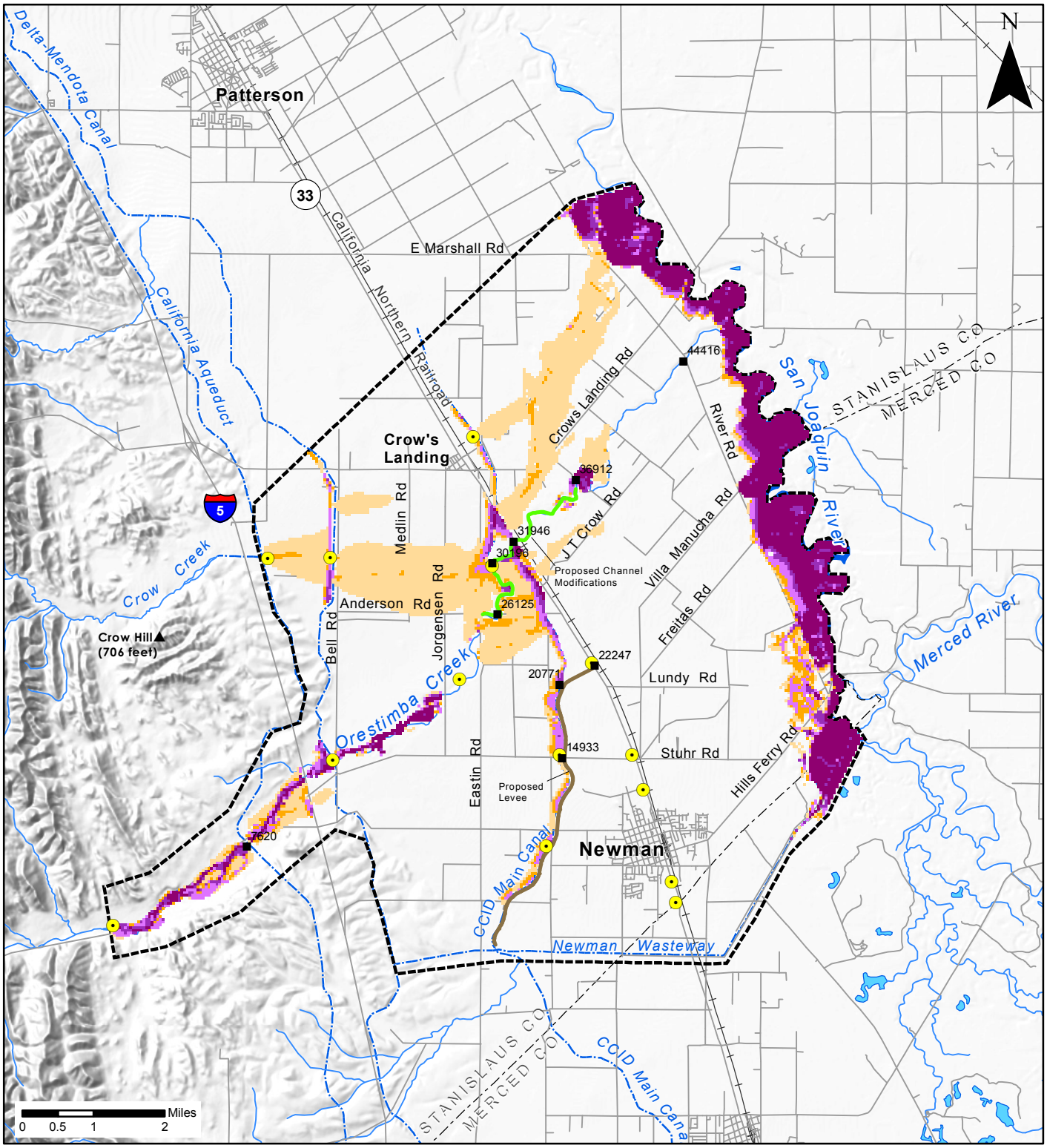
- Economic Index Point
- Inflow Node
- Canal
- Floodplain Mapping Extent

Note: Below Jorgensen Rd. in-channel flow depths are not shown.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
WITH 3,500CFS CHANNEL MODIFICATIONS
20% (1/5) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



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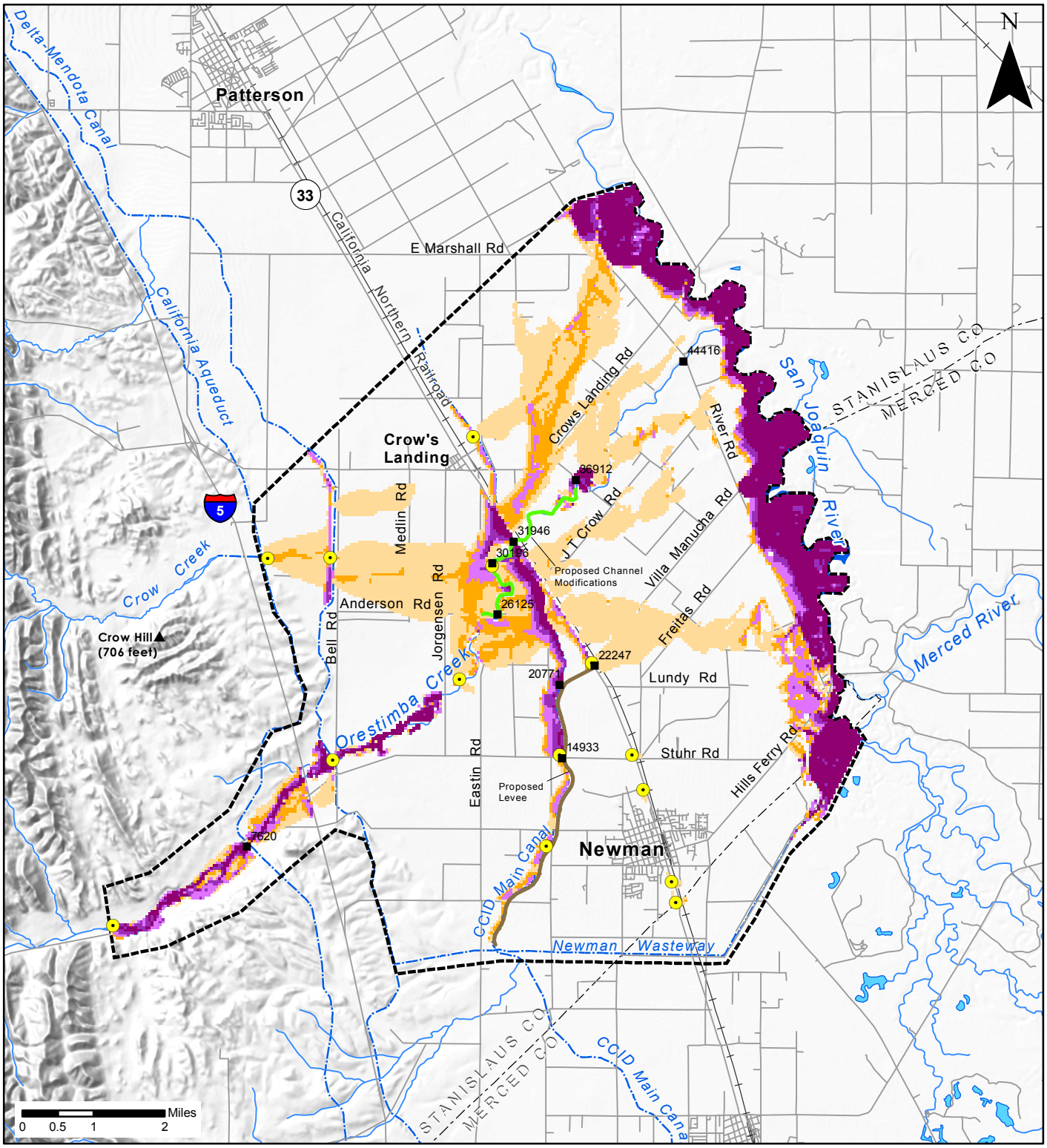
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
WITH 3,500 CFS CHANNEL MODIFICATIONS
10% (1/10) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



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FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
WITH 3,500 CFS CHANNEL MODIFICATIONS
5% (1/20) ACE FLOOD EVENT

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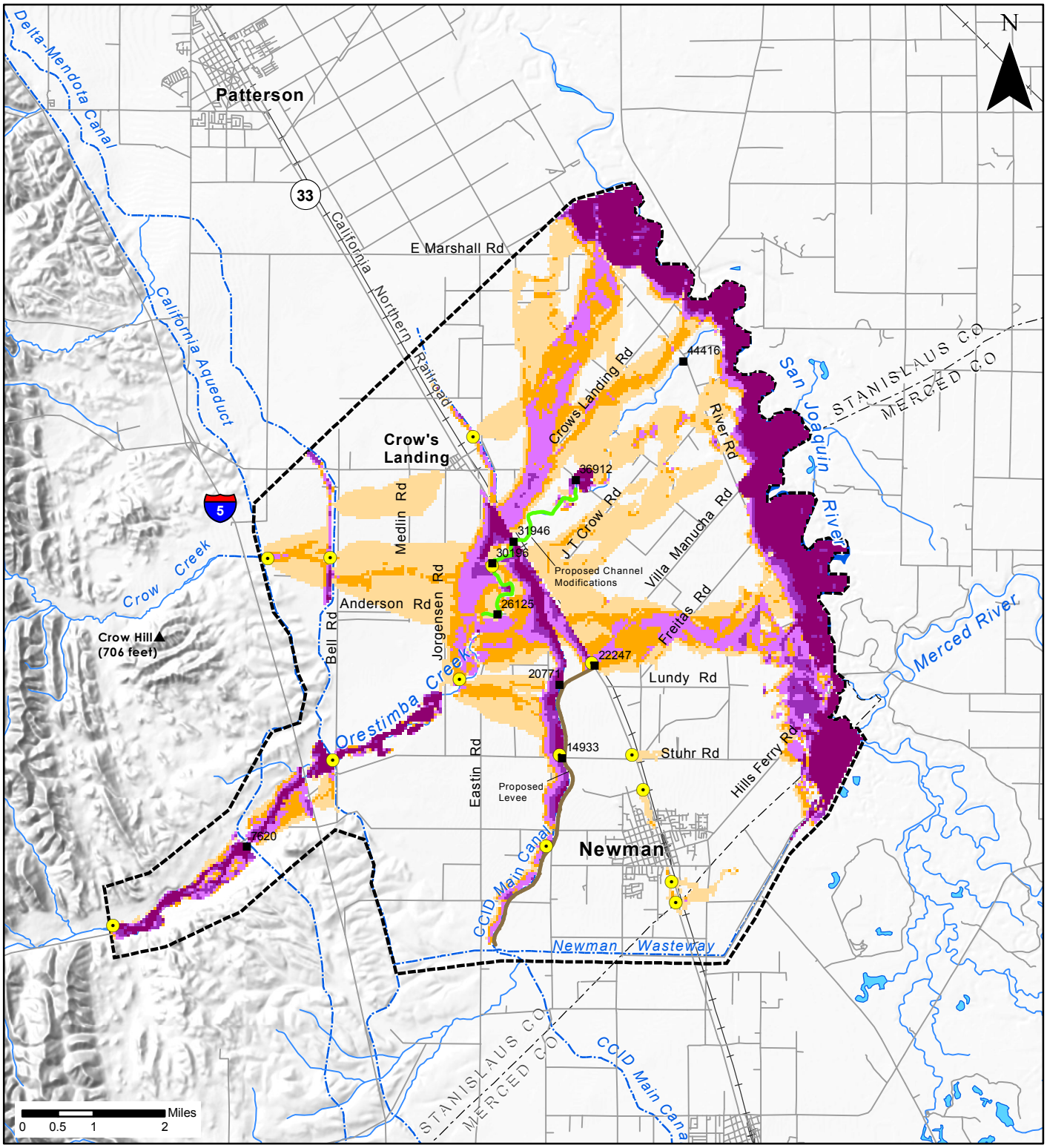
SACRAMENTO DISTRICT



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WITH 3,500CFS CHANNEL MODIFICATIONS
2% (1/50) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
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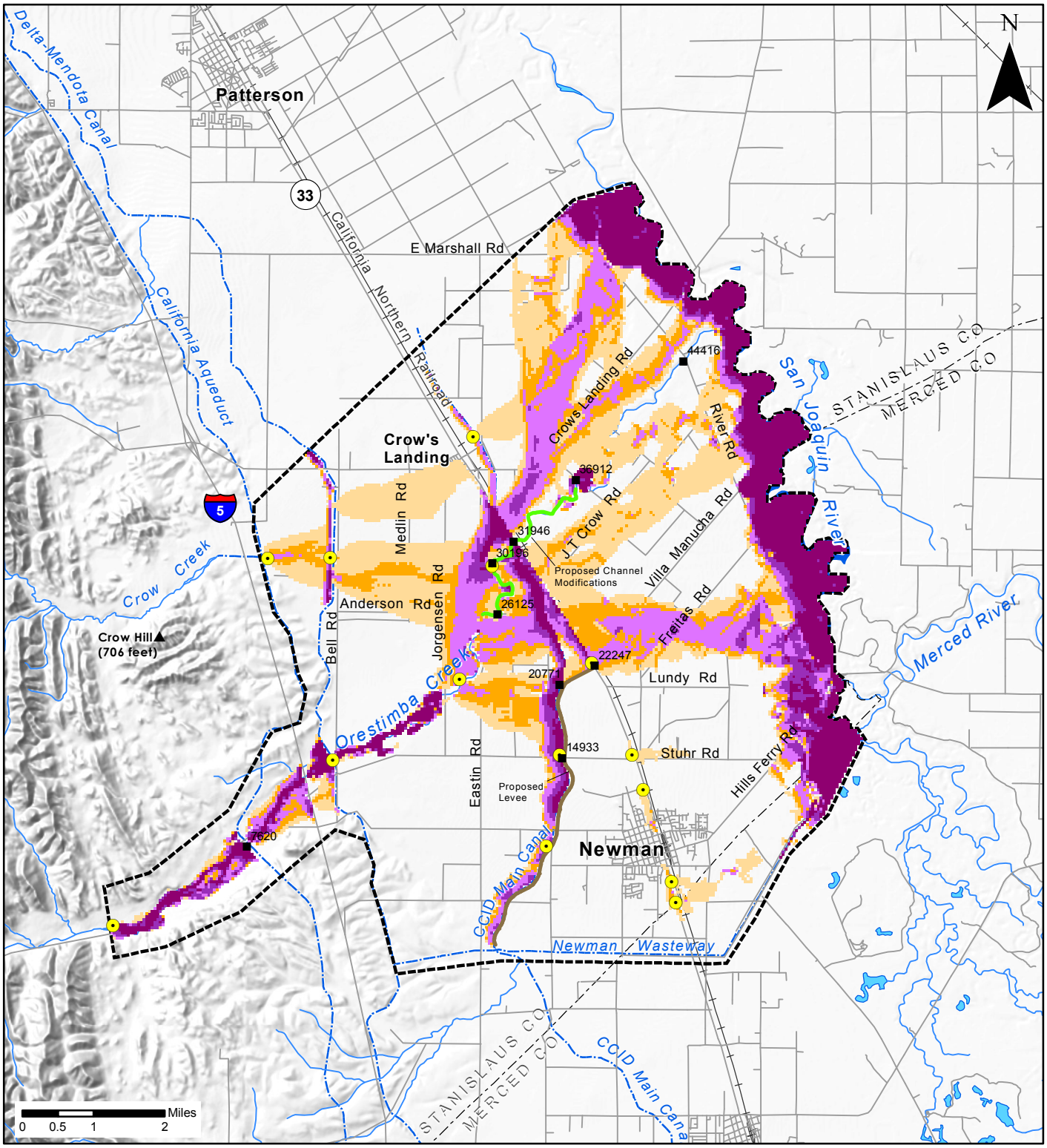

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FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
WITH 3,500 CFS CHANNEL MODIFICATIONS
1% (1/100) ACE FLOOD EVENT

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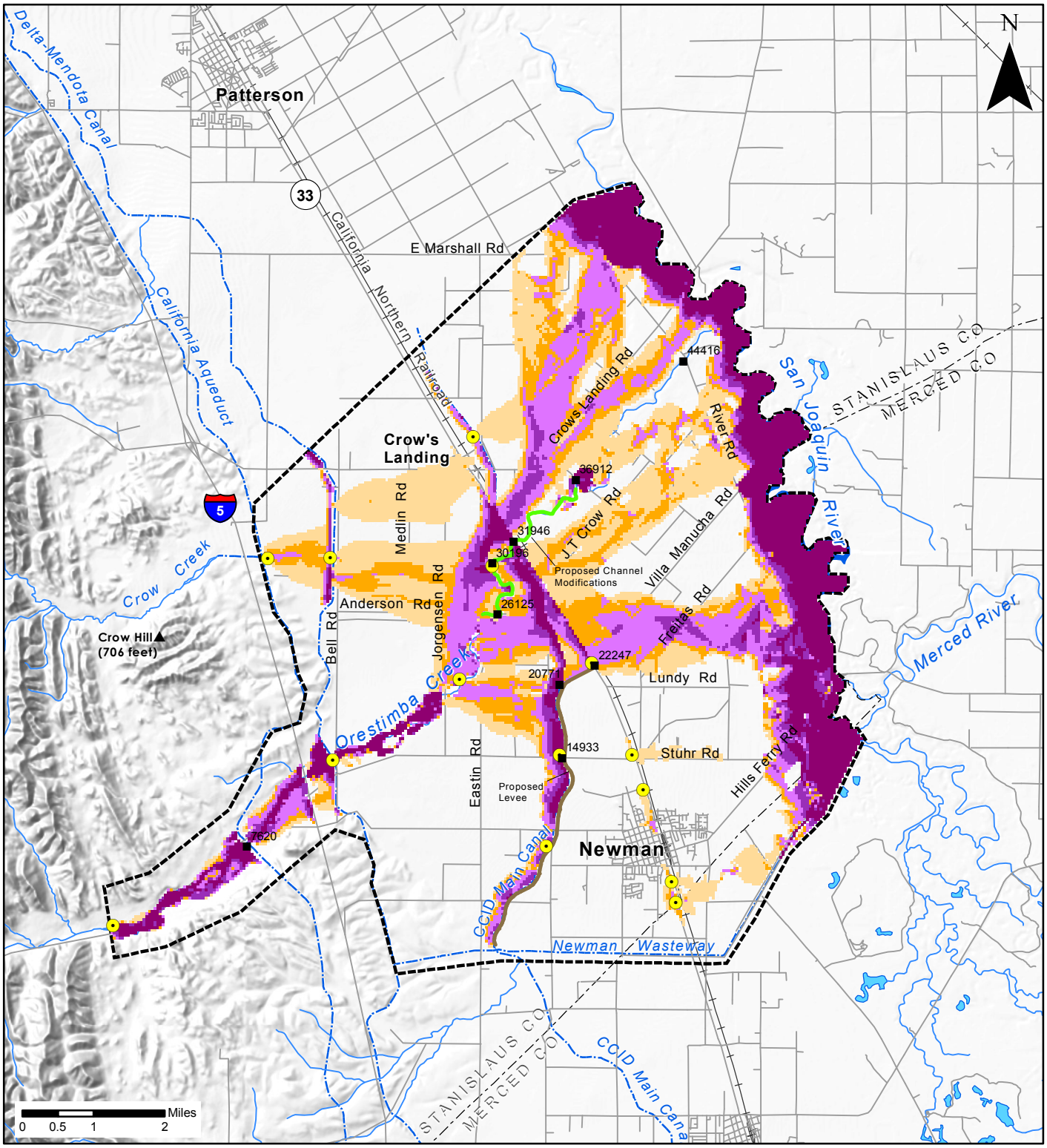
SACRAMENTO DISTRICT



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FEASIBILITY STUDY

CHEVRON LEVEE -PROFILES B AND C
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0.5% (1/200) ACE FLOOD EVENT

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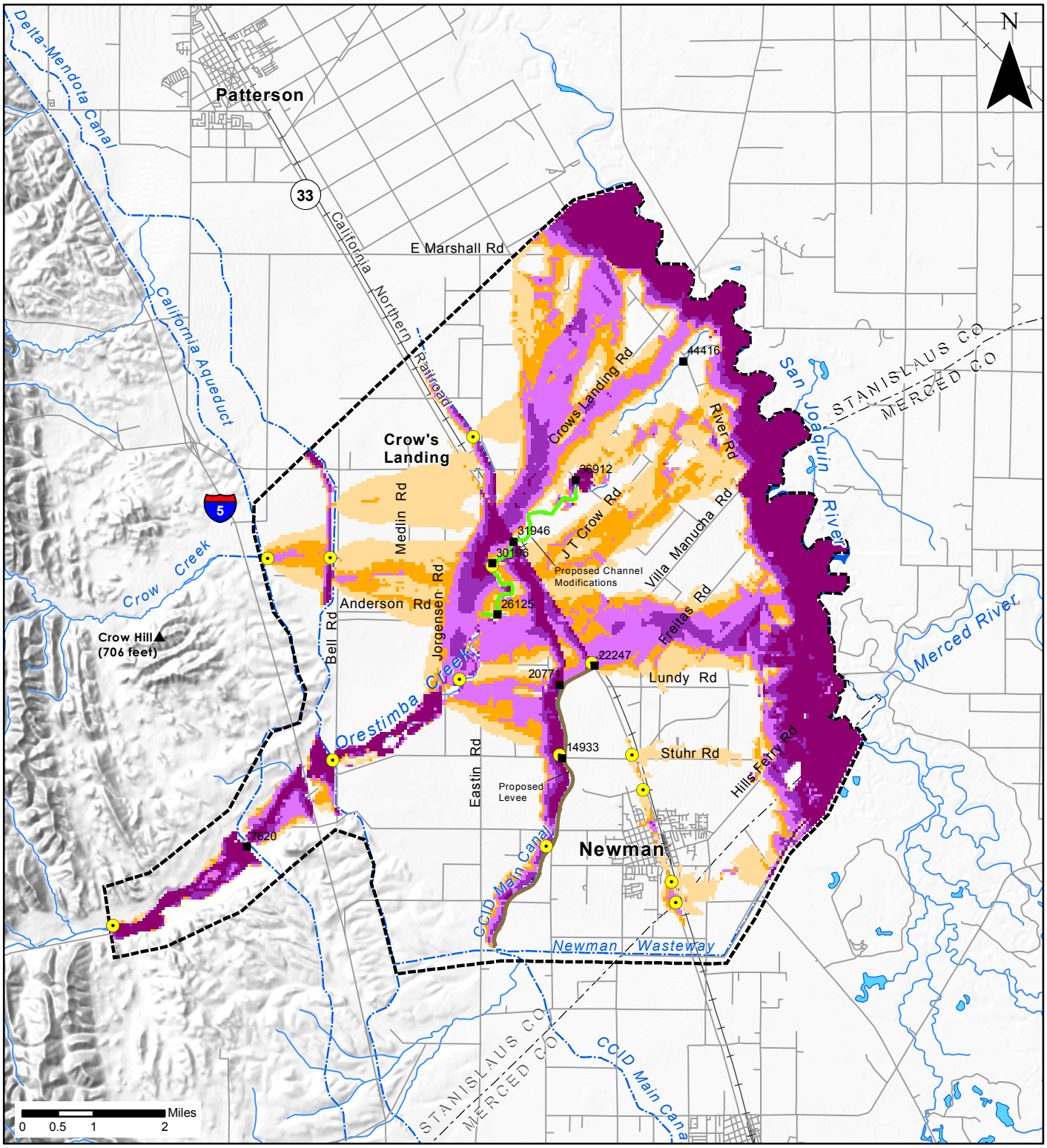
SACRAMENTO DISTRICT



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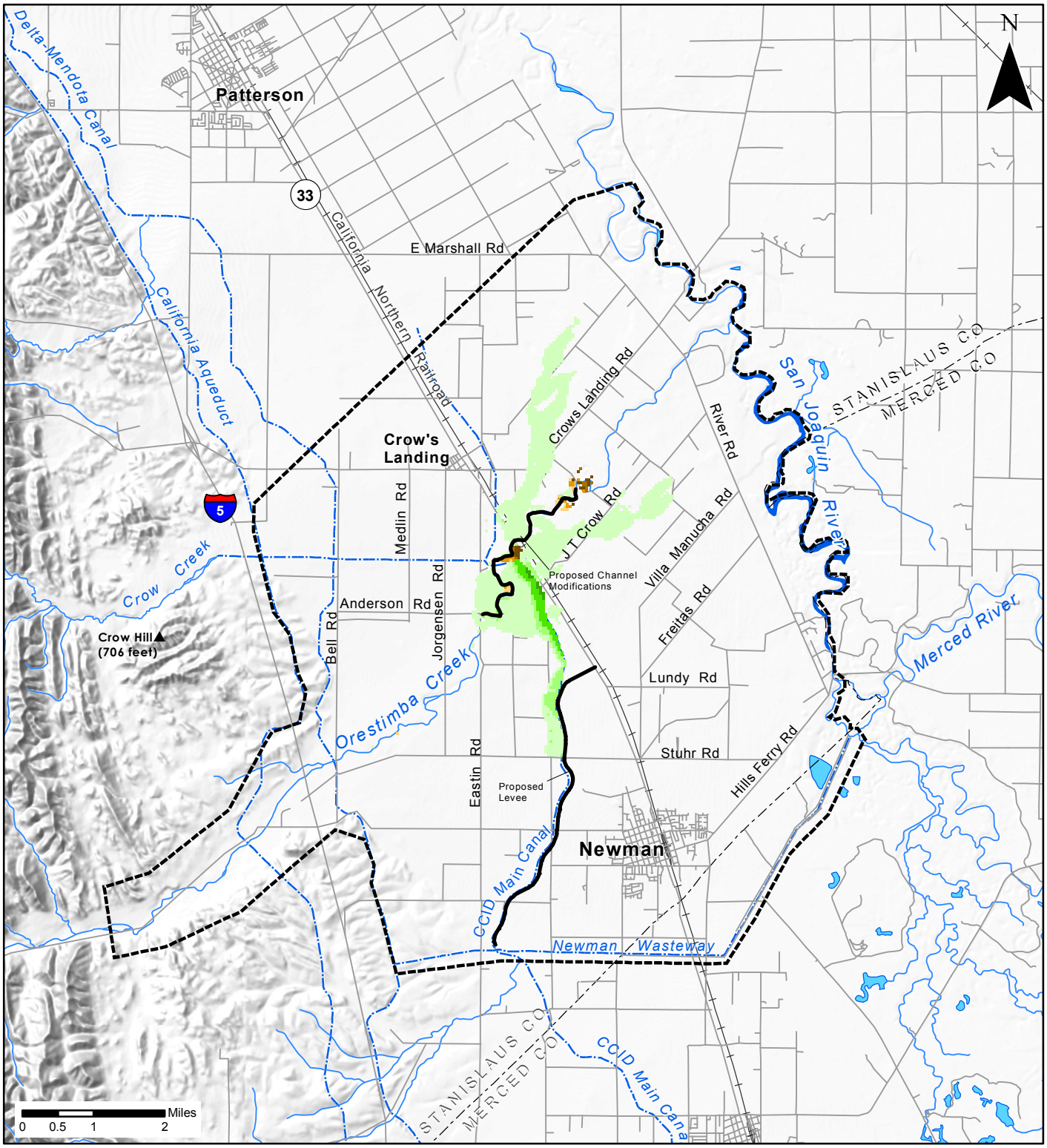
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C WITH 3,500 CFS CHANNEL MODIFICATIONS 0.2% (1/500) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



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- -2 to -1
- -1 to -0.1
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- Canal
- Floodplain Mapping Extent
- Chevron_Levee
- Channel Modifications

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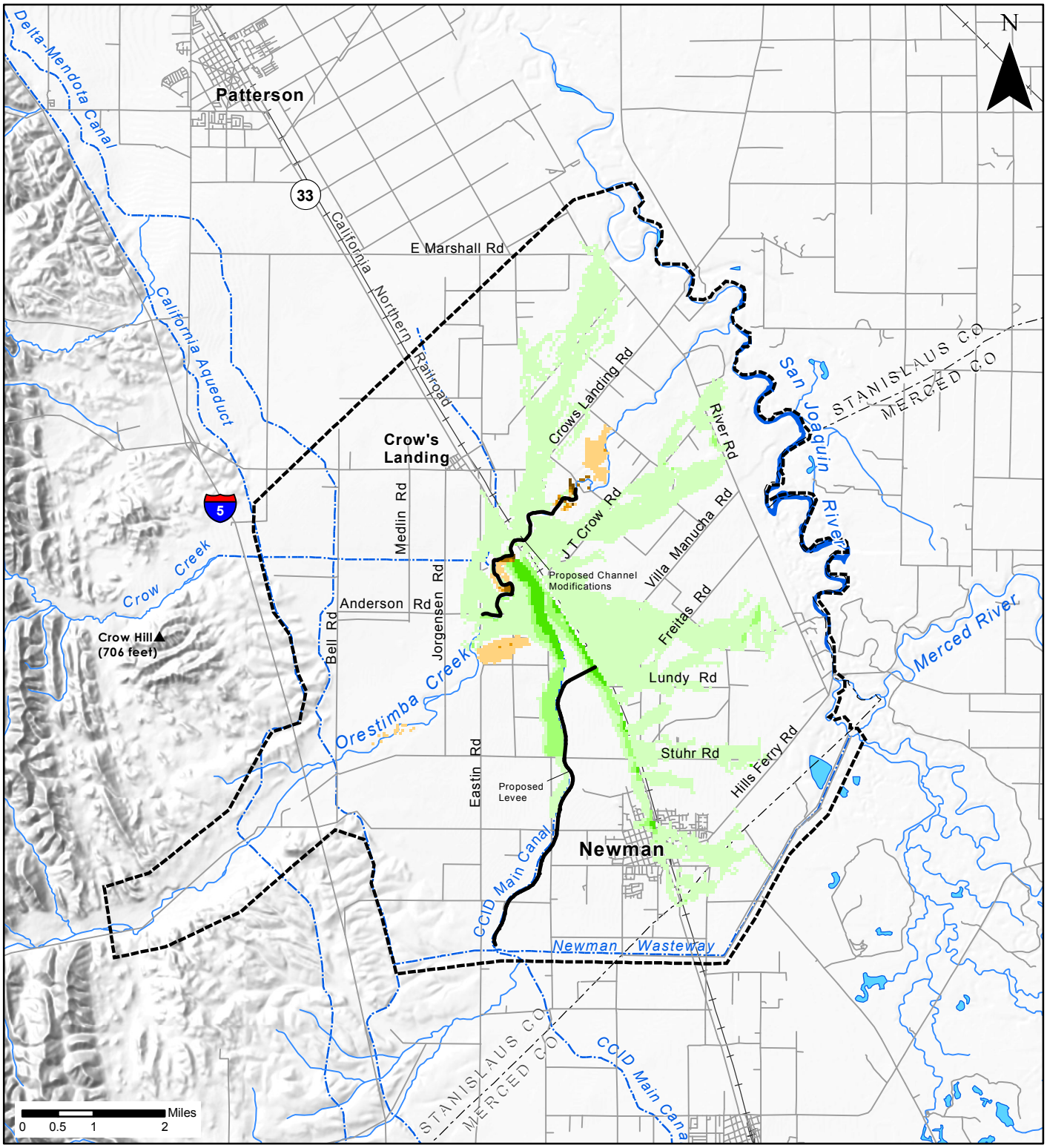
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C
WITH 3,500CFS CHANNEL MODIFICATIONS
AVERAGE CHANGE IN FLOOD DEPTH
20% (1/5) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



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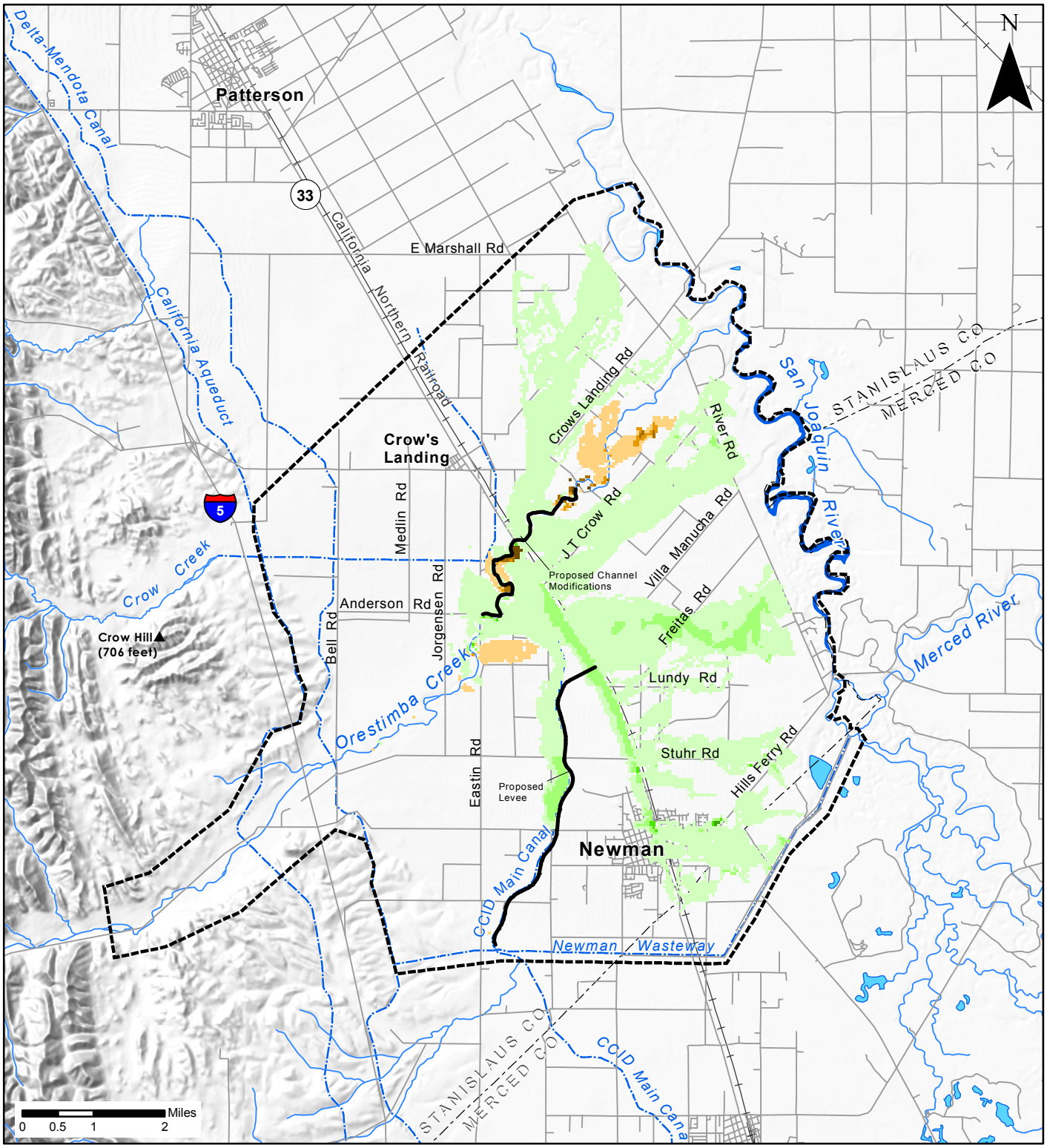
SACRAMENTO DISTRICT



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ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

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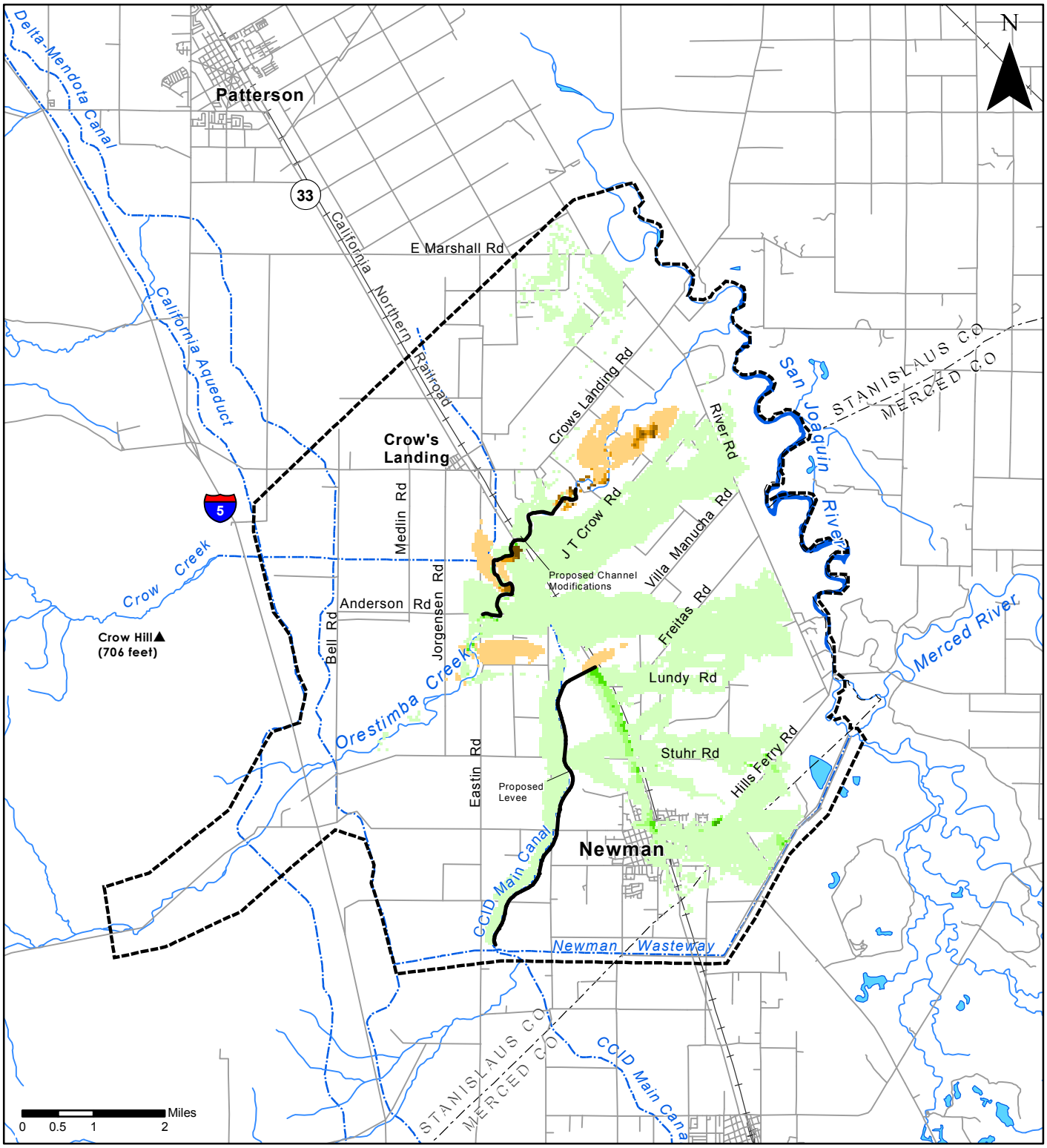
WITH 3,500CFS CHANNEL MODIFICATIONS
AVERAGE CHANGE IN FLOOD DEPTH
5% (1/20) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



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ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

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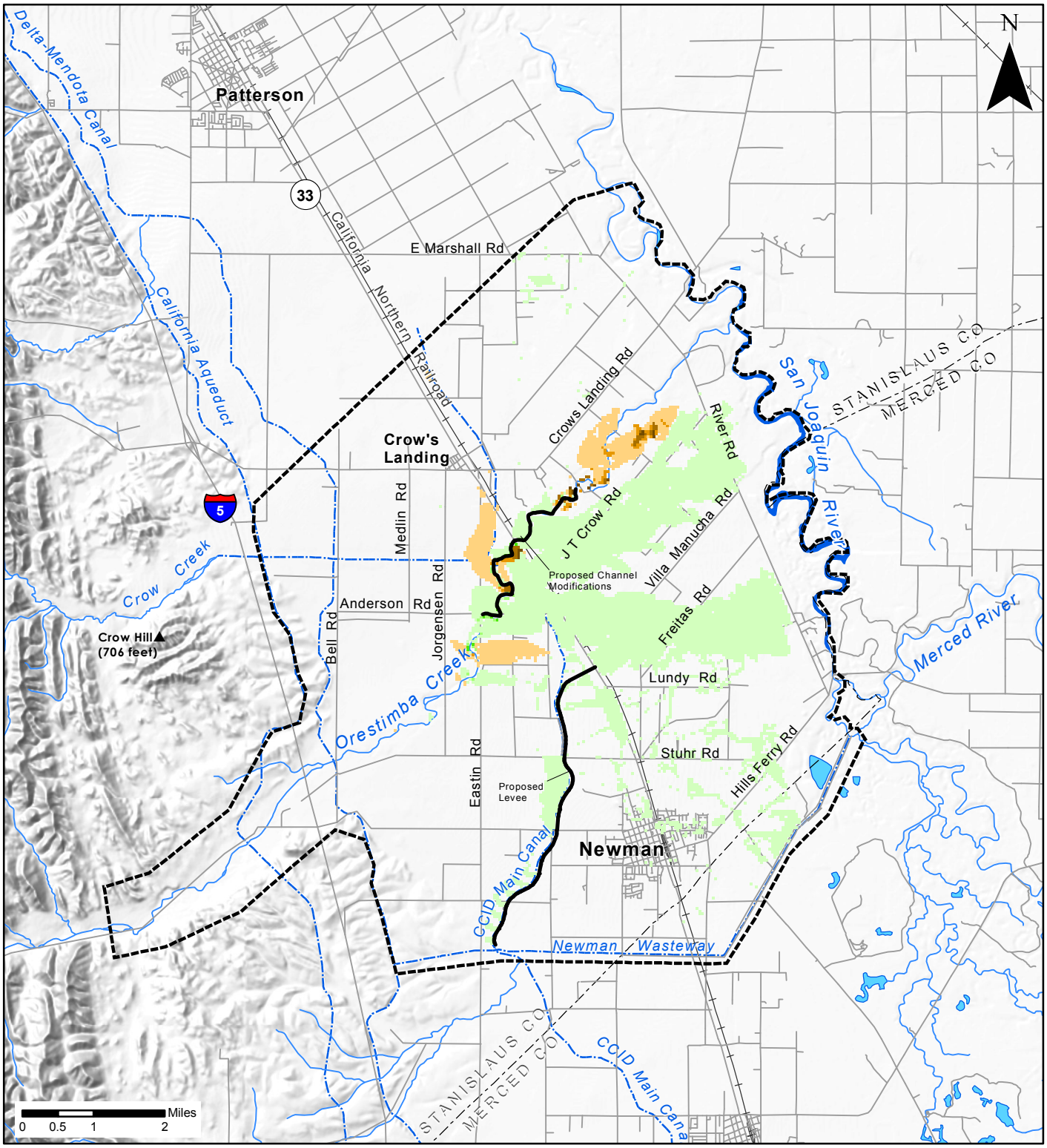
WITH 3,500CFS CHANNEL MODIFICATIONS
AVERAGE CHANGE IN FLOOD DEPTH
2% (1/50) ACE FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

SEP 2012



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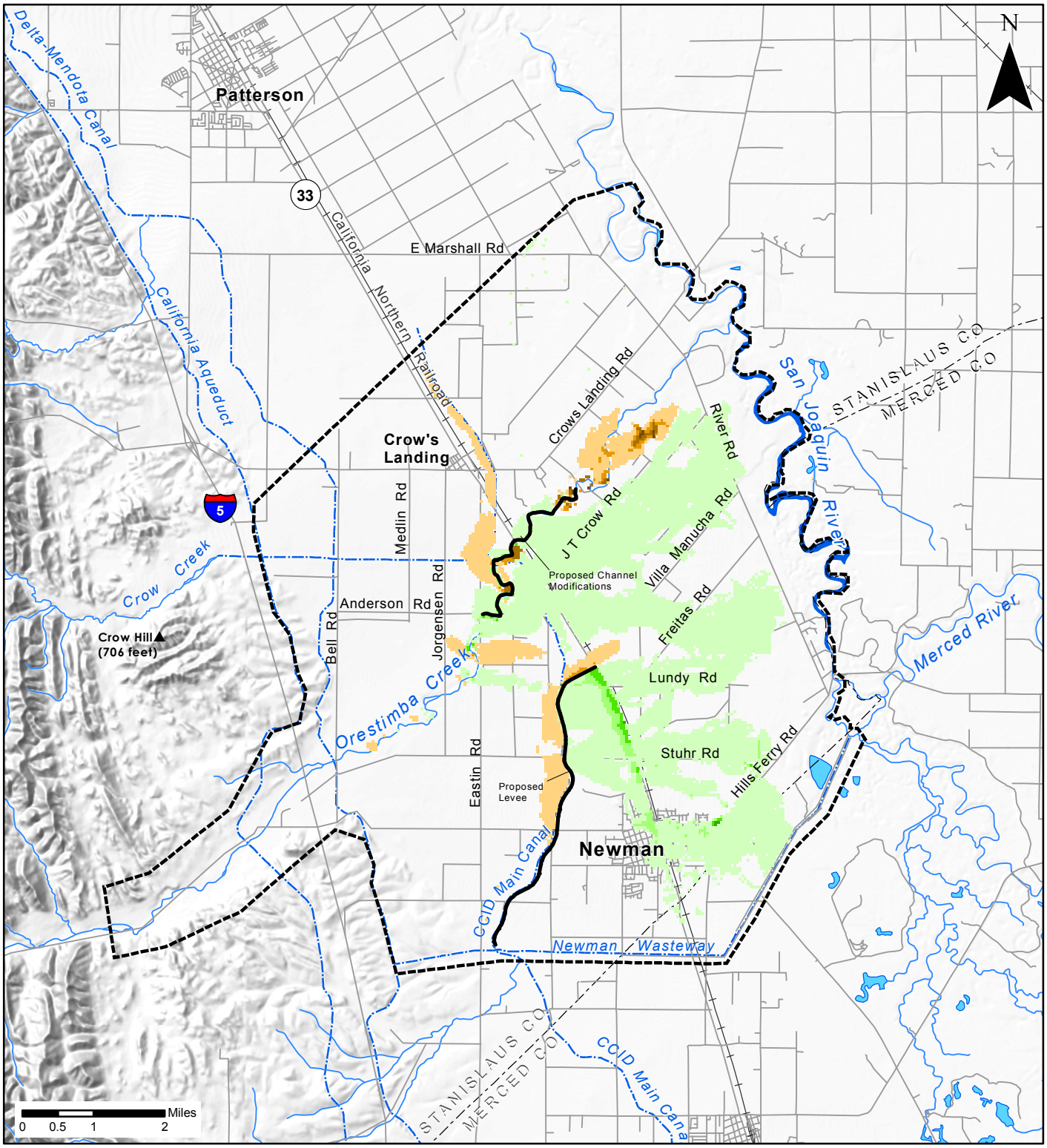
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C WITH 3,500CFS CHANNEL MODIFICATIONS AVERAGE CHANGE IN FLOOD DEPTH 1% (1/100) AEP FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



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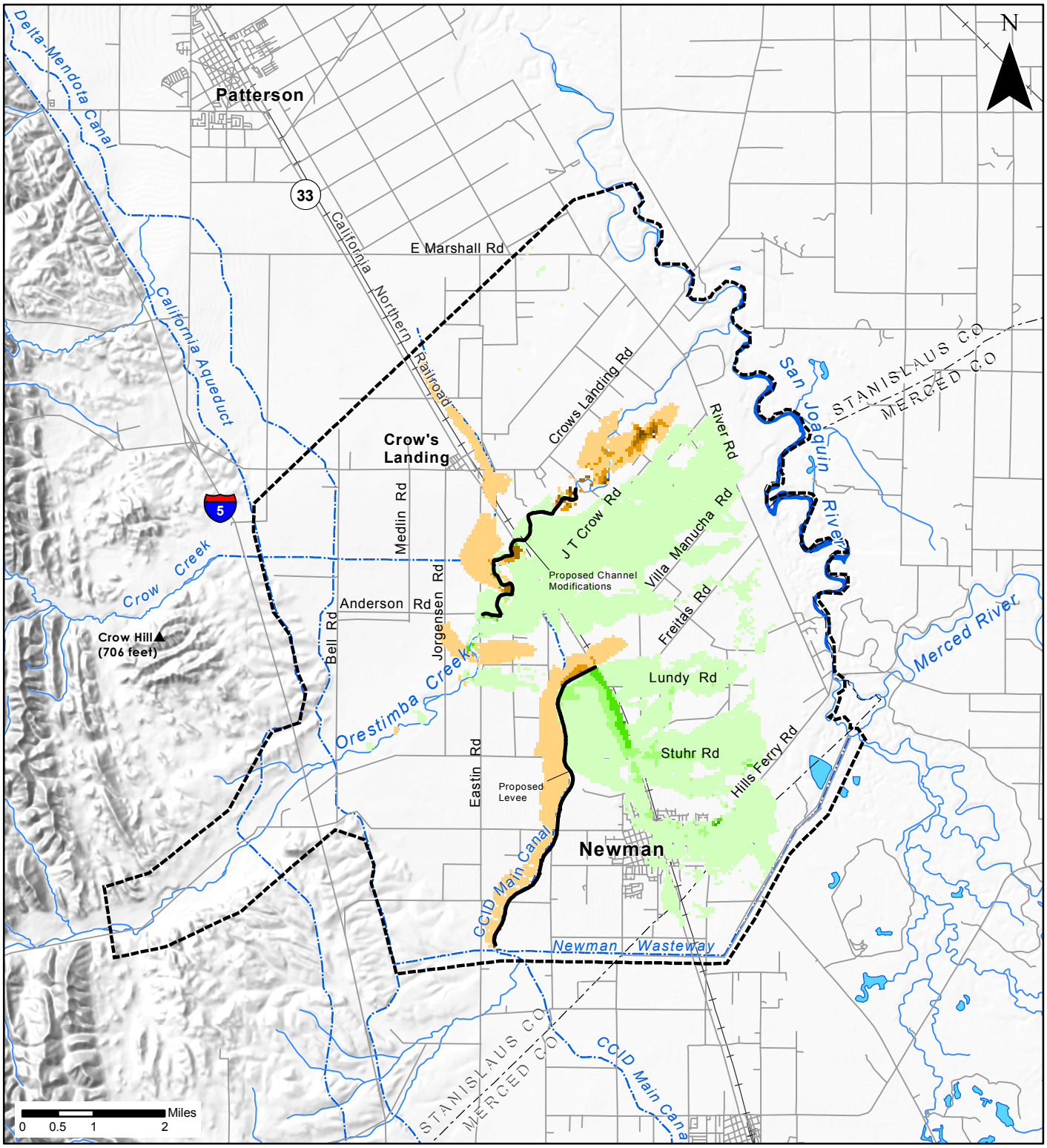
ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C WITH 3,500CFS CHANNEL MODIFICATIONS AVERAGE CHANGE IN FLOOD DEPTH 0.5% (1/200) AEP FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



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- Canal
- Floodplain Mapping Extent
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Note: Impacts near Orestimba Creek are due to model instability.

ORESTIMBA CREEK, STANISLAUS COUNTY, CALIFORNIA
FEASIBILITY STUDY

CHEVRON LEVEE - PROFILES B AND C WITH 3,500CFS CHANNEL MODIFICATIONS AVERAGE CHANGE IN FLOOD DEPTH 0.2% (1/500) AEP FLOOD EVENT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Orestimba Creek Hydrology

A Reevaluation Based on Updated Peak and Volume Frequency Curves

For the West Stanislaus Feasibility Study
Orestimba Creek, California
Damsite and Floodplain Evaluation

March 2008

U.S. Army Corps of Engineers
Water Management Section
Sacramento, California

Orestimba Creek Hydrology

A Reevaluation Based on Updated Peak and Volume Frequency Curves

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Orestimba Creek Hydrology

A Reevaluation Based on Updated Peak and Volume Frequency Curves

1. PURPOSE AND SCOPE

This report reevaluates the computational methods of the Orestimba Creek near Newman frequency curve, adds additional years of record, and recomputes the frequency curve using conditional probability methods described in Bulletin 17B. It also updates the frequency curves for Del Puerto Creek near Patterson and Salado Creek above Interstate 5 (I-5). The risk analysis of the previous Orestimba frequency curve revealed that a high standard deviation and a negative skew had combined to make the confidence bands on that curve extremely wide: a 1,000-year project would be needed to control a 10-year event, with 90% confidence. The reduced volumes of the recomputed frequency curve in this report may now make any flood control project built on Orestimba Creek more cost-effective.

After updating the frequency curves, the original hydrographs for the n-year flood events were rebalanced based on the new peak and volume duration curves. Hydraulic models, not presented in this report, will be used to route and combine these flood hydrographs to determine pre-project and project floodplains. These hydrographs include the 30-day flood series, which was designed to size a dry dam just above the Orestimba Creek near Newman gage. The maximum 10 days of this 30-day series can be used to determine pre-project floodplains and project levee designs without a dry dam component.

Also presented here are the 20, 10, 2.0, 1.0, 0.2, and newly added 0.5 percent exceedence probability flood hydrographs for Orestimba Creek and Crow Creek and their local areas below I-5. These were included to reflect the new flow frequency curves. Crow Creek, Crow Creek local, and Orestimba Creek local flood hydrographs are concurrent flows to a specific centering over Orestimba Creek above the California Aqueduct. Earlier studies, addendums and letter reports developed 7-, 15-, and 30-day floods based on hypothetical storms and the previous flow frequency curves. This report builds on that work and adds a balanced 30-day hydrograph for each subarea concentration point for each frequency flood. The balanced hydrographs reflect the peak, 3-, 5-, 7-, 10-, 15-, 20-, 25-, and 30-day event for each flood. Different time periods may be extracted from the 30-day floods, as needed.

No changes were made to the rainfall-runoff models used in the 2002 Sacramento and San Joaquin River Basins Comprehensive Study (Technical Studies Documentation, Appendix B, Synthetic Hydrology Technical Documentation) or the West Stanislaus County, California, 2001 Feasibility Study (Hydrology Appendix, prepared by Mid-Valley Engineering, Inc., of Modesto, California, for the Sacramento District of the Corps). And no new rainfall-runoff models were run.

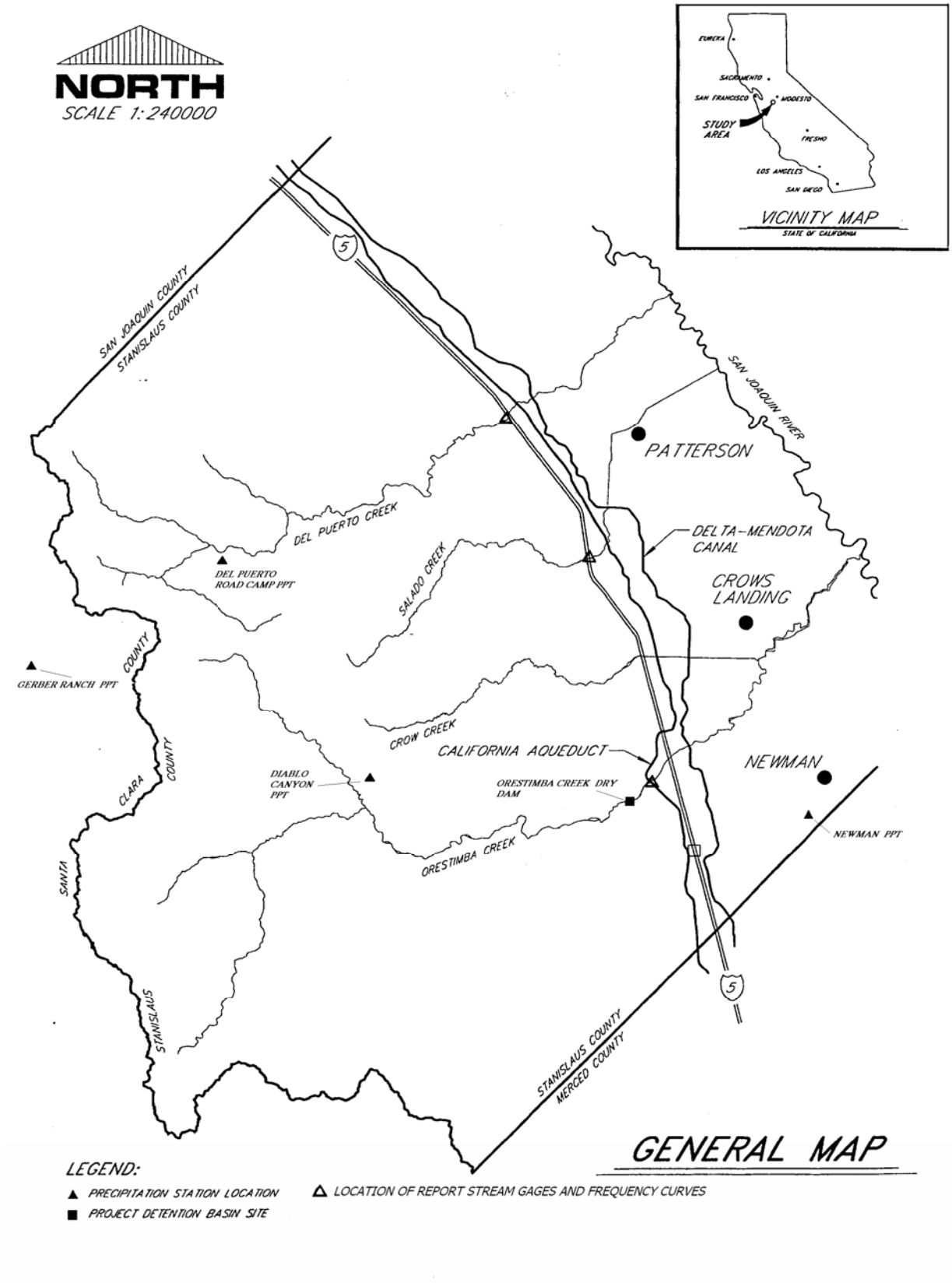


Figure 1. General Map

2. GENERAL DRAINAGE AREA: STREAM DESCRIPTIONS AND CLIMATE

Orestimba, Salado and Del Puerto creeks are west-side tributaries to the San Joaquin River. Their drainages lie in western Stanislaus County, on the eastern slopes of the Diablo Range section of the Coast Range Mountains. Elevations vary from 45 feet above mean sea level at the San Joaquin River to less than 200 feet at the California Aqueduct, 2600 feet in Salado Creek basin, and about 3600 feet in the headwaters of Del Puerto and Orestimba creeks.

The streams are ephemeral, with the highest flows usually occurring in late winter. They flow in a generally northeasterly direction through steep mountain canyons and emerge at the foothill line. Here on the gently sloping floor, the decreased slopes and sizes of the streambeds reduce the creeks' channel capacities. Flood flows spread over wide, undefined overflow areas typical of alluvial fans. Most west-side tributaries disappear in this area. Orestimba Creek is one of the few tributary streambeds to maintain a definite channel from the foothills to the San Joaquin River.

The climate is temperate and is characterized by hot, dry summers and mild winters. During winter, fog can occur in the lower areas. Normal annual precipitation ranges from 11.2 inches at Newman, elevation 90 feet msl, to over 18 inches in the higher mountains of Orestimba and Del Puerto drainages. Ninety-one percent of the precipitation occurs between November and April. Snowfall is negligible and does not affect runoff. It is rare for summer temperatures to exceed 110°F and winter temperatures to fall below 27°F.

Photos 1 through 5, below, were taken during a field trip to Orestimba Creek on January 29, 2008. The pastures were green this year due to above-average rainfall over the previous 3.5 months. The Diablo Canyon gage elevation 1,850 feet msl (CDEC call letters DBC), a precipitation gage about halfway up the Orestimba Creek basin, had accumulated 10.2 inches since October 2007. The average annual precipitation for this gage is about 14 inches.

Photo 1. Orestimba Creek at the California Aqueduct, looking downstream towards the Orestimba Creek gage.

Photo 2. Orestimba Creek, looking southwest 3.7 miles upstream from the California Aqueduct at the flow gage. Debris is from high water earlier in the month.

Photo 3. Orestimba Creek, looking east (downstream) 3.7 miles upstream from the California Aqueduct. The creek is on the far side of the Sycamore trees.

Photo 4. Orestimba Creek above the California Aqueduct, looking upstream. The well-drained rocky soils make this is one of the few places in the Central valley where sycamore trees still grow naturally.

Photo 5. Panoramic view, looking northwest from Orestimba Creek 3.7 miles upstream from the California Aqueduct.

3. FLOW FREQUENCY CURVES

The HEC-FFA (Flood Frequency Analysis) computer program (which incorporates the latest WRC Guidelines in Bulletin 17B) was used to compute the annual peak flow frequency curves—for Orestimba Creek near Newman (USGS gage no. 11274500 with 134 sq. mi. of drainage area), Del Puerto Creek near Patterson (USGS gage no.11274630, with 72.6 sq. mi. of drainage area), and Salado Creek above Interstate 5 (with 24.6 sq. mi. of drainage area)—by using ratios of Del Puerto Creek flows to compute the flow frequency curves, as was done in the original report. Gage locations for Orestimba Creek and Del Puerto Creek are shown in **Figure 1** as are the locations of the frequency curves. Salado Creek frequency curves were not used to compute any flows in this report; they were only updated to be used as a reference for future comparisons. Alternatives using the Salado Creek frequency curves studied in the earlier report are no longer considered viable and only the Orestimba Creek alternatives remained.

Del Puerto Creek frequency curves play an important part in this study: the volume-duration ratios for the local flows for Crow Creek are based on these same frequency curves. The methods employed at Salado Creek are consistent with the original hydrology.

The current analysis included an additional eight years of flow data. Orestimba Creek now has a peak record of 76 years, 1932-2007, and a daily flow record of 75 years, 1933-2007. Del Puerto Creek now has a peak record of 48 years, 1959-2006, and a daily flow record of 41 years, 1966-2006.

Del Puerto Creek near Patterson

The frequency curves for Del Puerto Creek near Patterson used 48 years of record for the peak flow and 41 years for the volume-duration analysis. The low outlier test in FFA identified one outlier in most of the durations. The lowest flow was dropped for all the curves, for consistency. The means and standard deviations were adjusted and stabilized by removing the second lowest year using the cutoff option in FFA. **Table 1** shows the four iterations used to determine Del Puerto Creek's final statistics.

Orestimba and Del Puerto creeks' drainage areas have similar physical characteristics, as described above. The important difference between the two gage records for these drainage areas is that there are no zero flow years for Del Puerto Creek. After removing low outliers, Del Puerto Creek's statistics are very similar to Orestimba Creek's. **Table 2** lists peak, 1-, 3-, 5-, 7-, 10-, 15-, 20-, and 30-day frequency statistics for Del Puerto Creek in four iterations. The first are the results of the statistics without a low outlier test. The second are the results considering low outliers. (In these runs, five out of the ten sets of flows identified a low outlier. The goal is to develop a family of curves from a limited data set that would represent a total population.) The third set of statistics eliminated the lowest flow from each set. This set provided data that produced frequency curves more consistent with a family of curves. The fourth and final set of FAA runs uses the low outlier cutoff option to exclude the two lowest flow years of each of the durations and sets the skew to -0.5 for each curve, as suggested in Reference d. After removing the second low flow, the resulting standard deviations and skews were very similar to those for Orestimba Creek. Note that the removed flows were 1 or 2 cfs or less. These flows should not drive the standard deviations or skews of the curves that determine the upper end of the frequency curves. The plots of the means and standard deviations of each set are shown in **Figure 2. Chart 1** omits the 20-day curve and data. **Table 2A and 2B** tabulate the peak and volume data for the period of record. These curves will be used to estimate Salado Creek's frequency curves and determine ratios of the 3-day and 5-day flood waves for the Crow Creek flood series.

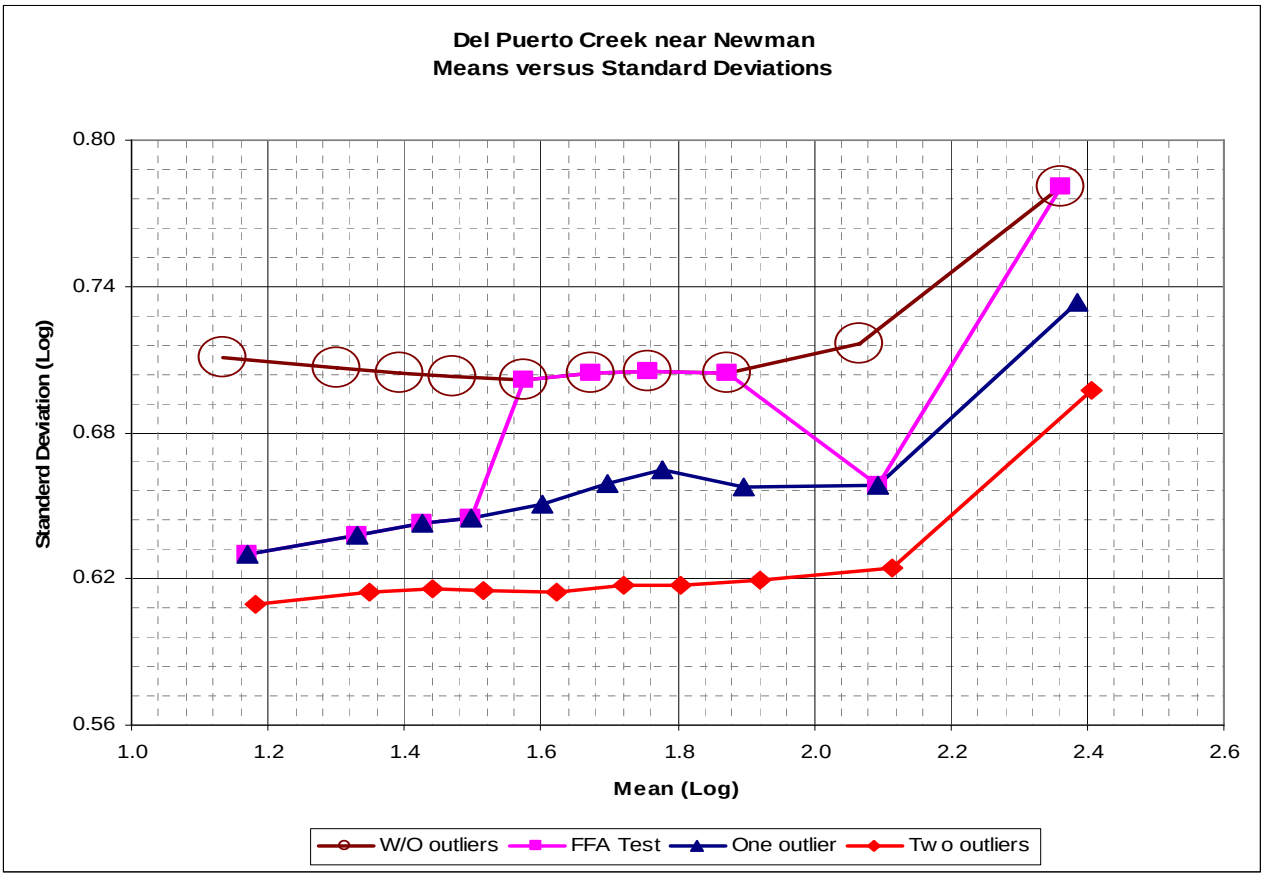


Figure 2. Del Puerto Creek near Patterson, Means versus Standard Deviations. The two outlier curves represent the final statistical curve. See **Chart 1** for Del Puerto Creek near Patterson peak and flow duration frequency curves.

Table 1
Summary of FFA Results
Del Puerto Creek near Patterson

FFA Output before Low Outlier Test				FFA after Low Outlier Test				Lowest Year Set as Only Low Outlier			Final Frequency Curve Low Outliers Set Exclude Lowest Two Flows			
Duration	Mean Log	Std. Dev. Log	Skew	Mean Log	Std. Dev. Log	Skew	FFA Out-liers	Mean Log	Std. Dev. Log	Skew	Mean log	Std. Dev. Log	Skew Com-puted	Skew Adopted
Peak	2.3608	0.7811	-0.9	2.3608	0.7811	-0.9	0	2.3855	0.7337	-0.7	2.4062	0.6970	-0.6	-0.5
1-Day	2.0654	0.7165	-0.9	2.0945	0.6581	-0.6	1	2.0945	0.6581	-0.6	2.1144	0.6242	-0.5	-0.5
3-Day	1.8735	0.7046	-0.8	1.8735	0.7046	-0.8	0	1.8983	0.6579	-0.7	1.9200	0.6196	-0.6	-0.5
5-Day	1.7566	0.7048	-0.7	1.7566	0.7048	-0.7	0	1.7789	0.6648	-0.7	1.8042	0.6171	-0.4	-0.5
7-Day	1.6735	0.7043	-0.7	1.6735	0.7043	-0.7	0	1.6978	0.6591	-0.6	1.7208	0.6172	-0.4	-0.5
10-Day	1.5749	0.7013	-0.7	1.5749	0.7013	-0.7	0	1.6012	0.6504	-0.5	1.6218	0.6144	-0.4	-0.5
15-Day	1.4699	0.7029	-0.7	1.4987	0.6450	-0.4	1	1.4987	0.6450	-0.4	1.5167	0.6152	-0.3	-0.5
20-day	1.3946	0.7043	-0.7	1.4249	0.6425	-0.4	1	1.4249	0.6425	-0.4	1.4415	0.6158	-0.3	-0.5
30-day	1.2995	0.7065	-0.7	1.3320	0.6381	-0.3	1	1.3320	0.6381	-0.3	1.3472	0.6145	-0.2	-0.5

1. Peak flow record 1958-2006 for 48 years of record. Daily flow record 1966-2006 for 41 years of record.
2. USGS Station 11274630 has a drainage area of 72.6 sq. mi.

TABLE 2A
Del Puerto Creek near Patterson
Flow Duration
Peak through 7-Day

	PEAK		1-DAY		3-DAY		5-DAY		7-DAY	
WY	Date	Flow	Date	Day-cfs	Date	Day-cfs	Date	Day-cfs	Date	Day-cfs
1959	2/16/1959	1800.0								
1960	2/9/1960	164.0								
1961	1/26/1961	26.0								
1962	2/15/1962	685.0								
1963	2/1/1963	490.0								
1964	1/21/1964	42.0								
1965	12/27/1964	104.0								
1966	12/29/1965	24.0	12/31/1965	20	12/30/1965	18.0	12/29/1965	16	12/29/1965	13
1967	1/22/1967	1180.0	1/22/1967	247	1/22/1967	163.7	1/22/1967	128	1/22/1967	100
1968	1/30/1968	75.0	1/31/1968	30	1/31/1968	13.9	1/30/1968	10	1/30/1968	8
1969	1/25/1969	913.0	2/24/1969	399	2/24/1969	267.7	2/24/1969	211	2/24/1969	190
1970	3/1/1970	182.0	3/1/1970	85	3/1/1970	60.7	3/1/1970	54	3/1/1970	46
1971	12/2/1970	125.0	12/21/1970	63	12/21/1970	38.7	12/20/1970	29	12/19/1970	24
1972	1/28/1972	4.9	1/28/1972	4.2	1/28/1972	3.5	1/27/1972	3	1/27/1972	3
1973	2/6/1973	491.0	2/11/1973	267	2/11/1973	195.7	2/10/1973	162	2/6/1973	159
1974	1/8/1974	99.0	1/8/1974	72	1/7/1974	54.3	1/6/1974	44	1/6/1974	38
1975	3/7/1975	209.0	3/8/1975	119	3/7/1975	84.3	3/7/1975	64	3/7/1975	52
1976	3/2/1976	3.5	3/3/1976	3.3	3/2/1976	2.6	3/2/1976	2	3/2/1976	2
1977	10/2/1976	5.0	10/2/1976	5	10/2/1976	1.9	10/1/1976	1	10/1/1976	1
1978	2/9/1978	750.0	3/5/1978	254	3/4/1978	200.0	3/4/1978	145	3/4/1978	118
1979	2/22/1979	158.0	2/21/1979	89	2/21/1979	77.7	2/21/1979	59	2/21/1979	47
1980	2/19/1980	1490.0	2/19/1980	767	2/17/1980	613.7	2/17/1980	520	2/16/1980	423
1981	1/29/1981	80.0	1/29/1981	38	1/28/1981	23.0	1/28/1981	17	1/27/1981	13
1982	1/5/1982	1290.0	1/5/1982	494	1/4/1982	277.7	1/4/1982	178	1/4/1982	132
1983	3/1/1983	1610.0	3/1/1983	973	2/28/1983	760.3	2/28/1983	604	2/28/1983	492
1984	12/25/1983	454.0	12/25/1983	317	12/25/1983	159.7	12/25/1983	110	12/25/1983	86
1985	3/28/1985	74.0	3/28/1985	39	3/27/1985	24.0	3/27/1985	18	3/27/1985	14
1986	2/18/1986	1520.0	2/19/1986	775	2/17/1986	630.7	2/15/1986	500	2/14/1986	423
1987	2/13/1987	117.0	2/13/1987	53	2/13/1987	27.4	2/13/1987	19	2/12/1987	14
1988	1/17/1988	80.0	1/18/1988	39	1/17/1988	30.0	1/17/1988	20	1/16/1988	15
1989	3/3/1989	1.8	3/3/1989	1.2	3/10/1989	1.1	3/10/1989	1	3/7/1989	1
1990	5/27/1990	371.0	5/28/1990	98	5/27/1990	49.1	5/27/1990	30	5/27/1990	22
1991	3/24/1991	710.0	3/25/1991	230	3/25/1991	128.0	3/25/1991	91	3/24/1991	72
1992	2/12/1992	614.0	2/12/1992	262	2/11/1992	110.7	2/12/1992	110	2/11/1992	89
1993	1/13/1993	913.0	1/13/1993	590	1/13/1993	333.7	1/13/1993	258	1/13/1993	220
1994	2/20/1994	39.0	2/20/1994	29	2/19/1994	19.7	2/19/1994	15	2/18/1994	13
1995	3/10/1995	3400.0	3/10/1995	1230	3/10/1995	650.0	3/10/1995	434	3/10/1995	329
1996	2/19/1996	623.0	2/20/1996	328	2/19/1996	267.3	2/19/1996	213	2/19/1996	171
1997	1/23/1997	1860.0	1/23/1997	735	1/23/1997	423.3	1/23/1997	391	1/22/1997	326
1998	2/3/1998	5270.0	2/3/1998	1870	2/2/1998	861.7	2/3/1998	711	2/2/1998	653
1999	2/9/1999	227.0	2/9/1999	79	2/8/1999	58.3	2/8/1999	45	2/7/1999	35
2000	2/14/2000	732.0	2/14/2000	288	2/13/2000	160.7	2/12/2000	112	2/12/2000	84
2001	3/5/2001	324.0	3/5/2001	175	3/4/2001	88.0	3/4/2001	61	3/4/2001	47
2002	1/3/2002	79.0	1/3/2002	51	1/3/2002	30.0	12/30/2001	23	12/29/2001	25
2003	12/19/2002	739.0	12/20/2002	220	12/19/2002	141.3	12/19/2002	102	12/16/2002	88
2004	2/25/2004	295.0	2/26/2004	143	2/25/2004	88.7	2/25/2004	62	2/25/2004	47
2005	12/31/2004	384.0	2/21/2005	205	2/20/2005	155.3	2/19/2005	125	2/16/2005	124
2006	1/2/2006	449.0	1/2/2006	173	4/4/2006	115.7	4/3/2006	84	4/3/2006	69

TABLE 2B
Del Puerto Creek near Patterson
Flow Duration
10-Day through 30-Day

WY	10-DAY Date	10-DAY Day-cfs	15-DAY Date	15-DAY Day-cfs	20-DAY Date	20-DAY Day-cfs	30-DAY Date	30-DAY Day-cfs
1966	12/29/1965	10.48	12/29/1965	8.11	12/29/1965	6.72	12/29/1965	5.14
1967	1/22/1967	96.70	1/22/1967	72.47	1/22/1967	56.42	1/21/1967	39.28
1968	1/30/1968	6.10	1/30/1968	4.68	1/30/1968	4.13	1/30/1968	3.52
1969	2/23/1969	155.60	2/15/1969	130.07	2/12/1969	119.05	2/6/1969	99.07
1970	3/1/1970	37.80	1/14/1970	31.93	1/10/1970	26.42	1/10/1970	20.21
1971	12/19/1970	19.57	12/19/1970	15.62	12/19/1970	13.04	11/29/1970	13.16
1972	1/27/1972	2.50	1/27/1972	2.37	1/27/1972	2.06	1/27/1972	1.69
1973	2/6/1973	146.80	2/6/1973	113.13	2/6/1973	91.65	2/6/1973	79.90
1974	1/5/1974	32.20	1/5/1974	26.33	12/27/1973	24.02	12/27/1973	20.15
1975	3/7/1975	45.20	3/7/1975	37.40	3/7/1975	35.90	3/7/1975	28.17
1976	3/2/1976	1.64	2/27/1976	1.33	2/24/1976	1.14	2/12/1976	0.94
1977	10/1/1976	0.56	10/1/1976	0.37	10/1/1976	0.28	10/1/1976	0.19
1978	3/4/1978	94.10	3/3/1978	71.40	3/3/1978	58.85	2/7/1978	61.13
1979	2/21/1979	35.78	2/20/1979	26.47	2/14/1979	21.97	2/14/1979	16.51
1980	2/16/1980	322.80	2/16/1980	233.33	2/16/1980	193.10	2/16/1980	142.97
1981	1/27/1981	10.38	1/27/1981	8.05	1/27/1981	6.78	3/19/1981	5.65
1982	3/30/1982	101.60	3/31/1982	101.40	3/30/1982	86.00	3/29/1982	65.53
1983	2/28/1983	397.80	2/28/1983	328.20	2/27/1983	283.80	2/26/1983	237.23
1984	12/24/1983	66.70	12/23/1983	49.07	12/10/1983	41.27	12/9/1983	33.85
1985	3/27/1985	10.78	3/26/1985	8.07	3/15/1985	6.67	3/7/1985	5.90
1986	2/13/1986	318.10	2/13/1986	221.80	2/13/1986	169.27	2/14/1986	135.88
1987	2/12/1987	10.63	2/11/1987	7.74	2/11/1987	6.19	2/13/1987	6.54
1988	1/15/1988	11.57	1/14/1988	8.37	1/13/1988	6.74	1/8/1988	5.01
1989	3/3/1989	1.04	3/3/1989	0.99	3/2/1989	0.93	3/2/1989	0.84
1990	5/27/1990	15.61	5/27/1990	10.42	5/27/1990	7.82	5/21/1990	5.22
1991	3/24/1991	54.70	3/18/1991	40.51	3/18/1991	32.50	3/4/1991	24.39
1992	2/11/1992	67.93	2/11/1992	49.05	2/11/1992	37.31	2/11/1992	27.33
1993	1/13/1993	166.40	2/18/1993	119.40	2/8/1993	103.85	2/8/1993	84.40
1994	2/18/1994	10.12	2/8/1994	7.75	2/7/1994	7.24	2/7/1994	5.78
1995	3/10/1995	245.70	3/10/1995	232.33	3/10/1995	194.30	3/10/1995	143.17
1996	2/19/1996	136.10	2/19/1996	108.53	2/19/1996	97.30	2/19/1996	86.87
1997	1/22/1997	252.50	1/22/1997	186.20	1/22/1997	149.25	1/1/1997	132.53
1998	2/2/1998	527.40	2/2/1998	423.27	2/3/1998	386.60	2/2/1998	329.17
1999	2/7/1999	27.24	2/8/1999	21.70	2/7/1999	18.62	1/31/1999	14.50
2000	2/14/2000	67.78	2/12/2000	65.39	2/12/2000	56.09	2/12/2000	43.16
2001	3/4/2001	35.40	2/24/2001	29.20	2/23/2001	23.62	2/11/2001	17.62
2002	12/29/2001	20.56	12/29/2001	15.65	12/29/2001	12.84	12/21/2001	9.90
2003	12/16/2002	67.65	12/16/2002	53.82	12/16/2002	47.37	12/16/2002	34.15
2004	2/25/2004	35.26	2/25/2004	25.16	2/25/2004	19.83	2/18/2004	14.39
2005	2/16/2005	101.60	2/15/2005	79.60	2/15/2005	68.55	2/15/2005	52.30
2006	4/3/2006	55.90	4/3/2006	45.33	4/1/2006	38.30	3/26/2006	30.10

Orestimba Creek near Newman

Accurate analysis of flood flow requires a reliable, representative time sample of random homogeneous events for the study location. Orestimba Creek's arid climate and heavily unconsolidated sediment produce non-homogeneous basin runoff characteristics. Orestimba is a low flow threshold stream. Significantly higher losses occur on the lower flows than on the high flows. Some of this is due to the arid climate and the inability of the soils to hold moisture for an extended period. This is apparent in the drainage area's vegetative cover of mostly grasses, which quickly die off as spring and summer approach. Storms must be closely spaced to have significant runoff. Only in 1 out of 10 years, for example, is there enough runoff to sustain the growth of young Sycamore trees in Orestimba Creek's lower streambed below the foothills. Several other factors, factors that can be observed by plotting the flows on a log probability scale, lead to the conclusion that the basin rainfall-runoff response is non-homogeneous. These include the following: (1) There is a constant slope for the largest 26 out of 76 years of data ((the largest third of the flows (33% probability and less)). But this slope changes for the next third of the data and again for the last third of the data, which contain an average of 12 years of zero flows. (The slope of the data indicates its standard deviation. A reasonably constant slope indicates homogeneity.) (2) A second factor is that 12 of 75 years of recorded runoff for the basin show no flows at all. This occurred at the same time that an adjacent basin, Puerto Creek, with the same climate and similar upper basin geology had runoff for each of Orestimba Creek's zero flow years. The main cause is the dramatic difference in the rainfall-runoff response depending on antecedent rainfall and its magnitude. (3) A third factor is seen in the comparison of the flows and statistics of the upper quartile of Orestimba Creek flows with a similar watershed's flows (i.e., Del Puerto). This permits the comparison of flood frequency estimates and statistics with those that might be expected in a homogeneous region.

Orestimba Creek emerges from the foothills about five miles upstream of the Orestimba Creek near Newman gage. The shallow stream flows through moderately deep valley fill alluvium composed of coarse-grained unconsolidated sediments (Reference c). These unconsolidated sediments induce large channel losses at the beginning of the flood season, causing much of the flow for smaller events to be adsorbed and flow under the surface of the streambed itself. As a result, many low rainfall years show zero flow at the gage. This flow regime quickly stores early or light runoff until the storage capacity is satisfied. Then—and only then—is there surface runoff. As a result, 12 of the 76 years of record show no flow at the gage for the drier years. The flow regime changes as channel storage increases: the wetter the antecedent conditions and the larger the storm, the greater the percentage of storm runoff.

The Orestimba Creek near Newman analysis used the log-Pearson Type III distribution with the conditional probability adjustment option of Appendix 5 in Bulletin 17 B. This adjustment is recommended to obtain the frequency curve for stations where the record of annual peaks is truncated by the omission of peaks below a gage base and years with zero flow and/or low outlier criteria. Bulletin 17B recommends not eliminating more than 25% of the flow. This study eliminates 40% of the flows. The upper 60 percent of the data was used (highest 45 years of record) to determine points needed to establish the statistics. Using 60% of the flows minimizes the non-homogeneity of the flows and provides enough data to estimate the 0.5, 0.1, and 0.01 exceedence probabilities needed to compute conditional probability adjustment. The regional characteristics and other stream characteristics indicate that the removal of these data brings the frequency curve moments into closer alignment with Del Puerto Creek and other streams on the west side of the valley that have not been mentioned.

Chart 2, the peak and volume flow frequency curve for Orestimba Creek near Newman, shows the annual flow data on a log-normal probability scale. **Chart 3** plots Orestimba Creek near Newman Peak Flow Frequency curve and the peak flow 5% and 95% confidence bands. The upper half of the data better represents less frequent floods than the whole data set, because at this point in the data the flow regime is more stable and homogeneous (it also resembles the slope of the Del Puerto Creek data (see **Chart 1**)). The slope of this curve is represents to the standard deviation of the data.

Del Puerto Creek basin is north of Orestimba Creek. It emerges from the foothills just upstream of the Del Puerto Creek stream gage, has a similar climate, elevation range, and normal annual basin precipitation, but is a little over half its size (72.6 square miles versus 134 square miles). Unlike Orestimba, this streambed has accumulated very little alluvium sediment above the gage and the creek doesn't have any zero-flow years of record.

The upper half of the Orestimba Creek flows correlated well with the overlapping water years of Del Puerto Creek. Based on results from REGFREQ (The Corps' regional frequency program), peaks had a correlation coefficient of 89 percent and all the duration data, 1-day through 30-day, had a correlation coefficient greater than 90 percent.

To isolate higher flows for FFA analysis, the low flow cutoff option was used. The FFA steps used to determine the final statistics are documented in **Tables 3 and 4**. Orestimba Creek's final statistics are listed in **Table 4**. Means and standard deviations of the curves were checked for consistency by plotting them against each other (see **Figure 3**). The values plot very close to the best-fit regression curve. Since those points generally follow a straight line, the curves will not cross. Skews were smoothed to produce reasonable volume mass curves for flood wave development (Reference d).

Table 3 shows the FAA output of the multiple curve statistics only considering non zero-flow years. It provides the peak, maximum 1-, 3-, 5-, 7-, 10-, 15- 20-, and 30-day flow volumes for Orestimba Creek. FFA includes some low outliers in some of these durations, but does not influence these statistics.

Table 4 shows the final statistics of the FFA computer run and the final adopted skews. It also shows the run's setup parameters for cutoff flows, zero flows, total number of zero and low cutoff flows, total number of years, and percentage of years used.

Table 3
FFA Statistical Output before Screening Input for Orestimba Creek

Duration	Mean Log	Std. Dev. Log	Computed Skew	Years of Record	Zero-Flow Years
PEAK	3.0800	0.7192	-1.33	76	11
1-DAY	2.7289	0.6332	-1.18	75	12
3-DAY	2.5205	0.6352	-1.20	75	12
7-DAY	2.2901	0.6641	-1.22	75	12
5-DAY	2.3833	0.6547	-1.31	75	12
10-DAY	2.1791	0.6758	-1.26	75	12
15-DAY	2.0556	0.6948	-1.29	75	12
20-DAY	1.9592	0.7067	-1.29	75	12
30-DAY	1.8353	0.7227	-1.23	75	12

Table 4
FFA Results for Orestimba Creek

FFA Statistics				Final	FFA	Zero-	Record			
Duration	Log Mean	Log Std. Dev.	Computed Skew	Adopted Skew	Cutoff Flow (cfs)	Flow Years	Low Outliers Cutoff Years	Years Used	% Years Used	Years of Record
Peak	3.0782	0.5636	-0.59	-0.60	900.0	11	20	45	58.5	76
1-day	2.7177	0.5026	-0.43	-0.50	355.0	12	18	45	59.3	75
3-day	2.5011	0.5161	-0.46	-0.50	200.0	12	18	45	59.3	75
5-day	2.3638	0.5279	-0.51	-0.50	150.0	12	18	45	59.3	75
7-day	2.2651	0.5448	-0.50	-0.55	120.0	12	18	45	59.3	75
10-day	2.1548	0.5552	-0.57	-0.60	90.3	12	18	45	59.3	75
15-day	2.0283	0.5788	-0.69	-0.70	63.0	12	18	45	59.3	75
20-day	1.9299	0.5905	-0.68	-0.70	49.0	12	18	45	59.3	75
30-day	1.8071	0.6015	-0.59	-0.70	35.0	12	18	45	59.3	75

Using the same cutoff years produces means and standard deviations that prevent the peak and flood flow volume-duration curves from crossing when plotted on a log-probability scale. **Figure 3** plots the means against the standard deviations of the frequency curves for Orestimba Creek. The flow data used are listed in **Tables 3A and 3B**. The data points and frequency curves are plotted on **Chart 1. Chart 2** shows just the peak flow frequency curve and its 90 percent confidence limits.

The Orestimba Creek flow frequency curves and data from the West Stanislaus 2001 feasibility report are shown in **Chart 4**. Notice how the previous peak flow and 3-day frequency curves over-estimated the less frequent floods.

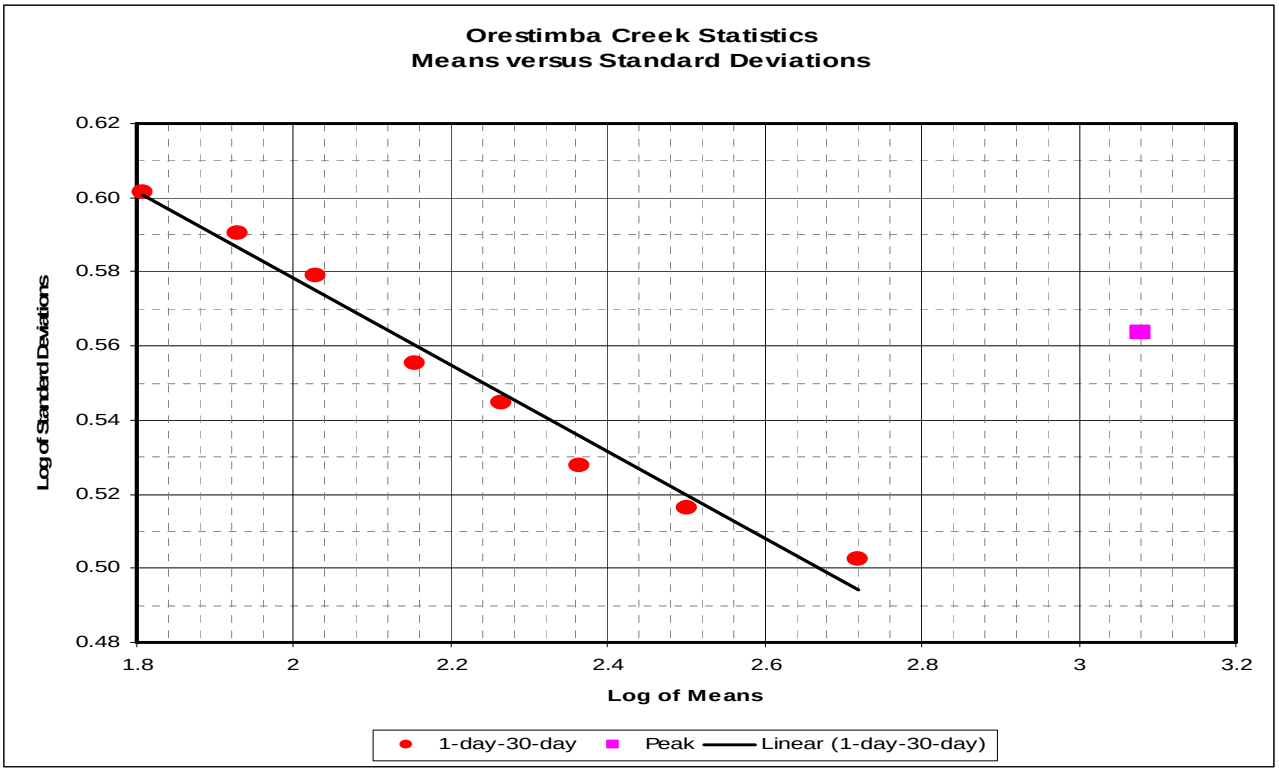


Figure 3. Orestimba Creek Statistics, Means versus Standard Deviations

TABLE 5A
Orestimba Creek near Newman
Flow Duration
Peak through 7-Day

	PEAK		1-DAY		3-DAY		5-DAY		7-DAY	
WY	Date	Flow	Date	Day-cfs	Date	Day-cfs	Date	Day-cfs	Date	Day-cfs
1932	2/8/1932	4260								
1933	1/29/1933	345	1/29/1933	89	1/29/1933	53.3	1/29/1933	33.1	1/27/1933	23.7
1934	1/1/1934	516	1/1/1934	199	1/1/1934	99.7	12/30/1933	67.4	12/30/1933	49.9
1935	4/8/1935	1320	4/8/1935	634	4/8/1935	286.3	4/7/1935	193.4	4/7/1935	145.4
1936	2/13/1936	1200	2/13/1936	630	2/13/1936	406.3	2/12/1936	362.4	2/12/1936	311.9
1937	2/13/1937	2180	2/14/1937	774	2/13/1937	472.0	3/21/1937	358.2	3/21/1937	296.0
1938	2/11/1938	3230	2/11/1938	1780	2/10/1938	1214.0	2/10/1938	1117.6	2/9/1938	928.6
1939	3/9/1939	115	3/10/1939	50	3/9/1939	35.7	3/9/1939	24.3	3/9/1939	18.0
1940	2/27/1940	3440	2/28/1940	1240	2/27/1940	963.3	2/26/1940	698.8	2/26/1940	544.7
1941	4/4/1941	3070	2/9/1941	1280	2/9/1941	955.3	2/9/1941	803.2	2/9/1941	672.4
1942	1/24/1942	1880	1/25/1942	677	1/24/1942	444.7	1/24/1942	349.2	1/24/1942	277.7
1943	1/21/1943	6450	1/22/1943	1050	1/21/1943	836.7	1/21/1943	554.0	1/21/1943	408.6
1944	2/29/1944	1290	2/29/1944	856	2/29/1944	433.0	2/29/1944	313.4	2/29/1944	274.6
1945	2/2/1945	5970	2/2/1945	2550	2/1/1945	1192.7	2/1/1945	771.2	2/1/1945	564.4
1946	12/25/1945	782	12/25/1945	354	12/23/1945	179.7	12/23/1945	132.8	12/23/1945	105.3
1947	10/1/1946	0	10/1/1946	0	10/1/1946	0.0	10/1/1946	0.0	10/1/1946	0.0
1948	10/1/1947	0	10/1/1947	0	10/1/1947	0.0	10/1/1947	0.0	10/1/1947	0.0
1949	3/12/1949	335	3/12/1949	196	3/12/1949	102.0	3/12/1949	65.5	3/12/1949	48.0
1950	2/5/1950	175	2/5/1950	98	2/5/1950	77.7	2/5/1950	52.6	2/5/1950	42.1
1951	12/3/1950	2920	12/8/1950	935	12/7/1950	428.7	12/4/1950	399.2	12/3/1950	363.1
1952	1/12/1952	3660	1/12/1952	1450	1/12/1952	903.0	1/12/1952	800.4	1/12/1952	636.0
1953	12/7/1952	147	12/31/1952	49	1/8/1953	38.7	1/8/1953	32.0	1/8/1953	27.1
1954	10/1/1953	0	10/1/1953	0	10/1/1953	0.0	10/1/1953	0.0	10/1/1953	0.0
1955	1/19/1955	16	1/19/1955	7.5	2/28/1955	4.6	2/28/1955	3.0	2/26/1955	2.1
1956	12/23/1955	5620	12/23/1955	3170	12/23/1955	1593.3	12/23/1955	1042.6	12/23/1955	768.4
1957	2/24/1957	1440	2/25/1957	411	2/24/1957	231.7	2/24/1957	154.6	2/24/1957	120.9
1958	4/2/1958	10200	4/3/1958	3010	4/1/1958	1965.7	4/1/1958	1449.8	4/1/1958	1224.7
1959	2/16/1959	5380	2/16/1959	1570	2/16/1959	805.0	2/16/1959	550.8	2/16/1959	554.9
1960	2/10/1960	448	2/10/1960	264	2/9/1960	179.3	2/8/1960	126.0	2/6/1960	103.4
1961	10/1/1960	0	10/1/1960	0	10/1/1960	0.0	10/1/1960	0.0	10/1/1960	0.0
1962	2/15/1962	1740	2/15/1962	1080	2/14/1962	658.7	2/12/1962	463.8	2/10/1962	447.7
1963	2/1/1963	8300	2/1/1963	2090	1/31/1963	1225.0	1/31/1963	764.0	1/31/1963	552.0
1964	1/22/1964	156	1/22/1964	60	1/22/1964	39.7	1/22/1964	26.6	1/22/1964	19.5
1965	1/6/1965	560	1/6/1965	359	1/6/1965	273.7	1/4/1965	207.8	1/3/1965	176.6
1966	12/30/1965	128	12/31/1965	107	12/30/1965	94.7	12/30/1965	71.2	12/30/1965	54.6
1967	1/24/1967	4200	1/24/1967	1580	1/24/1967	753.3	1/22/1967	582.6	1/24/1967	460.7
1968	10/1/1967	0	10/1/1967	0	10/1/1967	0.0	10/1/1967	0.0	10/1/1967	0.0
1969	1/25/1969	5080	1/25/1969	2060	1/25/1969	1323.3	2/24/1969	882.4	1/20/1969	817.9
1970	3/1/1970	1010	1/16/1970	474	1/16/1970	319.7	3/1/1970	269.0	3/1/1970	224.3
1971	12/21/1970	584	12/21/1970	320	12/20/1970	175.3	12/19/1970	139.6	12/19/1970	106.7
1972	10/1/1971	0	10/1/1971	0	10/1/1971	0.0	10/1/1971	0.0	10/1/1971	0.0
1973	2/11/1973	1510	2/11/1973	914	2/11/1973	650.7	2/10/1973	537.6	2/7/1973	497.7
1974	3/3/1974	922	3/3/1974	489	3/2/1974	310.7	3/2/1974	217.0	3/2/1974	169.0
1975	3/8/1975	1010	3/8/1975	514	3/7/1975	303.7	3/7/1975	217.8	3/7/1975	166.7
1976	10/1/1975	0	10/1/1975	0	10/1/1975	0.0	10/1/1975	0.0	10/1/1975	0.0
1977	10/1/1976	0	10/1/1976	0	10/1/1976	0.0	10/1/1976	0.0	10/1/1976	0.0
1978	1/17/1978	4360	2/9/1978	1740	1/15/1978	1286.3	1/14/1978	858.6	1/14/1978	638.1
1979	2/21/1979	1270	2/21/1979	568	2/21/1979	390.0	2/21/1979	269.2	2/21/1979	203.7
1980	2/16/1980	5210	2/18/1980	2720	2/17/1980	2226.7	2/17/1980	2020.0	2/16/1980	1821.0
1981	1/29/1981	1130	3/22/1981	71	3/21/1981	52.3	3/20/1981	38.6	3/19/1981	32.0
1982	1/5/1982	5550	1/5/1982	1930	1/4/1982	1017.0	1/4/1982	630.8	3/31/1982	457.7
1983	1/24/1983	6360	3/1/1983	2560	2/28/1983	2053.3	2/27/1983	1435.4	2/26/1983	1113.1
1984	12/25/1983	991	12/25/1983	637	12/25/1983	343.7	12/25/1983	235.0	12/25/1983	184.6
1985	2/9/1985	50	2/9/1985	30	2/9/1985	18.0	2/9/1985	13.6	3/27/1985	10.7
1986	2/19/1986	6990	2/19/1986	2790	2/17/1986	2180.0	2/15/1986	1664.2	2/14/1986	1431.0
1987	3/6/1987	112	3/6/1987	77	3/6/1987	38.0	3/5/1987	25.8	3/5/1987	19.6
1988	10/1/1987	0	10/1/1987	0	10/1/1987	0.0	10/1/1987	0.0	10/1/1987	0.0
1989	10/1/1988	0	10/1/1988	0	10/1/1988	0.0	10/1/1988	0.0	10/1/1988	0.0
1990	5/28/1990	4	5/28/1990	0.29	5/26/1990	0.1	5/24/1990	0.1	5/22/1990	0.0
1991	3/24/1991	1260	3/25/1991	445	3/25/1991	315.0	3/24/1991	221.8	3/24/1991	165.3
1992	2/15/1992	888	2/15/1992	368	2/15/1992	212.7	2/12/1992	154.2	2/12/1992	123.7

TABLE 5A

Orestimba Creek near Newman

Flow Duration

Peak through 7-Day

	PEAK		1-DAY		3-DAY		5-DAY		7-DAY	
WY	Date	Flow	Date	Day-cfs	Date	Day-cfs	Date	Day-cfs	Date	Day-cfs
1993	1/13/1993	4190	1/13/1993	1990	1/13/1993	1102.7	1/13/1993	836.2	1/13/1993	708.6
1994	2/20/1994	12	2/20/1994	3.7	2/20/1994	2.1	2/20/1994	1.3	2/18/1994	0.9
1995	3/10/1995	12000	3/10/1995	4260	3/10/1995	2114.7	3/10/1995	1367.8	3/10/1995	1022.7
1996	2/19/1996	3130	2/20/1996	1190	2/19/1996	1044.3	2/19/1996	786.6	2/19/1996	608.0
1997	1/23/1997	3320	1/2/1997	1940	1/1/1997	1375.7	1/22/1997	1221.4	1/22/1997	1050.6
1998	2/3/1998	9470	2/3/1998	4550	2/2/1998	2412.7	2/3/1998	1743.8	2/2/1998	1779.9
1999	2/9/1999	833	2/9/1999	283	2/8/1999	172.3	2/8/1999	120.0	2/8/1999	90.1
2000	2/14/2000	2550	2/14/2000	1040	2/12/2000	548.3	2/12/2000	386.8	2/12/2000	286.1
2001	3/5/2001	958	3/5/2001	606	3/5/2001	285.0	3/4/2001	187.6	3/4/2001	140.4
2002	1/3/2002	425	1/3/2002	289	1/2/2002	149.7	12/30/2001	130.0	12/29/2001	116.1
2003	12/16/2002	2790	12/16/2002	576	12/20/2002	333.0	12/16/2002	303.0	12/16/2002	289.0
2004	2/25/2004	2990	2/26/2004	538	2/25/2004	410.0	2/25/2004	273.2	2/25/2004	203.6
2005	2/16/2005	1820	2/16/2005	930	2/20/2005	500.0	2/16/2005	459.8	2/16/2005	440.9
2006	1/2/2006	1630	4/5/2006	593	4/4/2006	455.7	4/3/2006	335.6	4/3/2006	263.1
2007	10/1/2006	0	10/1/2006	0	10/1/2006	0.0	10/1/2006	0.0	10/1/2006	0.0

TABLE 5B

Orestimba Creek near Newman

Flow Duration

10-Day through 30-Day

	10-DAY		15-DAY		20-DAY		30-DAY	
WY	Date	Day-cfs	Date	Day-cfs	Date	Day-cfs	Date	Day-cfs
1933	1/24/1933	16.6	1/19/1933	11.0	1/14/1933	8.3	1/4/1933	5.5
1934	12/28/1933	35.0	12/23/1933	23.3	12/18/1933	17.5	12/8/1933	11.7
1935	4/7/1935	112.5	4/7/1935	82.6	4/5/1935	64.0	3/24/1935	45.2
1936	2/13/1936	278.1	2/12/1936	263.9	2/12/1936	210.4	2/12/1936	145.1
1937	2/5/1937	266.7	2/5/1937	206.3	1/30/1937	164.6	1/30/1937	115.6
1938	2/9/1938	723.4	2/1/1938	680.1	2/1/1938	569.6	2/3/1938	468.1
1939	3/9/1939	12.9	3/5/1939	8.6	3/9/1939	6.4	2/27/1939	4.3
1940	2/25/1940	408.8	2/23/1940	289.7	2/23/1940	226.4	2/3/1940	163.0
1941	2/9/1941	597.1	2/9/1941	517.6	2/9/1941	450.0	2/8/1941	461.1
1942	1/24/1942	211.4	1/24/1942	207.3	1/24/1942	181.3	1/24/1942	131.2
1943	1/21/1943	380.0	1/21/1943	294.0	1/21/1943	227.0	1/21/1943	155.8
1944	2/22/1944	216.2	2/21/1944	190.9	2/21/1944	154.3	2/20/1944	107.5
1945	2/1/1945	402.4	2/1/1945	271.9	2/1/1945	205.4	2/1/1945	137.9
1946	12/23/1945	77.5	12/23/1945	57.7	12/23/1945	45.6	12/23/1945	31.5
1947	10/1/1946	0.0	10/1/1946	0.0	10/1/1946	0.0	10/1/1946	0.0
1948	10/1/1947	0.0	10/1/1947	0.0	10/1/1947	0.0	10/1/1947	0.0
1949	3/12/1949	34.6	3/11/1949	23.9	3/10/1949	18.1	2/28/1949	12.0
1950	2/5/1950	32.1	2/5/1950	21.9	2/2/1950	16.4	1/23/1950	11.0
1951	12/3/1950	273.3	12/3/1950	190.9	11/19/1950	161.3	11/19/1950	126.9
1952	1/12/1952	475.1	1/12/1952	429.7	1/12/1952	352.0	1/12/1952	249.7
1953	1/8/1953	24.4	12/31/1952	21.6	12/31/1952	20.1	12/31/1952	15.6
1954	10/1/1953	0.0	10/1/1953	0.0	10/1/1953	0.0	10/1/1953	0.0
1955	2/23/1955	1.5	2/18/1955	1.0	2/13/1955	0.7	2/3/1955	0.5
1956	12/23/1955	574.1	12/23/1955	418.5	12/23/1955	342.1	12/23/1955	248.2
1957	2/23/1957	90.2	2/23/1957	62.4	2/23/1957	47.6	2/21/1957	31.9
1958	4/1/1958	938.4	3/31/1958	670.8	3/21/1958	571.2	3/15/1958	463.9
1959	2/15/1959	425.7	2/15/1959	303.0	2/15/1959	233.8	2/11/1959	160.5
1960	2/5/1960	79.8	2/5/1960	55.7	2/5/1960	42.3	2/2/1960	28.4
1961	10/1/1960	0.0	10/1/1960	0.0	10/1/1960	0.0	10/1/1960	0.0
1962	2/9/1962	364.8	2/9/1962	264.2	2/9/1962	202.8	2/9/1962	164.7
1963	1/31/1963	389.4	1/31/1963	331.7	1/31/1963	265.7	1/31/1963	181.3
1964	1/19/1964	13.6	1/14/1964	9.1	1/9/1964	6.8	12/30/1963	4.5
1965	12/31/1964	145.2	12/28/1964	112.1	12/28/1964	89.2	12/28/1964	65.9
1966	12/30/1965	39.3	12/29/1965	26.8	12/27/1965	20.2	12/17/1965	13.4
1967	1/22/1967	434.5	1/22/1967	323.3	1/22/1967	249.8	1/22/1967	170.9
1968	10/1/1967	0.0	10/1/1967	0.0	10/1/1967	0.0	10/1/1967	0.0
1969	1/19/1969	766.9	1/19/1969	557.6	1/19/1969	486.1	1/19/1969	416.3
1970	1/16/1970	209.1	1/15/1970	156.1	1/15/1970	119.9	1/15/1970	82.5
1971	12/19/1970	81.2	12/19/1970	60.1	12/18/1970	47.1	12/19/1970	45.2
1972	10/1/1971	0.0	10/1/1971	0.0	10/1/1971	0.0	10/1/1971	0.0
1973	2/6/1973	453.4	2/6/1973	337.1	2/6/1973	266.4	2/6/1973	229.3
1974	3/1/1974	129.3	12/27/1973	105.6	12/27/1973	89.1	12/27/1973	71.7
1975	3/7/1975	145.2	3/8/1975	119.6	3/7/1975	109.0	3/7/1975	79.3
1976	10/1/1975	0.0	10/1/1975	0.0	10/1/1975	0.0	10/1/1975	0.0
1977	10/1/1976	0.0	10/1/1976	0.0	10/1/1976	0.0	10/1/1976	0.0
1978	1/14/1978	455.8	1/9/1978	312.2	3/3/1978	237.3	1/15/1978	278.1
1979	2/20/1979	149.8	2/14/1979	106.2	2/14/1979	83.4	2/14/1979	57.6
1980	2/16/1980	1348.0	2/16/1980	934.0	2/16/1980	738.6	2/16/1980	521.0
1981	3/19/1981	26.6	3/19/1981	21.7	3/19/1981	18.3	3/15/1981	13.0
1982	3/30/1982	364.8	3/31/1982	405.5	3/30/1982	339.1	3/29/1982	249.3
1983	2/26/1983	844.4	2/27/1983	607.3	1/22/1983	541.5	2/6/1983	416.6
1984	12/25/1983	142.0	12/24/1983	105.4	12/10/1983	86.2	12/9/1983	71.1
1985	3/27/1985	8.5	3/26/1985	5.8	3/12/1985	4.7	3/7/1985	5.2
1986	2/13/1986	1114.1	2/13/1986	805.3	2/13/1986	637.5	2/13/1986	534.4
1987	3/5/1987	14.4	3/5/1987	10.1	3/5/1987	8.0	2/13/1987	6.3
1988	10/1/1987	0.0	10/1/1987	0.0	10/1/1987	0.0	10/1/1987	0.0
1989	10/1/1988	0.0	10/1/1988	0.0	10/1/1988	0.0	10/1/1988	0.0
1990	5/19/1990	0.0	5/14/1990	0.0	5/9/1990	0.0	4/29/1990	0.0
1991	3/20/1991	125.0	3/18/1991	90.1	3/18/1991	68.1	3/4/1991	59.6
1992	2/12/1992	92.2	2/12/1992	63.9	2/12/1992	49.0	2/12/1992	34.8

TABLE 5B
Orestimba Creek near Newman
Flow Duration
10-Day through 30-Day

	10-DAY		15-DAY		20-DAY		30-DAY	
WY	Date	Day-cfs	Date	Day-cfs	Date	Day-cfs	Date	Day-cfs
1993	1/13/1993	552.1	1/13/1993	397.1	1/7/1993	319.1	1/13/1993	250.6
1994	2/15/1994	0.6	2/10/1994	0.4	2/5/1994	0.3	1/26/1994	0.2
1995	3/9/1995	749.6	3/10/1995	646.4	3/9/1995	519.7	3/9/1995	365.9
1996	2/19/1996	453.3	2/19/1996	335.1	2/4/1996	317.5	1/31/1996	274.8
1997	1/21/1997	790.3	1/20/1997	547.1	1/20/1997	423.6	1/1/1997	443.6
1998	2/2/1998	1404.3	2/2/1998	1073.0	2/2/1998	950.0	2/1/1998	776.6
1999	2/7/1999	65.7	1/31/1999	47.9	1/27/1999	40.2	1/27/1999	29.7
2000	2/14/2000	210.6	2/12/2000	205.5	2/12/2000	173.6	2/12/2000	128.0
2001	2/24/2001	114.3	2/24/2001	98.4	2/23/2001	76.4	2/12/2001	52.4
2002	12/29/2001	90.8	12/29/2001	63.1	12/21/2001	50.5	12/21/2001	34.7
2003	12/16/2002	212.2	12/16/2002	158.0	12/16/2002	135.3	12/16/2002	98.2
2004	2/25/2004	146.7	2/19/2004	103.6	2/18/2004	79.6	2/18/2004	53.9
2005	2/15/2005	351.0	2/15/2005	260.3	2/15/2005	213.4	2/15/2005	152.9
2006	4/1/2006	200.2	4/1/2006	146.9	3/26/2006	117.3	3/15/2006	94.1
2007	10/1/2006	0.0	10/1/2006	0.0	10/1/2006	0.0	10/1/2006	0.0

Salado Creek above I-5

The Salado Creek above I-5 flow frequency curve was computed by multiplying the Del Puerto flows by 34 percent. This factor is the ratio of the Salado drainage area to the Del Puerto drainage area (24.6/72.6 = 0.34). This same method and ratio are consistent with the original hydrology employed at Salado in the West Stanislaus County 2001 feasibility study. The statistical methods and options used here are the same used for the above Del Puerto Creek analysis. **Table 6** shows three iterations of Salado Creek above I-5 statistics. This table lists peak, 1-, 3-, 5-, 7-, 10-, 15-, 20-, and 30-day frequency statistics. The first are the results of the statistics without a low outlier test. The second are the results considering only the lowest water year as a low outlier. The third and final set of FAA runs uses the low outlier cutoff option to exclude the two lowest flow years of each of the durations and sets the skew to -0.5 for each curve. Note that the removed flows were 1 or 2 cfs or less. As with Del Puerto Creek, these flows should not drive the standard deviations or skews of the curves that determine the upper end of the frequency curves. **Chart 5** plots the means and standard deviations of each set. It omits the 20-day curve and data. **Table 7** tabulates the peak and volume data for the period of record. The dates are not included.

This analysis completes the update of the flow frequency curves found in the 2001 Feasibility Study, West Stanislaus County, California, and Hydrology Appendix for the Sacramento District USACE. Although not needed for this report, Salado Creek's frequency curves were updated to complete the set of the three frequency curves presented in the 2001 feasibility study. **Chart 5** displays the Salado Creek above I-5 peak and flow duration frequency curves.

Flood hydrographs are discussed following **Table 7**.

Table 6
FFA Results
Salado Creek above I-5

Statistics Reflect 34 Percent of All Del Puerto Creeks Flows before Outlier Tests				Lowest Year Set as Only Low Outlier			Final Frequency Statistics Low Outliers Set at Two			
Duration	Mean	Std. Dev.	Skew	Mean	Std. Dev.	Skew	Mean	Std. Dev.	Skew	Adopted Skew
Peak	1.8923	0.7811	-0.86	1.9371	0.7245	-0.74	1.9776	0.6767	-0.63	-0.50
1-Day	1.5969	0.7165	-0.85	1.6465	0.6503	-0.64	1.6875	0.6043	-0.53	-0.50
3-Day	1.4049	0.7049	-0.81	1.4507	0.6491	-0.68	1.4929	0.5993	-0.54	-0.50
5-Day	1.2880	0.7046	-0.74	1.3311	0.6564	-0.66	1.3760	0.5996	-0.43	-0.50
7-Day	1.2050	0.7042	-0.70	1.2492	0.6529	-0.58	1.2924	0.6007	-0.38	-0.50
10-Day	1.1063	0.7013	-0.69	1.1520	0.6455	-0.52	1.1931	0.5986	-0.35	-0.50
15-Day	1.0016	0.7027	-0.67	1.0491	0.6416	-0.45	1.0881	0.6000	-0.31	-0.50
20-day	0.9260	0.7044	-0.67	0.9747	0.6397	-0.40	1.0126	0.6010	-0.29	-0.50
30-day	0.8306	0.7072	-0.69	0.8813	0.6363	-0.35	0.9179	0.6005	-0.24	-0.50

NOTES:
1. Peak flow record 1958-2006 for 48 years of record. Daily flow record 1966-2006 for 41 years of record.
2. Drainage area of 24.6 sq. mi.

TABLE 7
Salado Creek at Damsite
Flow Duration

Peak and daily flow are 34 percent of Del Puerto Creek near Patterson

WY	Peak Flow	1-DAY Day-cfs	3-DAY Day-cfs	5-DAY Day-cfs	7-DAY Day-cfs	10-DAY Day-cfs	15-DAY Day-cfs	20-DAY Day-cfs	30-DAY Day-cfs
1959	612.0								
1960	55.8								
1961	8.8								
1962	232.9								
1963	166.6								
1964	14.3								
1965	35.4								
1966	8.2	6.8	6.1	5.4	4.5	3.6	2.8	2.3	1.7
1967	401.2	84.0	55.6	43.5	34.0	32.9	24.6	19.2	13.4
1968	25.5	10.2	4.7	3.3	2.7	2.1	1.6	1.4	1.2
1969	310.4	135.7	91.0	71.6	64.5	52.9	44.2	40.5	33.7
1970	61.9	28.9	20.6	18.4	15.7	12.9	10.9	9.0	6.9
1971	42.5	21.4	13.1	10.0	8.1	6.7	5.3	4.4	4.5
1972	1.7	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.6
1973	166.9	90.8	66.5	55.2	54.2	49.9	38.5	31.2	27.2
1974	33.7	24.5	18.5	14.8	12.8	10.9	9.0	8.2	6.9
1975	71.1	40.5	28.7	21.7	17.5	15.4	12.7	12.2	9.6
1976	1.2	1.1	0.9	0.7	0.7	0.6	0.5	0.4	0.3
1977	1.7	1.7	0.6	0.4	0.3	0.2	0.1	0.1	0.1
1978	255.0	86.4	68.0	49.4	40.2	32.0	24.3	20.0	20.8
1979	53.7	30.3	26.4	20.0	15.8	12.2	9.0	7.5	5.6
1980	506.6	260.8	208.6	176.9	143.7	109.8	79.3	65.7	48.6
1981	27.2	12.9	7.8	5.7	4.5	3.5	2.7	2.3	1.9
1982	438.6	168.0	94.4	60.4	44.7	34.5	34.5	29.2	22.3
1983	547.4	330.8	258.5	205.4	167.4	135.3	111.6	96.5	80.7
1984	154.4	107.8	54.3	37.3	29.3	22.7	16.7	14.0	11.5
1985	25.2	13.3	8.2	6.0	4.7	3.7	2.7	2.3	2.0
1986	516.8	263.5	214.4	169.9	143.9	108.2	75.4	57.6	46.2
1987	39.8	18.0	9.3	6.3	4.8	3.6	2.6	2.1	2.2
1988	27.2	13.3	10.2	6.9	5.3	3.9	2.8	2.3	1.7
1989	0.6	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3
1990	126.1	33.3	16.7	10.3	7.5	5.3	3.5	2.7	1.8
1991	241.4	78.2	43.5	31.0	24.6	18.6	13.8	11.1	8.3
1992	208.8	89.1	37.6	37.3	30.4	23.1	16.7	12.7	9.3
1993	310.4	200.6	113.4	87.6	74.8	56.6	40.6	35.3	28.7
1994	13.3	9.9	6.7	5.2	4.3	3.4	2.6	2.5	2.0
1995	1156.0	418.2	221.0	147.5	112.0	83.5	79.0	66.1	48.7
1996	211.8	111.5	90.9	72.4	58.3	46.3	36.9	33.1	29.5
1997	632.4	249.9	143.9	132.9	110.8	85.9	63.3	50.7	45.1
1998	1791.8	635.8	293.0	241.8	222.0	179.3	143.9	131.4	111.9
1999	77.2	26.9	19.8	15.2	11.9	9.3	7.4	6.3	4.9
2000	248.9	97.9	54.6	37.9	28.4	23.0	22.2	19.1	14.7
2001	110.2	59.5	29.9	20.9	16.1	12.0	9.9	8.0	6.0
2002	26.9	17.3	10.2	7.9	8.5	7.0	5.3	4.4	3.4
2003	251.3	74.8	48.1	34.6	29.9	23.0	18.3	16.1	11.6
2004	100.3	48.6	30.1	20.9	16.1	12.0	8.6	6.7	4.9
2005	130.6	69.7	52.8	42.4	42.0	34.5	27.1	23.3	17.8
2006	152.7	58.8	39.3	2001.0	23.5	19.0	15.4	1970.0	10.2

4. FLOOD HYDROGRAPHS

The original flood hydrographs for routing through the dry dam and project area were developed from the HEC-HMS model output using a 1 percent 96-hour storm centered above Orestimba Creek near Newman gage, site of the proposed dam on Orestimba Creek. A concurrent storm was developed for local areas below the Damsite to derive local flows that would flow into Orestimba Creek below the Damsite. **Figure 4** shows the procedure that translates the average daily flows from the frequency curves to the synthetic rain flood hydrographs. The peaks and average volumes of these hydrographs were modified to reflect the new peak and volume flow frequency curves. The 96-hour storm produced the 5 days of runoff pattern from the original report. This 5-day hydrograph became the main wave runoff pattern used to develop a 6-wave 30-day flood (examples showing the use of the 30-day flood series can be found in References g and h). Its volume was adjusted to match the peak, 3- and 4-day volume from its frequency curves. This pattern was then used to compute six 5-day waves to produce a 30-day 1 percent probability flood series. The 0.2, 0.5, 2, 10 and 20 percent probability floods are ratios of the 1 percent flood series based on ratios of flows from the peak and volume frequency curves. These floods will be used for sizing the reservoir and defining the Orestimba Creek floodplain. The flood series for the local areas used the concurrent 5-day wave and determined the other waves using the ratios of the volumes from the Orestimba and Del Puerto Creek frequency curves. See Reference b for the development of the unit hydrographs and routing in the HMS model.

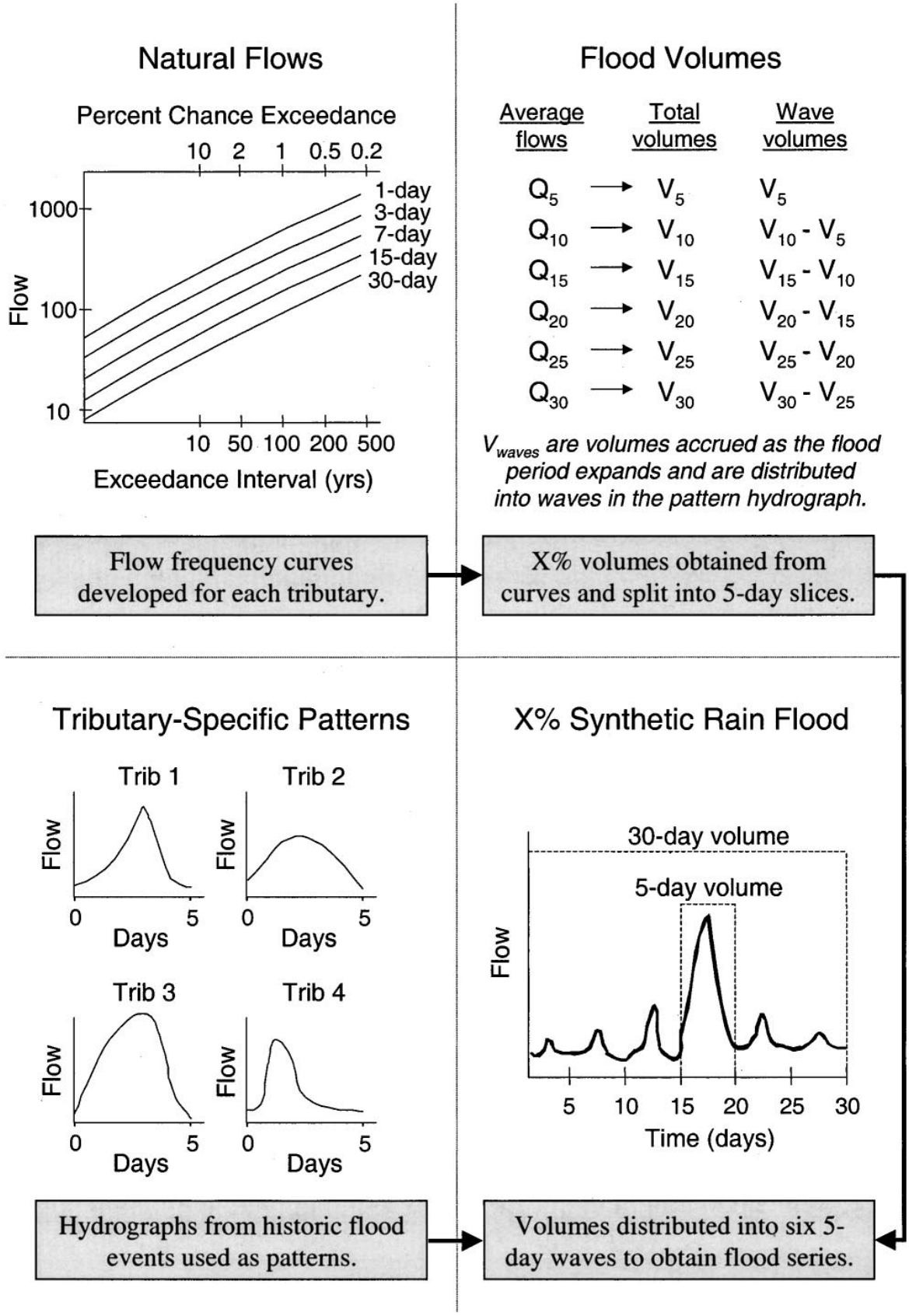


Figure 4. Translation of average natural flows from frequency curves to synthetic rain flood hydrographs. The 5-day pattern obtained from the 96-hour storm is repeated to form a 30-day series.

The adjusted hydrographs were developed only for those basins circled on **Figure 5**. The original HMS model routing diagram is shown in **Figure 6**. **Table 8** lists the names of the computed hydrographs and drainages areas. Volume summary tables for the new hydrographs are listed in **Figures 7 and 8**.

Table 8
Report Hydrograph Names and Drainage Areas

Basin Location and Description	Hydrograph Name	Drainage Area (sq. mi.)
Orestimba Creek	ORES1	134.0
Crow Creek above canal flow (at I-5)	CROW1	27.0
Crow Creek local flow	CRSUB2	3.91
Orestimba Creek local flow from subarea 4	ORSUB4	9.25
Orestimba Creek local flow from subarea 5	ORSUB5	1.78
Orestimba Creek local flow from subarea 6	ORSUB6	5.59
Orestimba Creek local flow from subarea 7	ORSUB7	5.70

Orestimba Creek above the gage (ORES1) is the concentration point for the three subareas above it and the location of a the proposed dry dam. This flow point in **Figure 6**, HMS Model Routing Diagram, is designated ORES1 (MC). The other hydrographs represent flows at other concentration points on **Figure 6**. The local flows may enter Orestimba Creek at many points along the reach that runs through that subarea.

Figure 5. Subarea Map. Report hydrograph locations are circled.

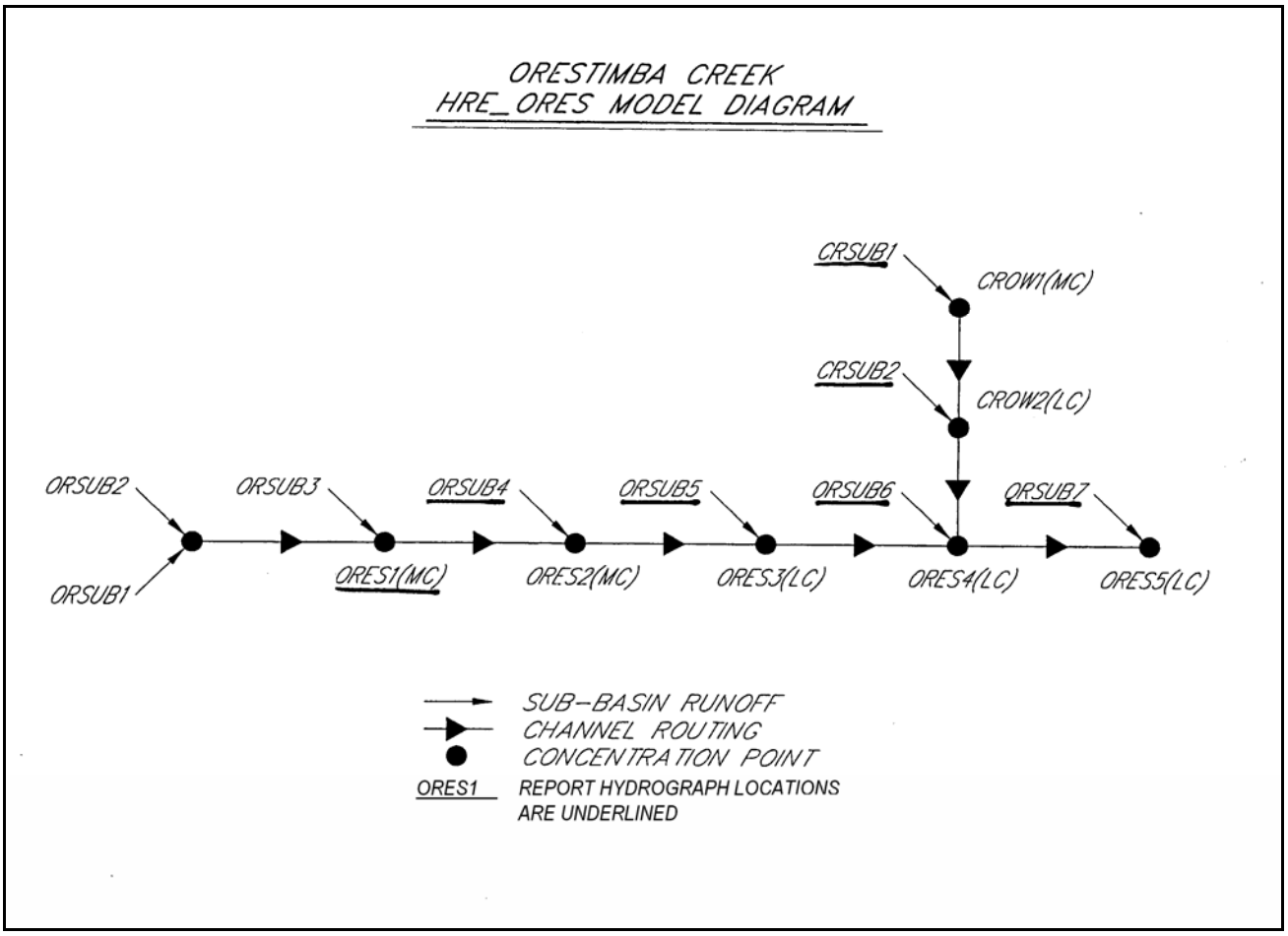
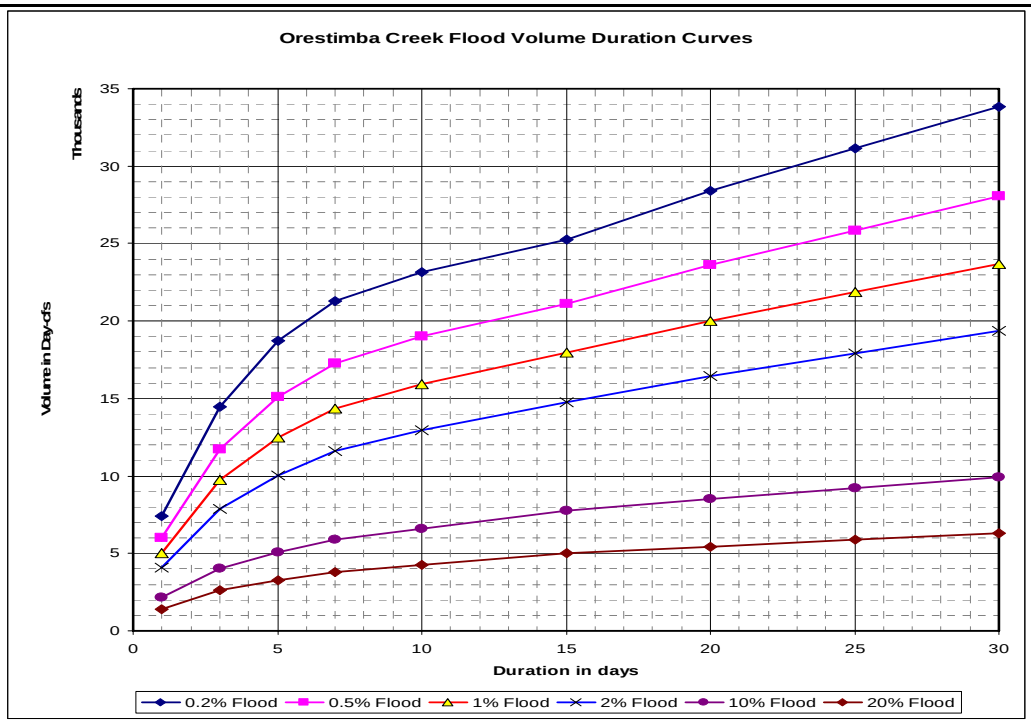


Figure 6. Orestimba Creek HMS Model Routing Diagram. Computed hydrographs are underlined.

Figures 7 and 8 summarize frequency peaks and volumes, determined in Section 3, with mass curves and tables.

All flood hydrographs for the Orestimba Creek model are based on the 1 percent 96-hour rain flood hydrograph shape from the 2001 West Stanislaus feasibility report (Reference b). The storm was centered over Orestimba Creek above the gage. Concurrent storms were developed for the six subbasins that flow into Orestimba Creek below the gage. The flood hydrograph volumes from this storm were adjusted to closely match the 3-day and 96-hour volumes of the Orestimba Creek 1 percent mass curve (see **Figure 7**). The 5-day volume from this hydrograph is the main 5-day wave of the 30-day series. The other 5-day waves are based on the volume ratios from the frequency curves. The main 5-day waves for the remaining floods are ratios of the 1 percent main wave. **Table A 1** (see appendix) shows the tabulation of Orestimba's 30-day hydrographs. The 6-wave 30-day concurrent Crow Creek hydrograph above I-5 used the 5-day 1 percent flood as the main wave. The remaining 5 waves were based on volume ratios from the Del Puerto Creek mass curve, **Figure 8**.

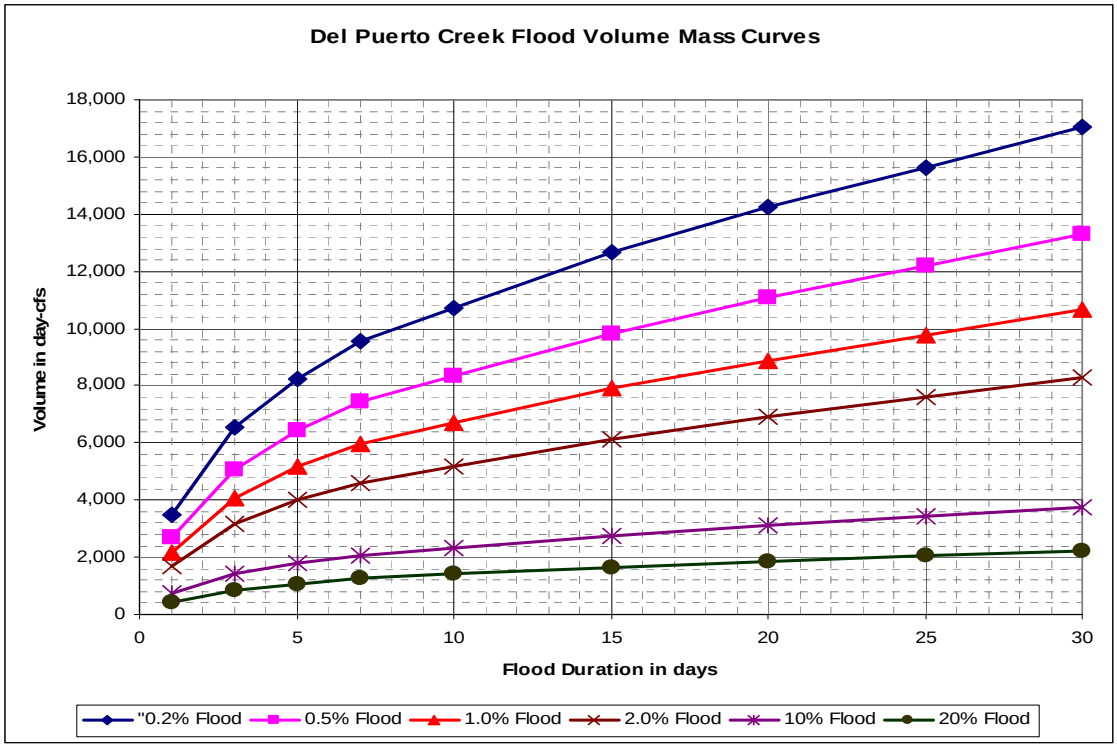


Duration	Flood Probability in Average Flow for each Duration in Day-cfs					
	0.2% 500 yr	0.5% 200 yr	1.0% 100 yr	2.0% 50 yr	10.0% 10 yr	20.0% 5 Yr
Peak (cfs)	20,255	16,553	13,831	11,208	5,679	3,634
1-Day-cfs	7,398	6,026	5,035	4,093	2,132	1,405
3-Day-cfs	4,825	3,908	3,250	2,627	1,344	876
5-Day-cfs	3,743	3,017	2,498	2,010	1,013	654
7-Day-cfs	3,039	2,467	2,052	1,657	838	539
10-Day-cfs	2,316	1,899	1,591	1,293	662	426
15-Day-cfs	1,685	1,408	1,196	985	516	334
20-Day-cfs	1,421	1,182	1,001	821	425	272
30-Day-cfs	1,128	936	790	646	330	210

Flood Flow Frequency Volumes in Day-cfs for Mass Curves

Duration	Flood Probability in Total Flood Volume for Each Duration in Day-cfs					
	0.2%	0.5%	1.0%	2.0%	10.0%	20.0%
1-Day	7,398	6,026	5,035	4,093	2,132	1,405
3-Days	14,474	11,724	9,750	7,881	4,033	2,628
5-Days	18,714	15,086	12,492	10,049	5,064	3,268
7-Days	21,270	17,266	14,363	11,598	5,864	3,770
10-Days	23,164	18,988	15,908	12,932	6,619	4,264
15-Days	25,279	21,117	17,939	14,774	7,743	5,003
20-Days	28,414	23,649	20,024	16,427	8,497	5,443
25-Days	31,133	25,865	21,863	17,900	9,198	5,865
30-Days	33,853	28,080	23,702	19,373	9,899	6,288

Figure 7. Orestimba Creek Flood Volume Mass Curves and Tabulation



Duration	Flood Probability in Average Flow for each Duration in Day-cfs					
	0.2%	0.5%	1.0%	2.0%	10.0%	20.0%
Peak (cfs)	10,069	7,576	5,905	4,430	1,793	1,005
1-Day-cfs	3,503	2,715	2,172	1,679	747	445
3-Day-cfs	2,186	1,697	1,360	1,053	471	282
5-Day-cfs	1,652	1,284	1,030	798	358	215
7-Day-cfs	1,364	1,060	850	659	296	177
10-Day-cfs	1,070	833	668	519	234	140
15-Day-cfs	844	656	527	409	184	110
20-Day-cfs	712	553	444	345	155	93
30-Day-cfs	569	443	355	276	124	75
Flood Flow Frequency Volumes in Day-cfs for Mass Curves						
Duration	Flood Probability in Total Flood Volume for Each Duration in Day-cfs					
	0.2%	0.5%	1.0%	2.0%	10.0%	20.0%
1-Day	3,503	2,715	2,172	1,679	747	445
3-Days	6,557	5,092	4,080	3,160	1,414	846
5-Days	8,259	6,420	5,149	3,992	1,792	1,074
7-Days	9,547	7,421	5,952	4,615	2,071	1,241
10-Days	10,699	8,326	6,685	5,189	2,337	1,404
15-Days	12,653	9,843	7,900	6,130	2,758	1,656
20-Days	14,233	11,070	8,883	6,891	3,098	1,859
25-Days	15,649	12,174	9,772	7,583	3,413	2,049
30-Days	17,065	13,279	10,661	8,275	3,727	2,238

Figure 8. Del Puerto Creek Flood Volume Mass Curves and Tabulation

Table 9 shows the ratios of Orestimba Creek's (ORES1) and Crow Creek's (CROW1 and CRSUB2) 5-day main wave used to produce the 1 percent 30-day series. Orestimba Creek's 5-day volume was a little less than the frequency curve's 5-day volume, so the second 5-day wave ratio was increased to make the 10-day volume match the frequency 10-day event. The same was done on the remainder of the main wave ratios so that the resulting volumes matched the Orestimba frequency curve. Orestimba Creek's ratios to the main wave are listed in **Table 10**. Crow Creek's main wave is the product of a concurrent 1 percent storm over its basin. The main wave is less than a specific centering over the same area. Ratios in **Table 9** are derived from Del Puerto Creek's volume flow frequency curves without any further adjustment.

Table 9
1 Percent 30-Day Flood Series
for Orestimba and Crow Creeks
Ratios of Main Waves
Used to Develop 30-Day Series

Start Day	Relative Wave Size	Location	
		ORES1	CROW1 & CRSUB2
1	6	0.166	0.173
6	4	0.188	0.191
11	2	0.438	0.298
16	1	1.000	1.000
21	3	0.184	0.236
26	5	0.166	0.173

Note: Wave 1, the largest wave, occurs as the fourth wave. Wave 6 is the smallest wave.

The main 5-day wave for each of the additional five floods, 0.2, 0.5, 2.0, 10, and 20 percent, are ratios of their 5-day volumes to that of the 1 percent (100-year) 5-day volume, as shown below, and at the top of **Table 11** as the "Main Wave Ratios to the 1 Percent Probability Flood."

The main wave for each frequency flood is computed first and then ratios of that main wave are computed to fill in the remaining 5 of the six waves. **Table 11** shows the entire Orestimba Creek 30-day flood, 6-wave 5-day flood series ratios. **Figure 9**, Orestimba Creek near Newman, CA, (at the damsite) shows the main 5-day waves for the 20, 10, 2.0, 1.0, 0.5, and 0.2 percent probability flood. An example of the six 5-day waves (the Orestimba Creek near Newman (ORES2) 1 percent 30-day flood series) is shown in **Figure 10**. The same floods for Crow Creek (CROW1) are shown in **Figures 11 and 12**, respectively.

Table 10
Orestimba Creek 1 Percent Flood Hydrograph Flows

Duration	Units	Frequency Curve Flows	Adjusted Hydrograph Flows	Percent of Frequency Values
Peak	cfs	13,831	13,831	100
3-day (72-hr)	day-cfs	3,250	3,194	98
4-day (96-hr)	day-cfs	2,498	2,586	104
5-day (120-hr)	day-cfs	2,498	2,213	89
7-day	day-cfs	2,052	1,962	96
10-day	day-cfs	1,591	1,591	100
15-day	day-cfs	1,196	1,199	100
20-day	day-cfs	1,001	1,001	100
25-day	day-cfs	875	875	100
30-day	day-cfs	790	790	100

Table 11
Orestimba Creek at the Damsite
30-Day Flood, 6-Wave 5-Day Flood Series Ratios

Main Wave Ratios to the 1 Percent Probability Flood						
Percent Flood Probability	0.20%	0.5%	1.0%	2%	10%	20%
Common Flood Designation	500 yr	200 yr	100 yr	50 yr	10 yr	5 yr
Flood Main 5-Day Wave Ratio	1.500	1.210	1.000	0.810	0.410	0.270

Hydrograph Wave Order	5-Day Wave Ratios to Their Main Wave Ratios of main wave of the given frequency to compute the remaining 5 waves						
	Wave Size*	0.20%	0.5%	1.0%	2%	10%	20%
1	6	0.164	0.159	0.166	0.164	0.154	0.141
2	4	0.127	0.165	0.188	0.184	0.166	0.147
3	2	0.396	0.418	0.438	0.443	0.459	0.427
4	1	1.000	1.000	1.000	1.000	1.000	1.000
5	3	0.189	0.189	0.184	0.206	0.248	0.247
6	5	0.164	0.165	0.166	0.164	0.154	0.141

* Wave volumes are ranked from the largest volume to the smallest. Wave 1 is the largest wave and wave 6 is the smallest.

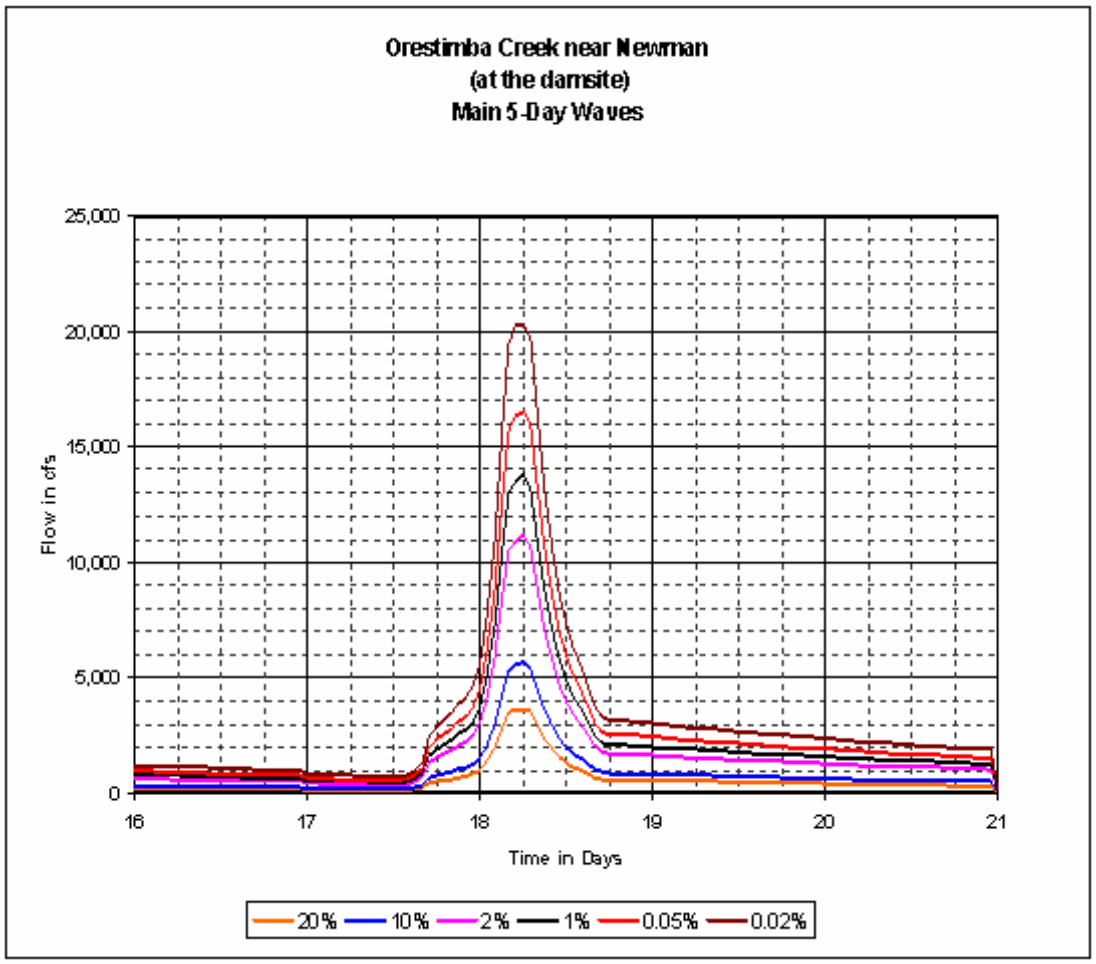


Figure 9. Orestimba Creek near Newman, Main 5-Day Wave Flood Frequency Series

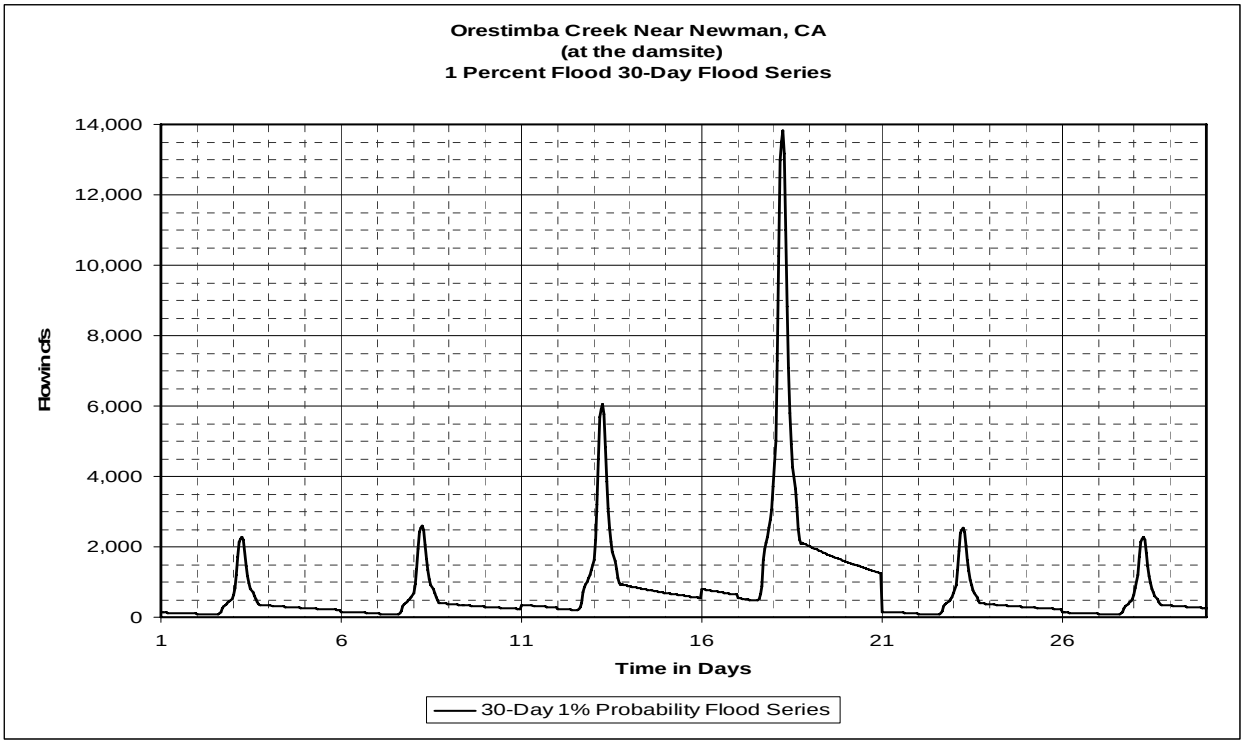


Figure 10. Orestimba Creek near Newman, 1 Percent Flood 30-Day Flood Series

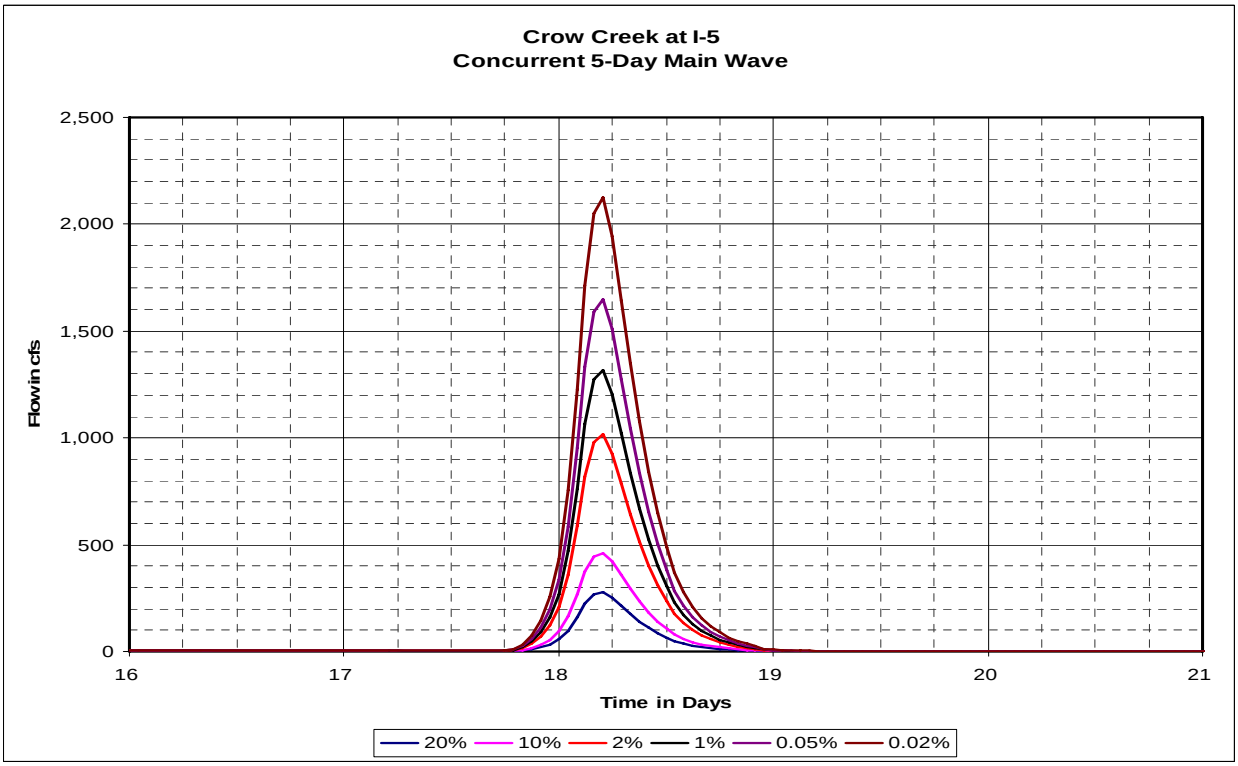


Figure 11. Crow Creek at I-5, Concurrent 5-Day Main Wave Flood Frequency Series

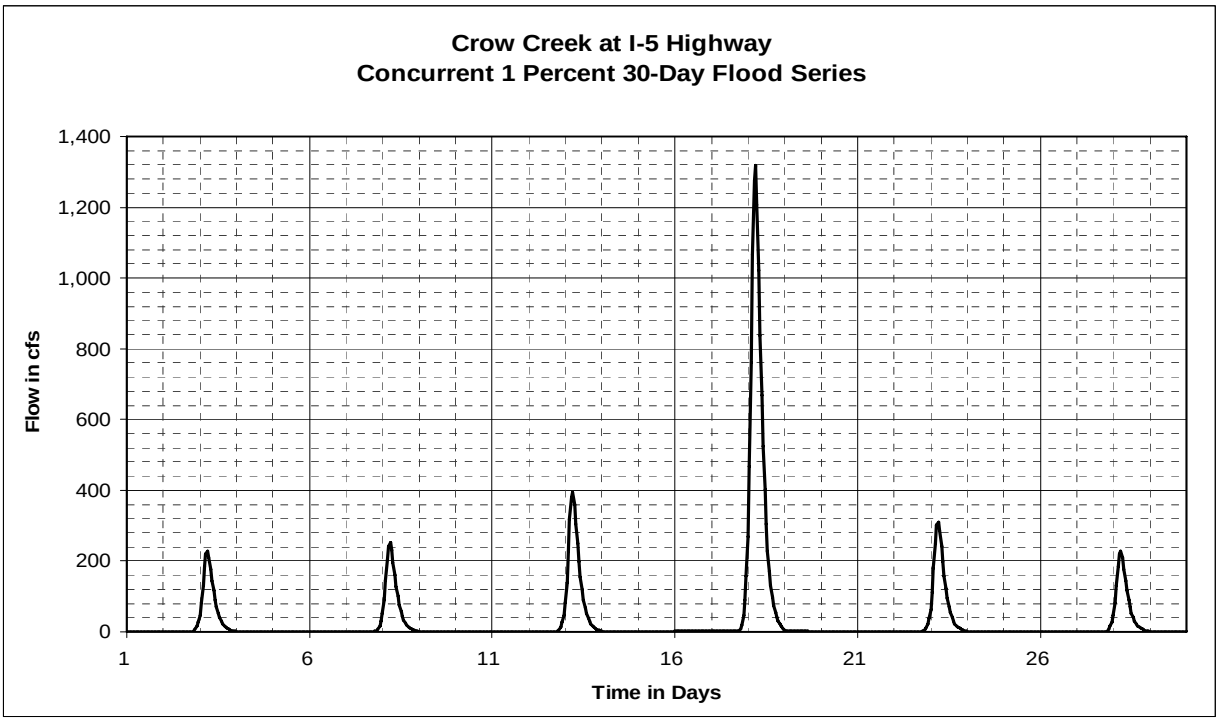


Figure 12. Crow Creek at I-5, Concurrent 1 Percent 30-Day Flood Series

Concurrent Flows

The concurrent local flows of CRSUB2, ORSUB4, ORSUB5, ORSUB6, and ORSUB7 are based on a concurrent 96-hour storm that produced a 7-day hydrograph. The precipitation losses prevented runoff for the first two days of the storm over the local area. The remaining five days of runoff were used as the main wave for all the local flow flood series. Subsequent wave volumes for ORSUB4, ORSUB5, ORSUB6, and ORSUB7 for the 1 percent flood came from the Orestimba Creek volume frequency curve ratios (see **Table 12**). Crow Creek CROW1 and Crow Creek local (CRSUB2) concurrent floods used volume ratios found for Del Puerto Creek near Patterson frequency curves (see **Table 9**). These ratios produced the 1 percent 30-day flood. The 1 percent 30-day flood derived from **Table 12** was then multiplied by a single ratio (listed at the top of **Table 11** as "Main Wave Ratios to the 1 Percent Probability Flood") to obtain the other frequency floods for local concurrent flow. The routing and combining of these subarea hydrographs will be done in a hydraulic model.

Table 12
1 Percent 30-Day Flood Series
for Orestimba Creek Subareas
Ratios of Main Wave
Used to Develop 30-Day Series

Start Day	Relative Wave Size	Location
		CRSUB2, ORSUB4, ORSUB5, ORSUB6, and ORSUB7
1	6	0.147
6	4	0.163
11	2	0.273
16	1	1.000
21	3	0.167
26	5	0.147

Note: Wave 1,the largest wave, occurs as the fourth wave. Wave 6 is the smallest wave.

ORSUB4 subarea flow is shown in **Figures 13 and 14** as an example of flow from one of the local agricultural valley areas. The flood series for the local agricultural areas start on day six. Precipitation for the first couple of waves is lost by infiltration or field storage.

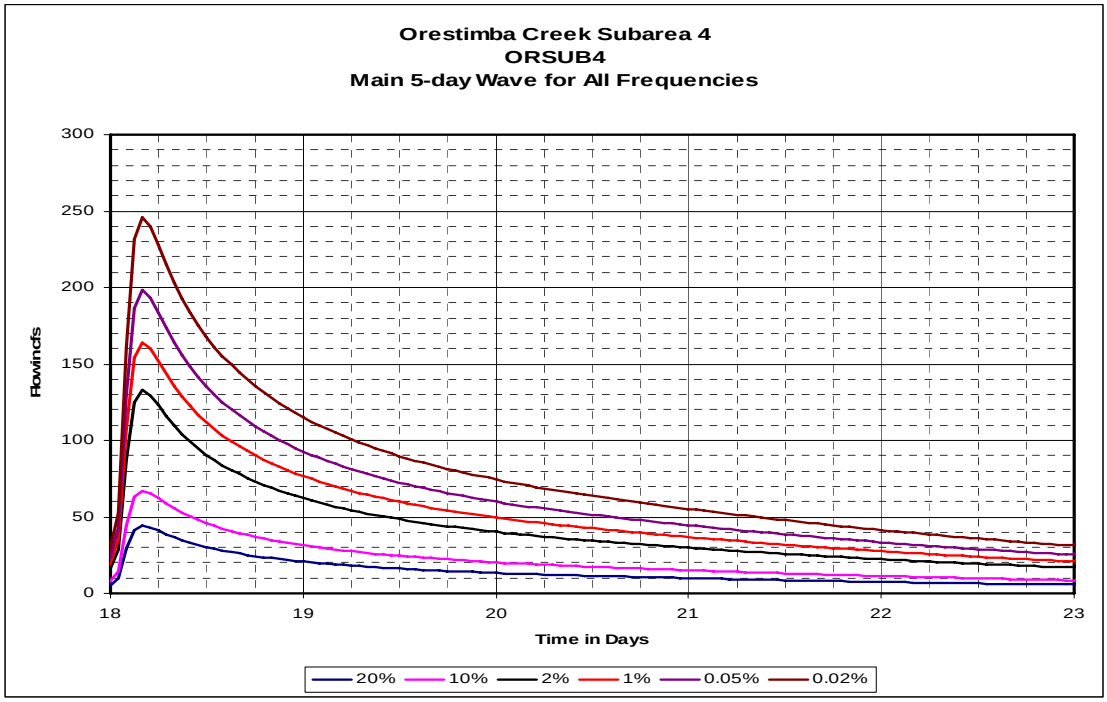


Figure 13. Orestimba Creek Subarea 4, Main 5-Day Wave for All Frequencies

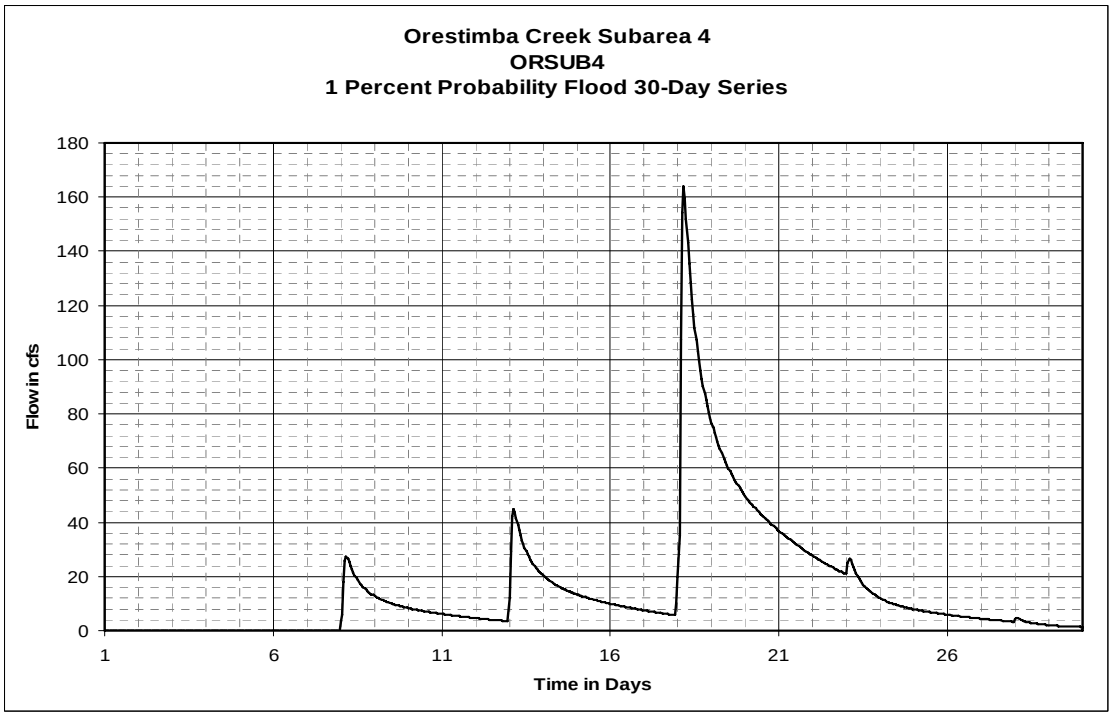


Figure 14. Orestimba Creek Subarea 4, 1 Percent Probability Flood 30-Day Series

5. SUMMARY AND RECOMMENDED USE OF FLOOD FREQUENCY ANALYSIS AND FLOOD HYDROGRAPHS

The updated frequency curves in this report include additional years of record (a total of 75 years of credible data) and additional volume-duration analysis. The influence of stream geomorphology and climate was also considered in developing the final frequency curves. The great similarities of the

statistics of the upper quartile of flows between Orestimba and Del Puerto creeks helped to determine reasonable and more positive skew for Orestimba Creek. It is recommended that risk analysis use 75 years of record to determine its confidence bands. The 2001 West Stanislaus feasibility study and subsequent reports had different hydrographs for different duration floods for different report alternatives. There are substantial changes in the revised hydrographs over the feasibility study's hydrographs. The peak, 24 - and 72-hour hydrographs are now, on average, over 20 percent lower. The 15-day has decreased an average of 13 percent. **Table 13** compares the 2001 study's frequency and flood hydrograph peaks and volumes with the updated floods.

This report has only one flood series for each of its six frequencies. The hydrographs are provided in the appendix of this report and can be made available in an Excel or DSS format. The hydrographs are in 720 one-hour time periods or for 30-days. Shorter durations may be extracted. To ensure proper timing, always use the same start day and hour for all the hydrographs (see **Table 12** for the start day for each wave). For example, the whole 30-day series may be used for sizing storage facilities. The maximum 5-day series starts on day 16. The maximum 10-day series starts on day 11. The maximum 15-day series also starts on day 11.

Table 13
Orestimba Creek near Newman
Comparison of 2001Feasibility Study Flow Values with the 2008 Updated Flows

Comparison of 2001 Feasibility Study Frequency Curve with 2008 Updated Frequency Curves						Comparison of 2001 Feasibility Study Rainfall-Runoff Hydrographs with 2008 Updated Hydrographs			
2001 FFA Frequency Curve Flow						2001 Rainfall-Runoff Flows from Model Runs			
Percent Probability	Peak cfs	1-day day-cfs	3-day day-cfs	7-day day-cfs	15-day day-cfs	Peak cfs	24-hr day-cfs	72-hr day-cfs	15-day day-cfs
0.2	27,100	8,990	5,450	2,770	1,820	25,258	12,293	5,807	1,820
1.0	19,800	6,760	4,120	2,130	1,390	18,437	8,974	4,239	1,390
2.0	16,200	5,650	3,440	1,810	1,170	15,118	7,358	3,476	1,170
10.0	7,680	2,870	1,760	974	613	7,190	3,500	1,653	613
2008 Updated FFA Frequency Curve Flows						2008 Updated Flood Hydrograph Flows			
0.2	20,255	7,398	4,823	3,039	1,685	20,255	9,231	4,785	1,685
1.0	13,831	5,035	3,249	2,052	1,196	13,831	6,168	3,194	1,196
2.0	11,208	4,093	2,626	1,657	985	11,208	4,996	2,588	985
10.0	5,679	2,132	1,344	838	516	5,679	2,529	1,310	516
Updated Flows as Percent of 2001 Flows									
0.2	75%	82%	89%	110%	93%	80%	75%	82%	93%
1.0	70%	74%	79%	96%	86%	75%	69%	75%	86%
2.0	69%	72%	76%	92%	84%	74%	68%	74%	84%
10.0	74%	74%	76%	86%	84%	79%	72%	79%	84%
Updated Flows as Percent Decrease of 2001 Flows									
0.2	25%	18%	11%	-10%	7%	20%	25%	18%	7%
1.0	30%	26%	21%	4%	14%	25%	31%	25%	14%
2.0	31%	28%	24%	8%	16%	26%	32%	26%	16%
10.0	26%	26%	24%	14%	16%	21%	28%	21%	16%
Average Decrease for All Durations without Regard to Volume									
	28%	24%	20%	4%	13%	23%	29%	22%	13%

6. REFERENCES

a. U.S. Army Corps of Engineers, Sacramento District, *Sacramento and San Joaquin River Basins Comprehensive Study*, Technical Studies Documentation, Appendix B: *Synthetic Hydrology Technical Documentation*, 2002.

b. U.S. Army Corps of Engineers, Sacramento District, *Hydrology Appendix to Feasibility Study*, West Stanislaus County, California, April 2001. (Prepared by Mid-Valley Engineering, Inc. Modesto, CA.)

c. Ayres Associate's Project Geomorphologist, *Orestimba Creek, Qualitative Geomorphic and Channel Stability Assessment*, August 1 and 2, 2007. Additional references are cited in this report.

d. U.S. Army Corps of Engineers, EM 1110-2-1415, *Hydrologic Frequency Analysis*, March 1993.

e. U.S. Army Corps of Engineers, EM 1110-2-1417, *Flood-Runoff Analysis*, August 1994

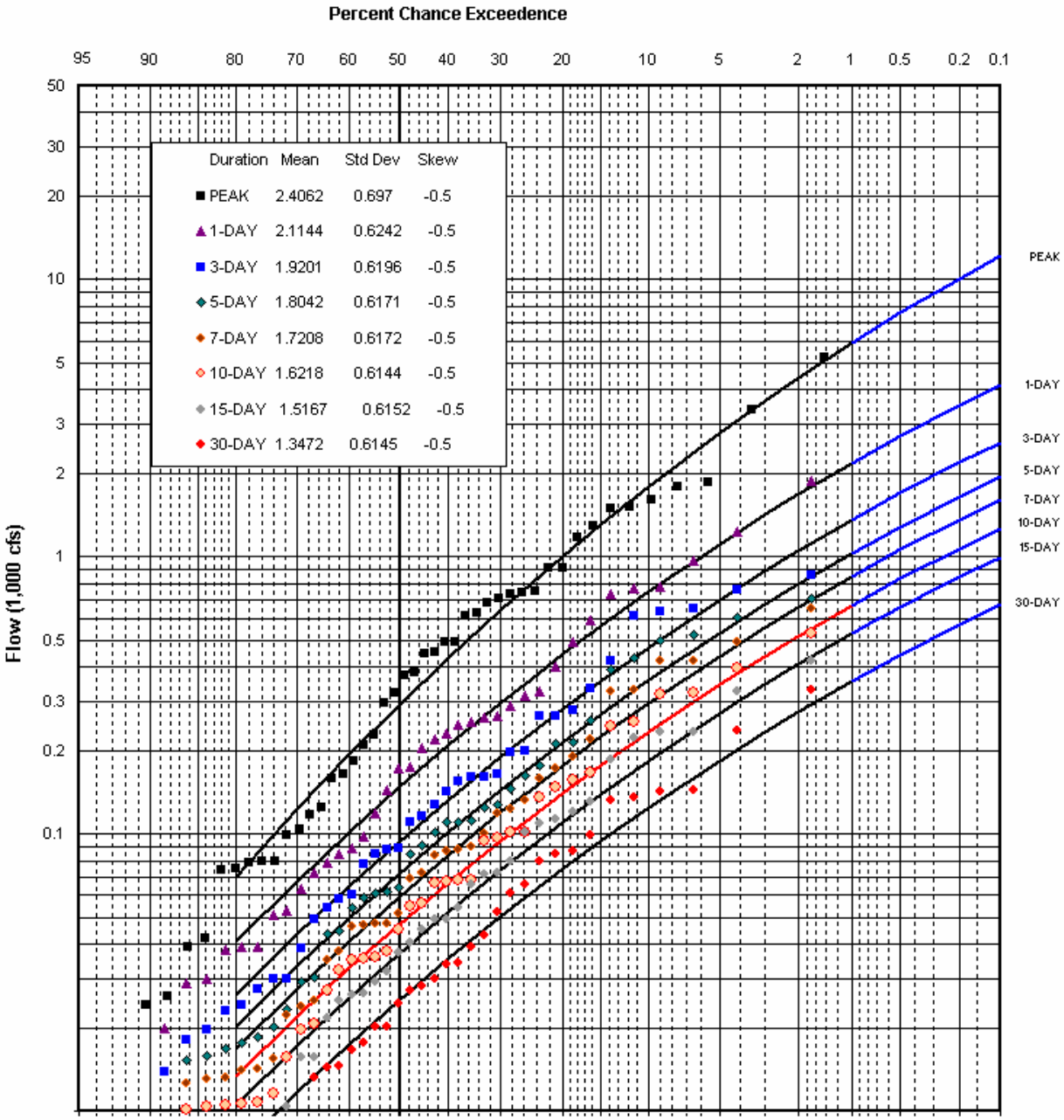
f. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-FFA Flood Frequency Analysis and Software Package. User's Manual, version 3.1, May 1992.

g. John T. Hickey et al, *Synthetic Rain Flood Hydrology for the Sacramento and San Joaquin River Basins*, Journal of Hydrologic Engineering, May/June 2002.

h. U.S. Army Corps of Engineers, Sacramento District, *Sacramento and San Joaquin River Basins Comprehensive Study*, Technical Studies Documentation, Appendix B, Interim Report, 2002. (http://www.spk.usace.army.mil/ projects/civil/compstudy/reports.html)

i. U.S. Department of the Interior, Geological Survey, Bulletin 17B of the Hydrology Subcommittee, *Guidelines for Determining Flood Flow Frequency*, Revised September 1981, Editorial Corrections March 1982.

CHARTS



RAIN FLOOD FREQUENCY CURVES
UNREGULATED CONDITIONS

PEAK & VOLUME FLOOD FLOW FREQUENCY CURVES
DEL PUERTO CREEK NEAR PATTERSON, CA
SAN JOAQUIN RIVER BASIN

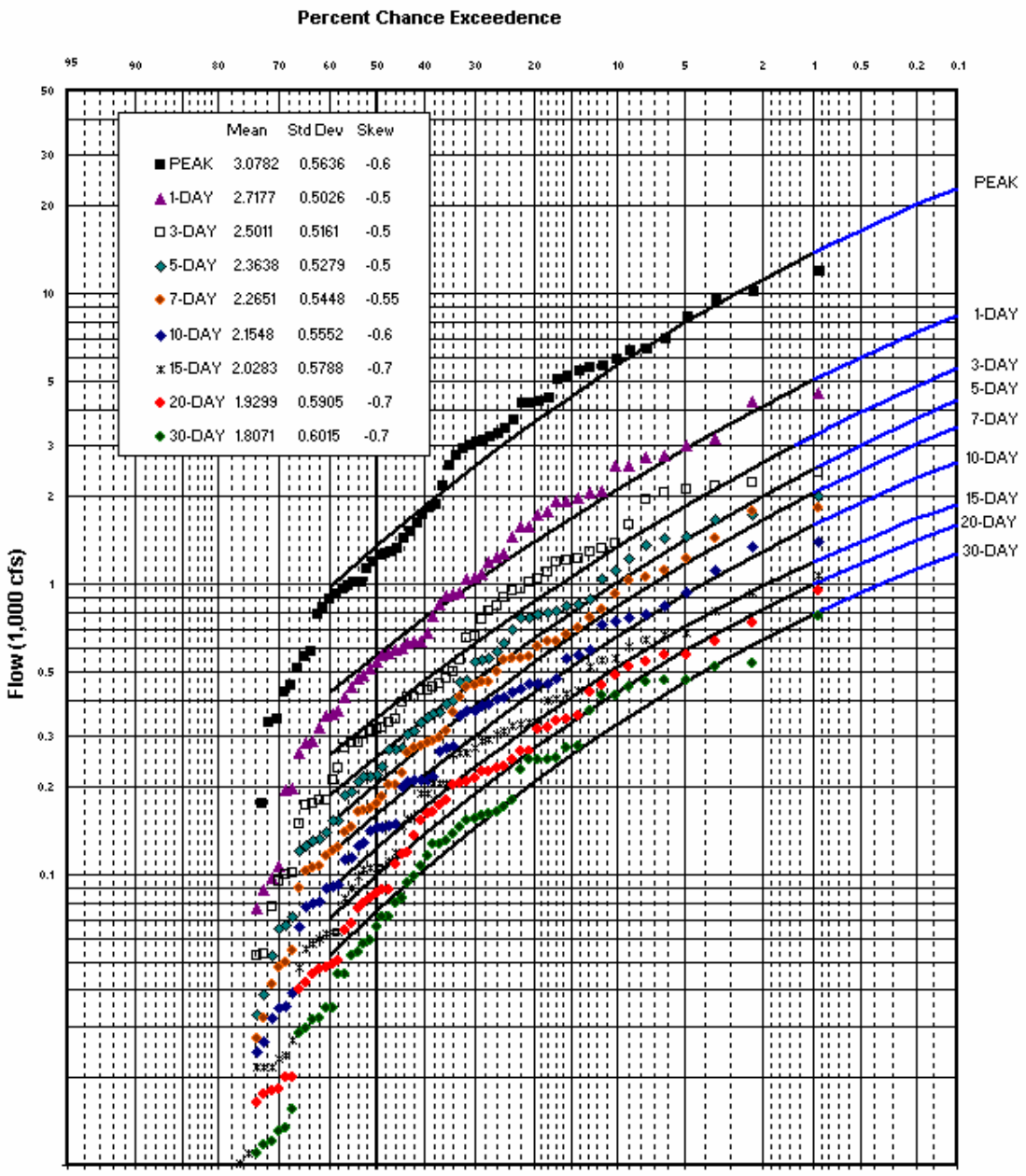
WATER YEARS 1959-2006

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

NOTES:

1. Peak flows WY 1959-2006, 48 years of record.
2. Volume daily flows WY 1966-2006, 41 years of record.
3. Median plotting positions used to plot flows.
4. Drainage area 72.6 sq. mi.
5. USGS Station 11274630

Chart 1



NOTES:

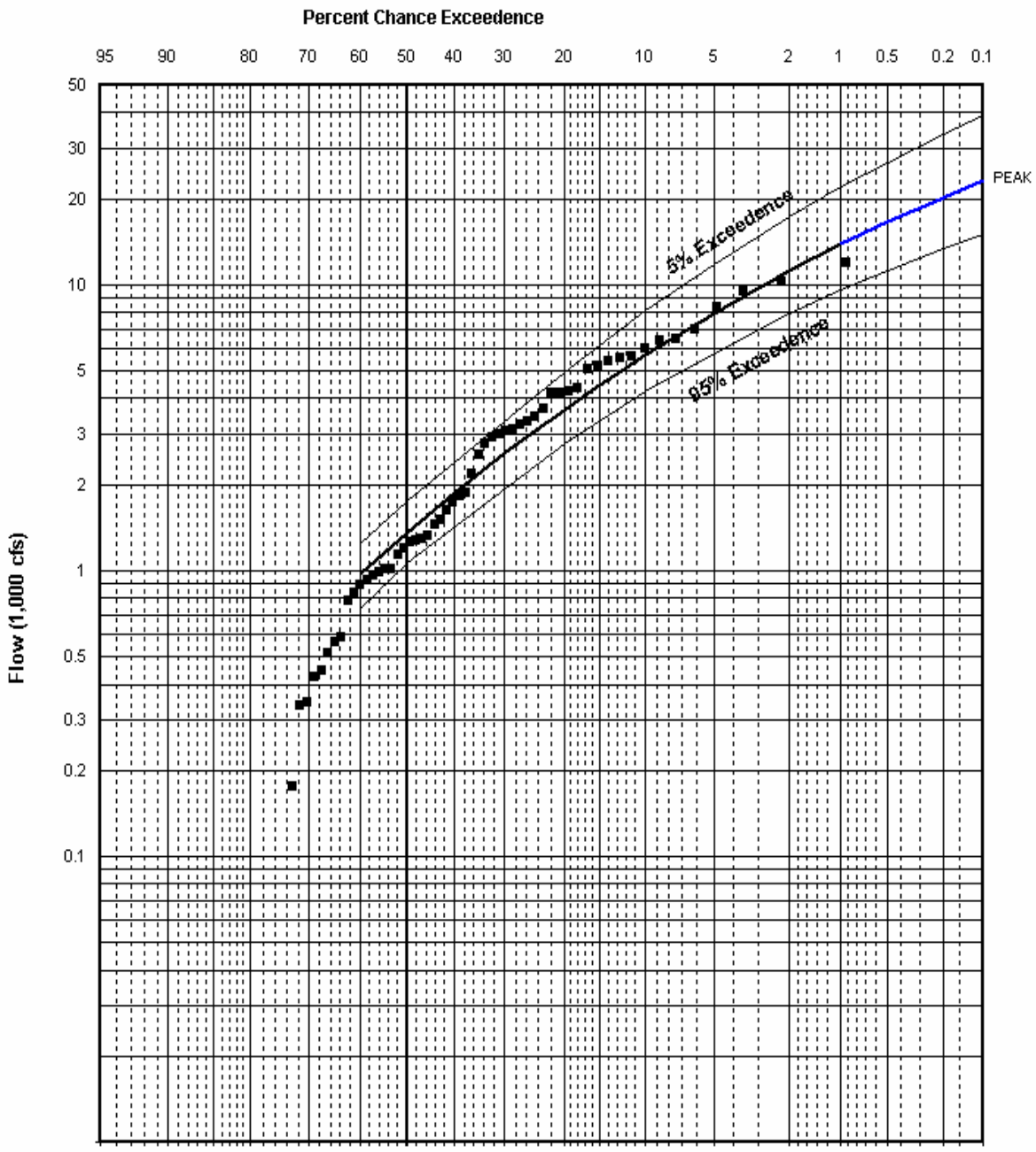
1. Period of record: water years1932-2006
2. Peak flow 76 years, daily flows 75 years of record
3. Median plotting positions used to plot flows.
4. Drainage area 134 sq.mi.
5. USGS Station 11274500

RAIN FLOOD FREQUENCY CURVES
UNREGULATED CONDITIONS

ORESTIMBA CREEK NEAR NEWMAN, CA
PEAK AND FLOW DURATION FREQUENCY CURVES
SAN JOAQUIN RIVER BASIN

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Chart 2



NOTES:

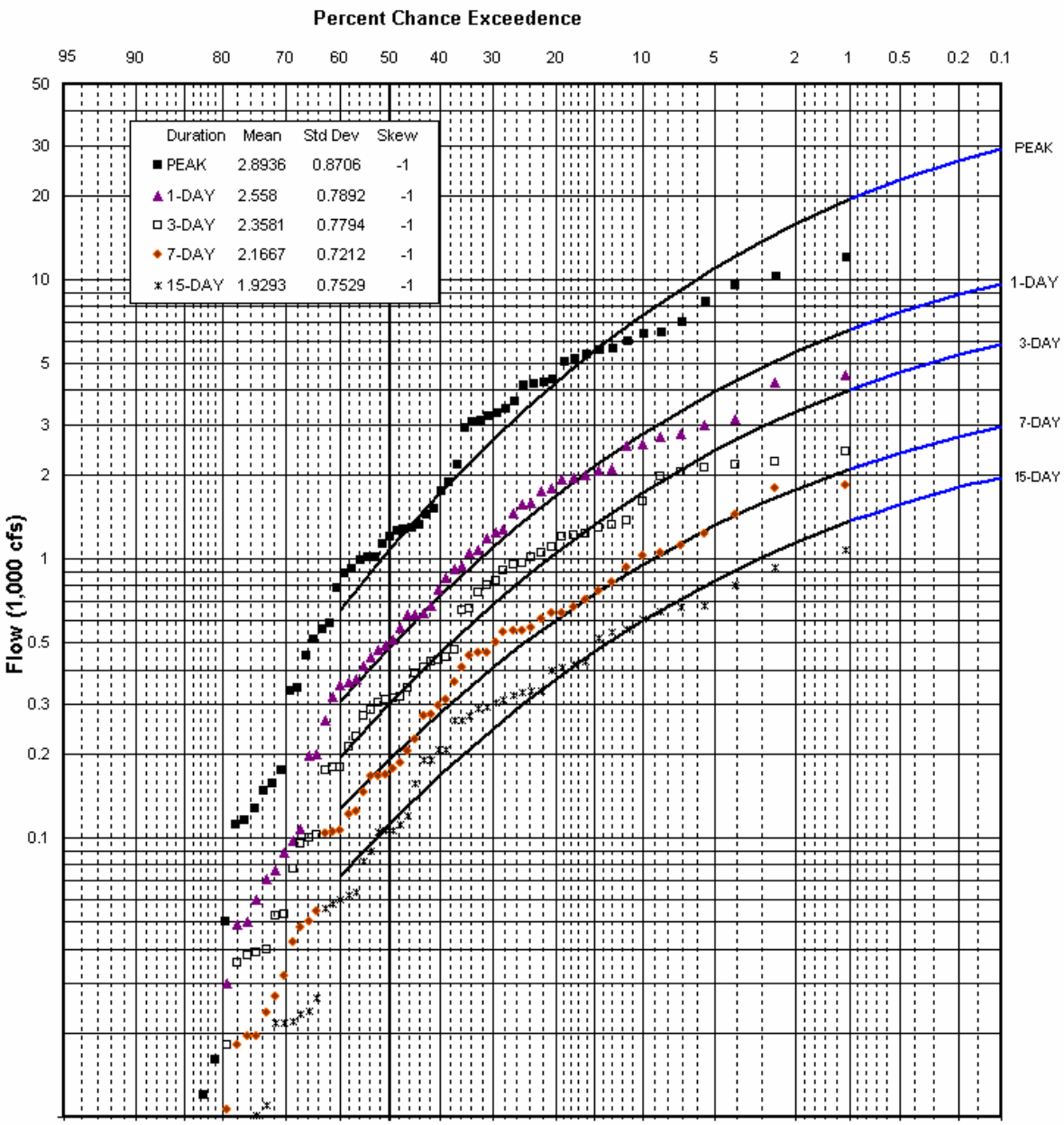
1. Period of record: water years 1932-2006
2. Peak flow has 76 years of record.
3. Median plotting positions used to plot flows.
4. Drainage area 134 sq. mi.
5. USGS Station 11274500

RAIN FLOOD FREQUENCY CURVES
UNREGULATED CONDITIONS

ORESTIMBA CREEK NEAR NEWMAN, CA
PEAK FLOW FREQUENCY CURVE
SAN JOAQUIN RIVER BASIN

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Chart 3



NOTES:

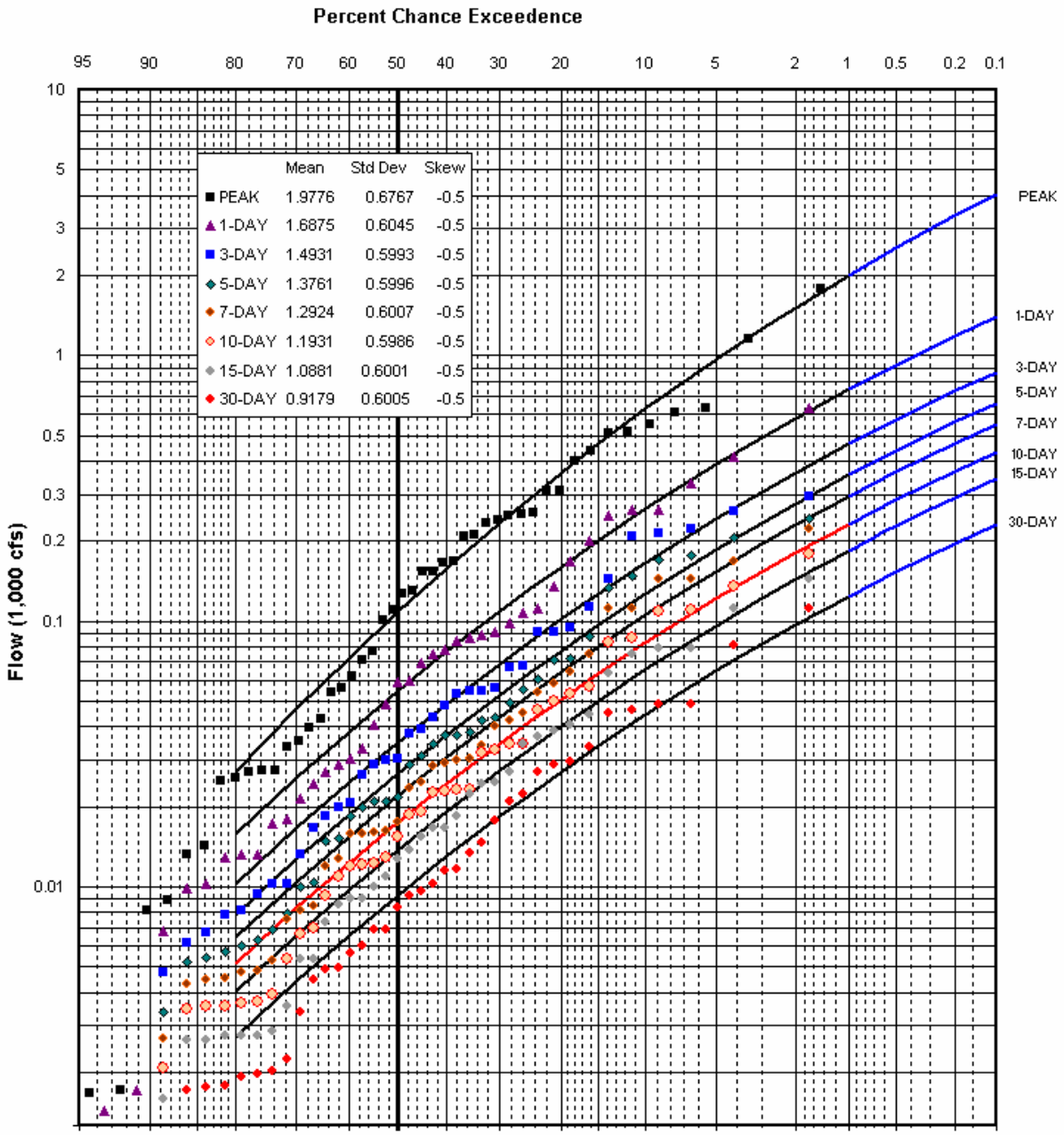
1. Statistics, frequency curves and data from 2001 report
2. Period of record: water years 1932-1998
3. Peak flow 67 years, daily flows 66 years of record
4. Median plotting positions used to plot flows.
5. Drainage area 134 sq. mi.
6. USGS Station 11274500
7. These frequency curves are superseded by the 2007 Orestimba Creek hydrology update report.

RAIN FLOOD FREQUENCY CURVES
UNREGULATED CONDITIONS

FROM 2001 GDM REPORT
ORESTIMBA CREEK NEAR NEWMAN, CA
PEAK AND FLOW DURATION FREQUENCY CURVES
SAN JOAQUIN RIVER BASIN

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Chart 4



NOTES:

1. Two lowest flows were considered outliers.
2. Median plotting positions
3. Drainage area 37 sq. mi.
4 Flows are 34 percent of Del Porto Creek near Patterson.
4. Peaks 1959-2007, 48 years of record.
5. Volume duration data 1966-2006, 41 years of record.

RAIN FLOOD FREQUENCY CURVES
UNREGULATED CONDITIONS

SALADO CREEK AT DAMSITE
SAN JOAQUIN RIVER BASIN

WATER YEARS 1959-2006

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Chart 5

APPENDIX

Table A1
Orestimba Creek Flood Hydrographs, ORES1
Specific Centering above Near Newman Gage

Period	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
1 - 00	31	51	107	134	155	198
1 - 01	30	51	106	133	154	197
1 - 02	30	50	105	132	152	195
1 - 03	30	50	104	130	151	193
1 - 04	30	49	103	129	149	191
1 - 05	29	49	102	128	148	189
1 - 06	29	48	101	126	146	187
1 - 07	29	48	100	125	145	185
1 - 08	28	47	99	124	143	183
1 - 09	28	47	98	123	142	182
1 - 10	28	46	97	121	141	180
1 - 11	28	46	96	120	139	178
1 - 12	27	45	95	119	138	176
1 - 13	27	45	94	118	136	174
1 - 14	27	44	93	116	135	173
1 - 15	26	44	92	115	134	171
1 - 16	26	43	91	114	132	169
1 - 17	26	43	90	113	131	167
1 - 18	26	43	89	112	130	166
1 - 19	25	42	89	111	128	164
1 - 20	25	42	88	110	127	162
1 - 21	25	41	87	108	126	161
1 - 22	25	41	86	107	124	159
1 - 23	26	42	89	111	129	165
2 - 00	21	34	72	90	104	133
2 - 01	20	34	71	89	103	132
2 - 02	20	33	70	88	102	130
2 - 03	20	33	70	87	101	129
2 - 04	20	33	69	86	100	128
2 - 05	20	32	68	85	99	126
2 - 06	19	32	68	84	98	125
2 - 07	19	32	67	84	97	124
2 - 08	19	31	66	83	96	122
2 - 09	19	31	65	82	95	121
2 - 10	19	31	65	81	94	120
2 - 11	18	30	64	80	93	119
2 - 12	18	30	64	79	92	118
2 - 13	18	30	64	80	92	118
2 - 14	20	33	69	86	100	128
2 - 15	25	41	86	107	124	159
2 - 16	34	56	118	147	170	218
2 - 17	62	103	217	271	314	402
2 - 18	74	123	259	324	375	480
2 - 19	81	134	282	353	409	523
2 - 20	87	145	305	381	442	565
2 - 21	97	161	339	423	491	628
2 - 22	105	174	366	458	531	678
2 - 23	117	194	408	510	591	755
3 - 00	142	235	494	617	715	915
3 - 01	191	317	667	834	966	1235
3 - 02	278	461	969	1211	1403	1794
3 - 03	391	648	1364	1705	1976	2526

Table A2
Crow Creek above Canal Flow, CROW1
Concurrent Centering

Period	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
1 - 00	0.1	0.2	0.5	0.7	0.8	1.1
1-1	0.1	0.2	0.5	0.7	0.8	1.1
1-2	0.1	0.2	0.5	0.7	0.8	1.1
1-3	0.1	0.2	0.5	0.6	0.8	1.0
1-4	0.1	0.2	0.5	0.6	0.8	1.0
1-5	0.1	0.2	0.5	0.6	0.8	1.0
1-6	0.1	0.2	0.5	0.6	0.8	1.0
1-7	0.1	0.2	0.5	0.6	0.8	1.0
1-8	0.1	0.2	0.5	0.6	0.8	1.0
1-9	0.1	0.2	0.5	0.6	0.8	1.0
1-10	0.1	0.2	0.5	0.6	0.7	1.0
1-11	0.1	0.2	0.5	0.6	0.7	0.9
1-12	0.1	0.2	0.4	0.6	0.7	0.9
1-13	0.1	0.2	0.4	0.6	0.7	0.9
1-14	0.1	0.2	0.4	0.6	0.7	0.9
1-15	0.1	0.2	0.4	0.6	0.7	0.9
1-16	0.1	0.2	0.4	0.6	0.7	0.9
1-17	0.1	0.2	0.4	0.5	0.7	0.9
1-18	0.1	0.2	0.4	0.5	0.7	0.9
1-19	0.1	0.2	0.4	0.5	0.7	0.9
1-20	0.1	0.2	0.4	0.5	0.7	0.8
1-21	0.1	0.2	0.4	0.5	0.6	0.8
1-22	0.1	0.2	0.4	0.5	0.6	0.8
1-23	0.1	0.2	0.4	0.5	0.6	0.8
2-0	0.1	0.2	0.4	0.5	0.6	0.8
2-1	0.1	0.2	0.4	0.5	0.6	0.8
2-2	0.1	0.2	0.4	0.5	0.6	0.8
2-3	0.1	0.2	0.4	0.5	0.6	0.8
2-4	0.1	0.2	0.4	0.5	0.6	0.8
2-5	0.1	0.2	0.4	0.5	0.6	0.8
2-6	0.1	0.2	0.4	0.5	0.6	0.8
2-7	0.1	0.2	0.4	0.5	0.6	0.7
2-8	0.1	0.2	0.4	0.5	0.6	0.7
2-9	0.1	0.2	0.3	0.5	0.6	0.7
2-10	0.1	0.2	0.3	0.4	0.6	0.7
2-11	0.1	0.2	0.3	0.4	0.5	0.7
2-12	0.1	0.2	0.3	0.4	0.5	0.7
2-13	0.1	0.2	0.3	0.4	0.5	0.7
2-14	0.1	0.1	0.3	0.4	0.5	0.7
2-15	0.1	0.1	0.3	0.4	0.5	0.7
2-16	0.1	0.1	0.3	0.4	0.5	0.7
2-17	0.1	0.1	0.3	0.4	0.5	0.7
2-18	0.1	0.2	0.4	0.6	0.7	0.9
2-19	0.3	0.5	1.0	1.3	1.7	2.1
2-20	0.7	1.2	2.7	3.5	4.3	5.6
2-21	1.7	2.8	6.1	7.9	9.8	12.7
2-22	3.2	5.4	11.9	15.4	19.3	24.9
2-23	5.7	9.6	21.1	27.4	34.2	44.1
3-0	9.8	16.3	35.8	46.5	58.1	74.8
3-1	17.0	28.3	62.3	81.0	101.2	130.3
3-2	27.6	46.0	101.3	131.5	164.4	211.7
3-3	38.6	64.4	141.6	183.9	229.8	296.0

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
3 - 04	494	819	1723	2153	2495	3191
3 - 05	512	852	1793	2241	2597	3321
3 - 06	512	875	1838	2296	2632	3322
3 - 07	501	832	1750	2186	2534	3240
3 - 08	419	695	1462	1827	2117	2707
3 - 09	336	558	1173	1466	1700	2173
3 - 10	269	447	940	1174	1361	1740
3 - 11	220	366	769	961	1114	1425
3 - 12	187	309	651	814	943	1206
3 - 13	162	268	564	705	817	1044
3 - 14	140	232	488	609	706	903
3 - 15	118	196	412	515	597	763
3 - 16	96	160	336	420	486	622
3 - 17	84	139	292	365	423	541
3 - 18	80	133	279	349	404	517
3 - 19	81	134	283	353	409	523
3 - 20	80	133	279	349	404	517
3 - 21	79	131	276	345	400	511
3 - 22	78	130	273	342	396	506
3 - 23	78	129	271	338	392	501
4 - 00	77	127	268	335	388	496
4 - 01	76	126	265	331	384	491
4 - 02	75	125	263	328	380	486
4 - 03	74	123	260	325	376	481
4 - 04	74	122	257	321	372	475
4 - 05	73	121	254	318	368	471
4 - 06	72	120	252	314	364	466
4 - 07	71	118	249	311	361	461
4 - 08	71	117	247	308	357	457
4 - 09	70	116	244	305	354	452
4 - 10	69	115	242	302	350	448
4 - 11	69	114	239	299	347	443
4 - 12	68	113	237	296	343	439
4 - 13	67	111	234	293	340	434
4 - 14	67	110	232	290	336	430
4 - 15	66	109	230	287	333	426
4 - 16	65	108	228	284	330	421
4 - 17	65	107	225	282	326	417
4 - 18	64	106	223	279	323	413
4 - 19	63	105	221	276	320	409
4 - 20	63	104	219	273	317	405
4 - 21	62	103	216	270	313	401
4 - 22	61	102	214	268	310	397
4 - 23	61	101	212	265	307	393
5 - 00	60	100	210	262	304	389
5 - 01	60	99	208	260	301	385
5 - 02	59	98	206	257	298	381
5 - 03	58	97	204	255	295	378
5 - 04	58	96	202	252	292	374
5 - 05	57	95	200	250	289	370
5 - 06	57	94	198	247	287	366
5 - 07	56	93	196	245	284	363

Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
3-4	46.2	77.0	169.3	219.9	274.9	354.1
3-5	47.8	79.7	175.3	227.7	284.6	366.5
3-6	43.7	72.9	160.3	208.2	260.3	335.3
3-7	37.0	61.7	135.7	176.3	220.3	283.8
3-8	30.4	50.6	111.3	144.5	180.7	232.7
3-9	24.3	40.5	89.0	115.6	144.5	186.1
3-10	19.0	31.6	69.6	90.4	113.0	145.5
3-11	14.6	24.3	53.4	69.4	86.7	111.7
3-12	11.0	18.4	40.4	52.5	65.6	84.5
3-13	8.3	13.8	30.4	39.5	49.4	63.6
3-14	6.2	10.4	22.9	29.7	37.1	47.8
3-15	4.7	7.8	17.2	22.4	27.9	36.0
3-16	3.5	5.9	13.0	16.8	21.0	27.1
3-17	2.7	4.4	9.8	12.7	15.8	20.4
3-18	2.0	3.3	7.3	9.5	11.9	15.4
3-19	1.5	2.5	5.5	7.2	8.9	11.5
3-20	1.1	1.9	4.1	5.3	6.7	8.6
3-21	0.8	1.4	3.0	3.9	4.9	6.3
3-22	0.6	0.9	2.1	2.7	3.4	4.3
3-23	0.3	0.5	1.1	1.4	1.8	2.3
4-0	0.2	0.3	0.7	0.9	1.1	1.5
4-1	0.1	0.2	0.5	0.6	0.8	1.0
4-2	0.1	0.2	0.3	0.5	0.6	0.7
4-3	0.1	0.1	0.3	0.4	0.4	0.6
4-4	0.1	0.1	0.2	0.3	0.4	0.5
4-5	0.1	0.1	0.2	0.3	0.3	0.4
4-6	0.1	0.1	0.2	0.3	0.3	0.4
4-7	0.1	0.1	0.2	0.3	0.3	0.4
4-8	0.1	0.1	0.2	0.3	0.3	0.4
4-9	0.1	0.1	0.2	0.3	0.3	0.4
4-10	0.1	0.1	0.2	0.3	0.3	0.4
4-11	0.1	0.1	0.2	0.2	0.3	0.4
4-12	0.1	0.1	0.2	0.2	0.3	0.4
4-13	0.1	0.1	0.2	0.2	0.3	0.4
4-14	0.1	0.1	0.2	0.2	0.3	0.4
4-15	0.0	0.1	0.2	0.2	0.3	0.4
4-16	0.0	0.1	0.2	0.2	0.3	0.4
4-17	0.0	0.1	0.2	0.2	0.3	0.4
4-18	0.0	0.1	0.2	0.2	0.3	0.4
4-19	0.0	0.1	0.2	0.2	0.3	0.4
4-20	0.0	0.1	0.2	0.2	0.3	0.4
4-21	0.0	0.1	0.2	0.2	0.3	0.4
4-22	0.0	0.1	0.2	0.2	0.3	0.3
4-23	0.0	0.1	0.2	0.2	0.3	0.3
5-0	0.0	0.1	0.2	0.2	0.3	0.3
5-1	0.0	0.1	0.2	0.2	0.3	0.3
5-2	0.0	0.1	0.2	0.2	0.3	0.3
5-3	0.0	0.1	0.2	0.2	0.3	0.3
5-4	0.0	0.1	0.2	0.2	0.3	0.3
5-5	0.0	0.1	0.2	0.2	0.2	0.3
5-6	0.0	0.1	0.2	0.2	0.2	0.3
5-7	0.0	0.1	0.1	0.2	0.2	0.3

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
5 - 08	56	92	194	242	281	359	5-8	0.0	0.1	0.1	0.2	0.2	0.3
5 - 09	55	91	192	240	278	356	5-9	0.0	0.1	0.1	0.2	0.2	0.3
5 - 10	54	90	190	238	275	352	5-10	0.0	0.1	0.1	0.2	0.2	0.3
5 - 11	54	89	188	235	273	349	5-11	0.0	0.1	0.1	0.2	0.2	0.3
5 - 12	53	89	186	233	270	345	5-12	0.0	0.1	0.1	0.2	0.2	0.3
5 - 13	53	88	184	231	267	342	5-13	0.0	0.1	0.1	0.2	0.2	0.3
5 - 14	52	87	183	228	265	338	5-14	0.0	0.1	0.1	0.2	0.2	0.3
5 - 15	52	86	181	226	262	335	5-15	0.0	0.1	0.1	0.2	0.2	0.3
5 - 16	51	85	179	224	259	332	5-16	0.0	0.1	0.1	0.2	0.2	0.3
5 - 17	51	84	177	222	257	328	5-17	0.0	0.1	0.1	0.2	0.2	0.3
5 - 18	50	83	176	219	254	325	5-18	0.0	0.1	0.1	0.2	0.2	0.3
5 - 19	50	83	174	217	252	322	5-19	0.0	0.1	0.1	0.2	0.2	0.3
5 - 20	49	82	172	215	249	319	5-20	0.0	0.1	0.1	0.2	0.2	0.3
5 - 21	49	81	170	213	247	315	5-21	0.0	0.1	0.1	0.2	0.2	0.3
5 - 22	48	80	169	211	244	312	5-22	0.0	0.1	0.1	0.2	0.2	0.3
5 - 23	48	79	167	209	242	309	5-23	0.0	0.1	0.1	0.2	0.2	0.3
6 - 00	32	55	120	151	161	153	6-0	0.2	0.3	0.6	0.7	0.9	1.2
6 - 01	32	54	119	150	160	152	6-1	0.2	0.3	0.6	0.7	0.9	1.2
6 - 02	31	54	118	149	158	151	6-2	0.2	0.3	0.6	0.7	0.9	1.2
6 - 03	31	53	117	148	157	149	6-3	0.1	0.2	0.5	0.7	0.9	1.1
6 - 04	31	53	116	146	155	148	6-4	0.1	0.2	0.5	0.7	0.9	1.1
6 - 05	31	52	115	145	153	146	6-5	0.1	0.2	0.5	0.7	0.9	1.1
6 - 06	30	52	113	143	152	145	6-6	0.1	0.2	0.5	0.7	0.9	1.1
6 - 07	30	51	112	142	150	144	6-7	0.1	0.2	0.5	0.7	0.8	1.1
6 - 08	30	51	111	140	149	142	6-8	0.1	0.2	0.5	0.7	0.8	1.1
6 - 09	29	50	110	139	147	141	6-9	0.1	0.2	0.5	0.7	0.8	1.1
6 - 10	29	50	109	137	146	139	6-10	0.1	0.2	0.5	0.7	0.8	1.1
6 - 11	29	49	108	136	144	138	6-11	0.1	0.2	0.5	0.6	0.8	1.0
6 - 12	28	49	107	135	143	136	6-12	0.1	0.2	0.5	0.6	0.8	1.0
6 - 13	28	48	106	133	141	135	6-13	0.1	0.2	0.5	0.6	0.8	1.0
6 - 14	28	48	105	132	140	134	6-14	0.1	0.2	0.5	0.6	0.8	1.0
6 - 15	28	47	103	131	139	132	6-15	0.1	0.2	0.5	0.6	0.8	1.0
6 - 16	27	47	102	129	137	131	6-16	0.1	0.2	0.5	0.6	0.8	1.0
6 - 17	27	46	101	128	136	130	6-17	0.1	0.2	0.5	0.6	0.8	1.0
6 - 18	27	46	100	127	134	128	6-18	0.1	0.2	0.5	0.6	0.7	1.0
6 - 19	26	45	99	125	133	127	6-19	0.1	0.2	0.5	0.6	0.7	0.9
6 - 20	26	45	98	124	132	126	6-20	0.1	0.2	0.4	0.6	0.7	0.9
6 - 21	26	44	97	123	130	124	6-21	0.1	0.2	0.4	0.6	0.7	0.9
6 - 22	26	44	96	122	129	123	6-22	0.1	0.2	0.4	0.6	0.7	0.9
6 - 23	27	46	100	126	134	128	6-23	0.1	0.2	0.4	0.6	0.7	0.9
7 - 00	21	37	80	102	108	103	7-0	0.1	0.2	0.4	0.6	0.7	0.9
7 - 01	21	36	80	101	107	102	7-1	0.1	0.2	0.4	0.5	0.7	0.9
7 - 02	21	36	79	99	106	101	7-2	0.1	0.2	0.4	0.5	0.7	0.9
7 - 03	21	36	78	98	105	100	7-3	0.1	0.2	0.4	0.5	0.7	0.9
7 - 04	21	35	77	98	104	99	7-4	0.1	0.2	0.4	0.5	0.7	0.9
7 - 05	20	35	77	97	102	98	7-5	0.1	0.2	0.4	0.5	0.7	0.8
7 - 06	20	35	76	96	101	97	7-6	0.1	0.2	0.4	0.5	0.6	0.8
7 - 07	20	34	75	95	100	96	7-7	0.1	0.2	0.4	0.5	0.6	0.8
7 - 08	20	34	74	94	99	95	7-8	0.1	0.2	0.4	0.5	0.6	0.8
7 - 09	20	34	73	93	98	94	7-9	0.1	0.2	0.4	0.5	0.6	0.8
7 - 10	19	33	73	92	97	93	7-10	0.1	0.2	0.4	0.5	0.6	0.8
7 - 11	19	33	72	91	96	92	7-11	0.1	0.2	0.4	0.5	0.6	0.8

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
7 - 12	19	33	71	90	95	91	7-12	0.1	0.2	0.4	0.5	0.6	0.8
7 - 13	19	33	71	90	96	91	7-13	0.1	0.2	0.4	0.5	0.6	0.8
7 - 14	21	35	78	98	104	99	7-14	0.1	0.2	0.4	0.5	0.6	0.8
7 - 15	26	44	96	121	129	123	7-15	0.1	0.2	0.4	0.5	0.6	0.7
7 - 16	35	60	132	166	177	169	7-16	0.1	0.2	0.4	0.5	0.6	0.7
7 - 17	65	111	244	307	326	311	7-17	0.1	0.2	0.3	0.5	0.6	0.7
7 - 18	77	133	291	367	389	371	7-18	0.1	0.2	0.5	0.6	0.8	1.0
7 - 19	84	145	317	400	424	405	7-19	0.3	0.5	1.1	1.5	1.8	2.4
7 - 20	91	156	342	432	458	437	7-20	0.8	1.3	3.0	3.8	4.8	6.2
7 - 21	101	174	380	480	509	486	7-21	1.8	3.0	6.7	8.7	10.9	14.0
7 - 22	109	188	411	518	551	525	7-22	3.6	6.0	13.1	17.1	21.3	27.5
7 - 23	122	209	458	577	613	585	7-23	6.4	10.6	23.3	30.2	37.8	48.7
8 - 00	148	253	554	699	742	708	8-0	10.8	18.0	39.5	51.3	64.2	82.7
8 - 01	199	342	748	944	1003	957	8-1	18.8	31.3	68.9	89.5	111.9	144.1
8 - 02	290	496	1087	1371	1456	1390	8-2	30.5	50.9	111.9	145.3	181.7	234.0
8 - 03	408	699	1531	1931	2050	1956	8-3	42.7	71.1	156.5	203.2	254.0	327.2
8 - 04	515	883	1933	2439	2590	2471	8-4	51.0	85.1	187.2	243.1	303.8	391.3
8 - 05	534	919	2012	2538	2695	2572	8-5	52.8	88.1	193.8	251.6	314.5	405.1
8 - 06	534	943	2062	2600	2731	2572	8-6	48.3	80.6	177.2	230.2	287.7	370.5
8 - 07	523	896	1963	2476	2629	2509	8-7	40.9	68.2	150.0	194.8	243.5	313.6
8 - 08	437	749	1640	2069	2197	2096	8-8	33.5	55.9	123.0	159.7	199.7	257.2
8 - 09	351	601	1317	1661	1764	1683	8-9	26.8	44.7	98.4	127.8	159.7	205.7
8 - 10	281	481	1054	1330	1412	1347	8-10	21.0	35.0	76.9	99.9	124.9	160.8
8 - 11	230	394	863	1089	1156	1103	8-11	16.1	26.8	59.0	76.7	95.8	123.4
8 - 12	195	334	730	921	979	934	8-12	12.2	20.3	44.7	58.0	72.5	93.4
8 - 13	168	289	633	798	847	809	8-13	9.2	15.3	33.6	43.7	54.6	70.3
8 - 14	146	250	547	690	733	699	8-14	6.9	11.5	25.3	32.8	41.0	52.9
8 - 15	123	211	462	583	619	591	8-15	5.2	8.6	19.0	24.7	30.9	39.8
8 - 16	100	172	377	475	505	482	8-16	3.9	6.5	14.3	18.6	23.3	30.0
8 - 17	87	150	328	414	439	419	8-17	2.9	4.9	10.8	14.0	17.5	22.6
8 - 18	83	143	313	395	419	400	8-18	2.2	3.7	8.1	10.5	13.2	17.0
8 - 19	84	145	317	400	425	405	8-19	1.7	2.8	6.1	7.9	9.9	12.7
8 - 20	83	143	313	395	419	400	8-20	1.2	2.1	4.5	5.9	7.4	9.5
8 - 21	83	141	310	391	415	396	8-21	0.9	1.5	3.3	4.3	5.4	7.0
8 - 22	82	140	307	387	411	392	8-22	0.6	1.0	2.3	3.0	3.7	4.8
8 - 23	81	139	304	383	407	388	8-23	0.3	0.5	1.2	1.6	2.0	2.5
9 - 00	80	137	301	379	403	384	9-0	0.2	0.4	0.8	1.0	1.3	1.6
9 - 01	79	136	298	375	399	380	9-1	0.1	0.2	0.5	0.7	0.9	1.1
9 - 02	78	135	295	372	395	377	9-2	0.1	0.2	0.4	0.5	0.6	0.8
9 - 03	78	133	291	368	390	372	9-3	0.1	0.1	0.3	0.4	0.5	0.6
9 - 04	77	132	288	363	386	368	9-4	0.1	0.1	0.3	0.3	0.4	0.5
9 - 05	76	130	285	360	382	364	9-5	0.1	0.1	0.2	0.3	0.4	0.5
9 - 06	75	129	282	356	378	361	9-6	0.1	0.1	0.2	0.3	0.4	0.5
9 - 07	74	128	279	353	374	357	9-7	0.1	0.1	0.2	0.3	0.4	0.5
9 - 08	74	126	277	349	371	354	9-8	0.1	0.1	0.2	0.3	0.4	0.5
9 - 09	73	125	274	346	367	350	9-9	0.1	0.1	0.2	0.3	0.3	0.4
9 - 10	72	124	271	342	363	347	9-10	0.1	0.1	0.2	0.3	0.3	0.4
9 - 11	71	123	268	339	360	343	9-11	0.1	0.1	0.2	0.3	0.3	0.4
9 - 12	71	121	266	335	356	340	9-12	0.1	0.1	0.2	0.3	0.3	0.4
9 - 13	70	120	263	332	352	336	9-13	0.1	0.1	0.2	0.3	0.3	0.4
9 - 14	69	119	260	329	349	333	9-14	0.1	0.1	0.2	0.3	0.3	0.4
9 - 15	69	118	258	325	345	330	9-15	0.1	0.1	0.2	0.3	0.3	0.4

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
9 - 16	68	117	255	322	342	326	9-16	0.1	0.1	0.2	0.3	0.3	0.4
9 - 17	67	115	253	319	339	323	9-17	0.1	0.1	0.2	0.3	0.3	0.4
9 - 18	67	114	250	316	335	320	9-18	0.1	0.1	0.2	0.3	0.3	0.4
9 - 19	66	113	248	313	332	317	9-19	0.1	0.1	0.2	0.2	0.3	0.4
9 - 20	65	112	245	309	329	314	9-20	0.1	0.1	0.2	0.2	0.3	0.4
9 - 21	65	111	243	306	325	310	9-21	0.1	0.1	0.2	0.2	0.3	0.4
9 - 22	64	110	240	303	322	307	9-22	0.1	0.1	0.2	0.2	0.3	0.4
9 - 23	63	109	238	300	319	304	9-23	0.0	0.1	0.2	0.2	0.3	0.4
10 - 00	63	108	236	297	316	301	10-0	0.0	0.1	0.2	0.2	0.3	0.4
10 - 01	62	107	233	294	313	298	10-1	0.0	0.1	0.2	0.2	0.3	0.4
10 - 02	62	105	231	291	309	295	10-2	0.0	0.1	0.2	0.2	0.3	0.4
10 - 03	61	104	229	289	306	292	10-3	0.0	0.1	0.2	0.2	0.3	0.4
10 - 04	60	103	226	286	303	289	10-4	0.0	0.1	0.2	0.2	0.3	0.4
10 - 05	60	102	224	283	300	287	10-5	0.0	0.1	0.2	0.2	0.3	0.4
10 - 06	59	101	222	280	297	284	10-6	0.0	0.1	0.2	0.2	0.3	0.4
10 - 07	59	100	220	277	294	281	10-7	0.0	0.1	0.2	0.2	0.3	0.3
10 - 08	58	99	218	274	291	278	10-8	0.0	0.1	0.2	0.2	0.3	0.3
10 - 09	57	98	215	272	289	275	10-9	0.0	0.1	0.2	0.2	0.3	0.3
10 - 10	57	97	213	269	286	273	10-10	0.0	0.1	0.2	0.2	0.3	0.3
10 - 11	56	96	211	266	283	270	10-11	0.0	0.1	0.2	0.2	0.3	0.3
10 - 12	56	95	209	264	280	267	10-12	0.0	0.1	0.2	0.2	0.3	0.3
10 - 13	55	95	207	261	277	265	10-13	0.0	0.1	0.2	0.2	0.2	0.3
10 - 14	55	94	205	258	275	262	10-14	0.0	0.1	0.2	0.2	0.2	0.3
10 - 15	54	93	203	256	272	259	10-15	0.0	0.1	0.2	0.2	0.2	0.3
10 - 16	53	92	201	253	269	257	10-16	0.0	0.1	0.1	0.2	0.2	0.3
10 - 17	53	91	199	251	266	254	10-17	0.0	0.1	0.1	0.2	0.2	0.3
10 - 18	52	90	197	248	264	252	10-18	0.0	0.1	0.1	0.2	0.2	0.3
10 - 19	52	89	195	246	261	249	10-19	0.0	0.1	0.1	0.2	0.2	0.3
10 - 20	51	88	193	243	259	247	10-20	0.0	0.1	0.1	0.2	0.2	0.3
10 - 21	51	87	191	241	256	244	10-21	0.0	0.1	0.1	0.2	0.2	0.3
10 - 22	50	86	189	239	253	242	10-22	0.0	0.1	0.1	0.2	0.2	0.3
10 - 23	50	86	187	236	251	239	10-23	0.0	0.1	0.1	0.2	0.2	0.3
11 - 00	93	151	289	352	407	478	11-0	0.2	0.4	0.9	1.2	1.4	1.9
11 - 01	92	151	287	351	405	475	11-1	0.2	0.4	0.9	1.1	1.4	1.8
11 - 02	91	149	284	347	401	471	11-2	0.2	0.4	0.9	1.1	1.4	1.8
11 - 03	90	148	282	344	397	466	11-3	0.2	0.4	0.9	1.1	1.4	1.8
11 - 04	90	146	279	340	393	461	11-4	0.2	0.4	0.8	1.1	1.4	1.8
11 - 05	89	145	276	337	389	457	11-5	0.2	0.4	0.8	1.1	1.4	1.8
11 - 06	88	143	273	333	385	452	11-6	0.2	0.4	0.8	1.1	1.3	1.7
11 - 07	87	142	270	330	381	447	11-7	0.2	0.4	0.8	1.1	1.3	1.7
11 - 08	86	140	268	327	377	443	11-8	0.2	0.4	0.8	1.0	1.3	1.7
11 - 09	85	139	265	323	373	438	11-9	0.2	0.4	0.8	1.0	1.3	1.7
11 - 10	84	138	262	320	370	434	11-10	0.2	0.4	0.8	1.0	1.3	1.6
11 - 11	83	136	260	317	366	430	11-11	0.2	0.4	0.8	1.0	1.3	1.6
11 - 12	83	135	257	314	362	425	11-12	0.2	0.3	0.8	1.0	1.2	1.6
11 - 13	82	133	254	310	358	421	11-13	0.2	0.3	0.8	1.0	1.2	1.6
11 - 14	81	132	252	307	355	417	11-14	0.2	0.3	0.8	1.0	1.2	1.6
11 - 15	80	131	249	304	351	412	11-15	0.2	0.3	0.7	1.0	1.2	1.6
11 - 16	79	129	247	301	348	408	11-16	0.2	0.3	0.7	1.0	1.2	1.5
11 - 17	78	128	244	298	344	404	11-17	0.2	0.3	0.7	0.9	1.2	1.5
11 - 18	78	127	242	295	341	400	11-18	0.2	0.3	0.7	0.9	1.2	1.5
11 - 19	77	125	239	292	337	396	11-19	0.2	0.3	0.7	0.9	1.1	1.5

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
11 - 20	76	124	237	289	334	392	11-20	0.2	0.3	0.7	0.9	1.1	1.5
11 - 21	75	123	234	286	330	388	11-21	0.2	0.3	0.7	0.9	1.1	1.4
11 - 22	75	122	232	283	327	384	11-22	0.2	0.3	0.7	0.9	1.1	1.4
11 - 23	77	126	241	294	339	399	11-23	0.2	0.3	0.7	0.9	1.1	1.4
12 - 00	62	102	194	237	273	321	12-0	0.2	0.3	0.7	0.9	1.1	1.4
12 - 01	62	101	192	234	270	318	12-1	0.2	0.3	0.7	0.9	1.1	1.4
12 - 02	61	100	190	232	268	314	12-2	0.2	0.3	0.7	0.8	1.1	1.4
12 - 03	60	99	188	229	265	311	12-3	0.2	0.3	0.6	0.8	1.0	1.3
12 - 04	60	98	186	227	262	308	12-4	0.2	0.3	0.6	0.8	1.0	1.3
12 - 05	59	97	184	225	260	305	12-5	0.2	0.3	0.6	0.8	1.0	1.3
12 - 06	59	96	182	223	257	302	12-6	0.2	0.3	0.6	0.8	1.0	1.3
12 - 07	58	95	181	220	254	299	12-7	0.2	0.3	0.6	0.8	1.0	1.3
12 - 08	57	94	179	218	252	296	12-8	0.2	0.3	0.6	0.8	1.0	1.3
12 - 09	57	93	177	216	249	293	12-9	0.2	0.3	0.6	0.8	1.0	1.3
12 - 10	56	92	175	214	247	290	12-10	0.2	0.3	0.6	0.8	1.0	1.2
12 - 11	56	91	173	212	244	287	12-11	0.2	0.3	0.6	0.8	0.9	1.2
12 - 12	55	90	172	209	242	284	12-12	0.2	0.3	0.6	0.7	0.9	1.2
12 - 13	55	90	172	210	242	285	12-13	0.2	0.3	0.6	0.7	0.9	1.2
12 - 14	60	98	187	228	263	309	12-14	0.2	0.3	0.6	0.7	0.9	1.2
12 - 15	74	121	232	283	327	383	12-15	0.2	0.3	0.6	0.7	0.9	1.2
12 - 16	102	167	318	388	448	526	12-16	0.2	0.3	0.6	0.7	0.9	1.2
12 - 17	188	308	586	716	827	971	12-17	0.1	0.2	0.5	0.7	0.9	1.1
12 - 18	225	367	700	854	986	1158	12-18	0.2	0.3	0.7	1.0	1.2	1.5
12 - 19	245	400	763	931	1075	1263	12-19	0.5	0.8	1.8	2.3	2.9	3.7
12 - 20	265	432	824	1006	1161	1364	12-20	1.3	2.1	4.6	6.0	7.5	9.7
12 - 21	294	480	915	1117	1290	1515	12-21	2.9	4.8	10.5	13.6	17.0	21.9
12 - 22	318	519	989	1208	1395	1638	12-22	5.6	9.3	20.5	26.7	33.3	42.9
12 - 23	354	578	1102	1345	1553	1824	12-23	9.9	16.5	36.4	47.3	59.1	76.1
13 - 00	429	700	1334	1629	1881	2209	13-0	16.8	28.1	61.8	80.2	100.3	129.2
13 - 01	579	945	1802	2200	2540	2983	13-1	29.4	48.9	107.7	139.8	174.8	225.1
13 - 02	841	1373	2618	3195	3690	4333	13-2	47.7	79.5	174.9	227.1	283.9	365.6
13 - 03	1184	1933	3685	4498	5194	6101	13-3	66.7	111.1	244.5	317.6	396.9	511.3
13 - 04	1495	2441	4654	5681	6560	7705	13-4	79.8	132.9	292.5	379.8	474.8	611.5
13 - 05	1550	2541	4844	5913	6828	8019	13-5	82.6	137.6	302.8	393.2	491.5	633.0
13 - 06	1552	2607	4965	6058	6919	8021	13-6	75.5	125.9	276.9	359.6	449.5	579.0
13 - 07	1518	2478	4726	5768	6661	7823	13-7	63.9	106.5	234.4	304.4	380.5	490.1
13 - 08	1269	2071	3948	4820	5565	6536	13-8	52.4	87.4	192.2	249.6	312.0	401.9
13 - 09	1018	1662	3170	3869	4468	5247	13-9	41.9	69.9	153.7	199.6	249.5	321.4
13 - 10	815	1331	2538	3098	3578	4202	13-10	32.8	54.6	120.2	156.1	195.1	251.3
13 - 11	668	1090	2078	2537	2929	3440	13-11	25.2	41.9	92.2	119.8	149.7	192.8
13 - 12	565	922	1759	2147	2479	2911	13-12	19.0	31.7	69.8	90.7	113.4	146.0
13 - 13	489	799	1523	1859	2147	2521	13-13	14.3	23.9	52.5	68.2	85.3	109.9
13 - 14	423	691	1317	1608	1857	2180	13-14	10.8	18.0	39.5	51.3	64.1	82.6
13 - 15	358	584	1113	1359	1569	1843	13-15	8.1	13.5	29.7	38.6	48.3	62.2
13 - 16	291	476	907	1107	1279	1502	13-16	6.1	10.2	22.4	29.1	36.3	46.8
13 - 17	254	414	789	964	1113	1307	13-17	4.6	7.7	16.9	21.9	27.4	35.2
13 - 18	242	395	754	920	1062	1247	13-18	3.5	5.8	12.7	16.5	20.6	26.5
13 - 19	245	400	764	932	1076	1264	13-19	2.6	4.3	9.5	12.4	15.5	19.9
13 - 20	242	395	753	920	1062	1247	13-20	1.9	3.2	7.1	9.2	11.5	14.8
13 - 21	240	391	746	910	1051	1235	13-21	1.4	2.4	5.2	6.8	8.4	10.9
13 - 22	237	387	738	901	1041	1222	13-22	1.0	1.6	3.6	4.7	5.8	7.5
13 - 23	235	383	731	892	1030	1210	13-23	0.5	0.9	1.9	2.5	3.1	3.9

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
14 - 00	233	380	724	883	1020	1198	14-0	0.3	0.6	1.2	1.6	2.0	2.6
14 - 01	230	376	717	875	1010	1186	14-1	0.2	0.4	0.8	1.1	1.4	1.7
14 - 02	228	372	709	866	1000	1174	14-2	0.2	0.3	0.6	0.8	1.0	1.3
14 - 03	225	368	702	856	989	1161	14-3	0.1	0.2	0.5	0.6	0.8	1.0
14 - 04	223	364	694	847	978	1148	14-4	0.1	0.2	0.4	0.5	0.6	0.8
14 - 05	221	360	686	838	968	1136	14-5	0.1	0.2	0.4	0.5	0.6	0.8
14 - 06	218	356	680	830	958	1125	14-6	0.1	0.2	0.3	0.5	0.6	0.7
14 - 07	216	353	673	821	948	1114	14-7	0.1	0.2	0.3	0.4	0.6	0.7
14 - 08	214	349	666	813	939	1103	14-8	0.1	0.2	0.3	0.4	0.6	0.7
14 - 09	212	346	660	805	930	1092	14-9	0.1	0.2	0.3	0.4	0.5	0.7
14 - 10	210	342	653	797	920	1081	14-10	0.1	0.2	0.3	0.4	0.5	0.7
14 - 11	208	339	646	789	911	1070	14-11	0.1	0.1	0.3	0.4	0.5	0.7
14 - 12	206	336	640	781	902	1059	14-12	0.1	0.1	0.3	0.4	0.5	0.7
14 - 13	204	332	633	773	893	1049	14-13	0.1	0.1	0.3	0.4	0.5	0.7
14 - 14	201	329	627	766	884	1038	14-14	0.1	0.1	0.3	0.4	0.5	0.7
14 - 15	199	326	621	758	875	1028	14-15	0.1	0.1	0.3	0.4	0.5	0.7
14 - 16	197	322	615	750	866	1018	14-16	0.1	0.1	0.3	0.4	0.5	0.6
14 - 17	196	319	609	743	858	1007	14-17	0.1	0.1	0.3	0.4	0.5	0.6
14 - 18	194	316	603	735	849	997	14-18	0.1	0.1	0.3	0.4	0.5	0.6
14 - 19	192	313	597	728	841	987	14-19	0.1	0.1	0.3	0.4	0.5	0.6
14 - 20	190	310	591	721	832	978	14-20	0.1	0.1	0.3	0.4	0.5	0.6
14 - 21	188	307	585	714	824	968	14-21	0.1	0.1	0.3	0.4	0.5	0.6
14 - 22	186	304	579	707	816	958	14-22	0.1	0.1	0.3	0.4	0.5	0.6
14 - 23	184	301	573	700	808	949	14-23	0.1	0.1	0.3	0.4	0.5	0.6
15 - 00	182	298	567	693	800	939	15-0	0.1	0.1	0.3	0.4	0.5	0.6
15 - 01	181	295	562	686	792	930	15-1	0.1	0.1	0.3	0.4	0.5	0.6
15 - 02	179	292	556	679	784	921	15-2	0.1	0.1	0.3	0.4	0.4	0.6
15 - 03	177	289	551	672	776	912	15-3	0.1	0.1	0.3	0.4	0.4	0.6
15 - 04	175	286	545	666	768	903	15-4	0.1	0.1	0.3	0.3	0.4	0.6
15 - 05	173	283	540	659	761	894	15-5	0.1	0.1	0.3	0.3	0.4	0.6
15 - 06	172	280	534	652	753	885	15-6	0.1	0.1	0.3	0.3	0.4	0.5
15 - 07	170	277	529	646	746	876	15-7	0.1	0.1	0.3	0.3	0.4	0.5
15 - 08	168	275	524	639	738	867	15-8	0.1	0.1	0.3	0.3	0.4	0.5
15 - 09	167	272	519	633	731	859	15-9	0.1	0.1	0.3	0.3	0.4	0.5
15 - 10	165	269	513	627	724	850	15-10	0.1	0.1	0.2	0.3	0.4	0.5
15 - 11	163	267	508	621	717	842	15-11	0.1	0.1	0.2	0.3	0.4	0.5
15 - 12	162	264	503	614	709	833	15-12	0.1	0.1	0.2	0.3	0.4	0.5
15 - 13	160	261	498	608	702	825	15-13	0.1	0.1	0.2	0.3	0.4	0.5
15 - 14	159	259	493	602	695	817	15-14	0.1	0.1	0.2	0.3	0.4	0.5
15 - 15	157	256	488	596	689	809	15-15	0.1	0.1	0.2	0.3	0.4	0.5
15 - 16	155	254	484	590	682	801	15-16	0.1	0.1	0.2	0.3	0.4	0.5
15 - 17	154	251	479	585	675	793	15-17	0.1	0.1	0.2	0.3	0.4	0.5
15 - 18	152	249	474	579	668	785	15-18	0.1	0.1	0.2	0.3	0.4	0.5
15 - 19	151	246	469	573	662	777	15-19	0.1	0.1	0.2	0.3	0.4	0.5
15 - 20	149	244	465	567	655	769	15-20	0.1	0.1	0.2	0.3	0.4	0.5
15 - 21	148	241	460	562	649	762	15-21	0.1	0.1	0.2	0.3	0.4	0.5
15 - 22	146	239	456	556	642	754	15-22	0.1	0.1	0.2	0.3	0.4	0.5
15 - 23	145	237	451	551	636	747	15-23	0.1	0.1	0.2	0.3	0.3	0.4
16 - 00	217	330	651	804	973	1206	16-0	0.8	1.4	3.0	3.9	4.8	6.2
16 - 01	216	328	648	800	968	1200	16-1	0.8	1.3	2.9	3.8	4.8	6.2
16 - 02	214	325	642	793	959	1189	16-2	0.8	1.3	2.9	3.8	4.7	6.1
16 - 03	212	322	636	785	949	1177	16-3	0.8	1.3	2.9	3.7	4.7	6.0

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
16 - 04	210	318	629	777	940	1165	16-4	0.8	1.3	2.8	3.7	4.6	5.9
16 - 05	208	315	623	769	930	1153	16-5	0.8	1.3	2.8	3.6	4.6	5.9
16 - 06	205	312	616	761	921	1141	16-6	0.8	1.3	2.8	3.6	4.5	5.8
16 - 07	203	309	610	753	911	1130	16-7	0.7	1.2	2.7	3.6	4.5	5.7
16 - 08	201	306	604	746	902	1119	16-8	0.7	1.2	2.7	3.5	4.4	5.7
16 - 09	199	303	598	738	893	1107	16-9	0.7	1.2	2.7	3.5	4.4	5.6
16 - 10	197	300	592	731	884	1096	16-10	0.7	1.2	2.6	3.4	4.3	5.5
16 - 11	195	297	586	723	875	1085	16-11	0.7	1.2	2.6	3.4	4.2	5.5
16 - 12	193	294	580	716	866	1074	16-12	0.7	1.2	2.6	3.4	4.2	5.4
16 - 13	191	291	574	709	857	1063	16-13	0.7	1.2	2.6	3.3	4.1	5.3
16 - 14	189	288	568	702	849	1052	16-14	0.7	1.1	2.5	3.3	4.1	5.3
16 - 15	187	285	562	694	840	1042	16-15	0.7	1.1	2.5	3.2	4.0	5.2
16 - 16	186	282	557	687	832	1031	16-16	0.7	1.1	2.5	3.2	4.0	5.2
16 - 17	184	279	551	681	823	1021	16-17	0.7	1.1	2.4	3.2	4.0	5.1
16 - 18	182	276	546	674	815	1010	16-18	0.7	1.1	2.4	3.1	3.9	5.0
16 - 19	180	273	540	667	807	1000	16-19	0.6	1.1	2.4	3.1	3.9	5.0
16 - 20	178	271	535	660	799	990	16-20	0.6	1.1	2.3	3.0	3.8	4.9
16 - 21	176	268	529	653	791	980	16-21	0.6	1.1	2.3	3.0	3.8	4.8
16 - 22	175	265	524	647	783	970	16-22	0.6	1.0	2.3	3.0	3.7	4.8
16 - 23	181	275	544	671	812	1007	16-23	0.6	1.0	2.3	2.9	3.7	4.7
17 - 00	146	221	437	540	654	810	17-0	0.6	1.0	2.2	2.9	3.6	4.7
17 - 01	144	219	433	535	647	802	17-1	0.6	1.0	2.2	2.9	3.6	4.6
17 - 02	143	217	429	529	640	794	17-2	0.6	1.0	2.2	2.8	3.5	4.6
17 - 03	141	215	424	524	634	786	17-3	0.6	1.0	2.2	2.8	3.5	4.5
17 - 04	140	213	420	519	628	778	17-4	0.6	1.0	2.1	2.8	3.5	4.5
17 - 05	139	210	416	513	621	770	17-5	0.6	1.0	2.1	2.7	3.4	4.4
17 - 06	137	208	412	508	615	762	17-6	0.6	0.9	2.1	2.7	3.4	4.4
17 - 07	136	206	408	503	609	755	17-7	0.6	0.9	2.1	2.7	3.3	4.3
17 - 08	134	204	403	498	602	747	17-8	0.6	0.9	2.0	2.6	3.3	4.3
17 - 09	133	202	399	493	596	739	17-9	0.5	0.9	2.0	2.6	3.3	4.2
17 - 10	132	200	395	488	590	732	17-10	0.5	0.9	2.0	2.6	3.2	4.1
17 - 11	130	198	391	483	584	725	17-11	0.5	0.9	2.0	2.5	3.2	4.1
17 - 12	129	196	387	478	579	717	17-12	0.5	0.9	1.9	2.5	3.1	4.0
17 - 13	129	197	388	479	580	719	17-13	0.5	0.9	1.9	2.5	3.1	4.0
17 - 14	141	213	422	520	630	781	17-14	0.5	0.9	1.9	2.5	3.1	4.0
17 - 15	174	265	523	646	781	968	17-15	0.5	0.8	1.9	2.4	3.0	3.9
17 - 16	239	363	717	885	1071	1328	17-16	0.5	0.8	1.8	2.4	3.0	3.9
17 - 17	441	670	1324	1634	1977	2451	17-17	0.5	0.8	1.8	2.4	3.0	3.8
17 - 18	527	800	1580	1950	2360	2925	17-18	0.7	1.1	2.5	3.2	4.0	5.2
17 - 19	574	872	1722	2126	2572	3189	17-19	1.6	2.7	5.9	7.7	9.6	12.4
17 - 20	620	941	1860	2296	2778	3444	17-20	4.2	7.0	15.5	20.1	25.1	32.4
17 - 21	689	1046	2066	2551	3087	3827	17-21	9.6	16.0	35.1	45.6	57.0	73.4
17 - 22	745	1131	2234	2758	3337	4136	17-22	18.8	31.3	68.9	89.4	111.8	144.0
17 - 23	829	1259	2488	3071	3716	4607	17-23	33.3	55.5	122.0	158.5	198.1	255.2
18 - 00	1004	1525	3012	3718	4499	5577	18-0	56.5	94.2	207.2	269.1	336.3	433.2
18 - 01	1356	2059	4068	5022	6076	7533	18-1	98.5	164.1	361.1	468.9	586.1	754.9
18 - 02	1970	2991	5909	7295	8827	10942	18-2	159.9	266.6	586.4	761.6	952.0	1226.2
18 - 03	2773	4211	8319	10270	12427	15405	18-3	223.6	372.7	820.0	1064.9	1331.1	1714.5
18 - 04	3502	5318	10506	12971	15695	19456	18-4	267.5	445.8	980.7	1273.7	1592.1	2050.7
18 - 05	3630	5535	10935	13500	16335	20250	18-5	276.9	461.5	1015.3	1318.5	1648.2	2122.9
18 - 06	3634	5679	11208	13831	16553	20255	18-6	253.3	422.1	928.6	1206.0	1507.5	1941.7
18 - 07	3556	5400	10668	13170	15936	19755	18-7	214.4	357.3	786.0	1020.8	1276.0	1643.5

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
18 - 08	2971	4512	8913	11004	13314	16506	18-8	175.8	293.0	644.6	837.1	1046.4	1347.7
18 - 09	2385	3622	7155	8834	10689	13251	18-9	140.6	234.3	515.5	669.4	836.8	1077.8
18 - 10	1910	2900	5729	7073	8559	10610	18-10	109.9	183.2	403.1	523.5	654.4	842.8
18 - 11	1564	2375	4691	5792	7008	8688	18-11	84.3	140.6	309.3	401.7	502.1	646.7
18 - 12	1323	2009	3970	4901	5930	7352	18-12	63.9	106.4	234.2	304.1	380.1	489.6
18 - 13	1146	1740	3438	4244	5136	6366	18-13	48.1	80.1	176.2	228.8	286.1	368.4
18 - 14	991	1505	2973	3671	4441	5506	18-14	36.1	60.2	132.5	172.1	215.1	277.0
18 - 15	838	1272	2513	3103	3754	4654	18-15	27.2	45.3	99.7	129.5	161.9	208.5
18 - 16	683	1037	2048	2528	3059	3792	18-16	20.5	34.1	75.1	97.5	121.9	157.0
18 - 17	594	902	1782	2200	2662	3300	18-17	15.4	25.7	56.5	73.4	91.8	118.2
18 - 18	567	861	1701	2100	2541	3150	18-18	11.6	19.3	42.5	55.2	69.1	88.9
18 - 19	575	872	1724	2128	2575	3192	18-19	8.7	14.5	31.9	41.5	51.8	66.8
18 - 20	567	861	1701	2100	2541	3150	18-20	6.5	10.8	23.8	30.9	38.6	49.8
18 - 21	561	852	1684	2079	2515	3118	18-21	4.8	7.9	17.4	22.6	28.3	36.5
18 - 22	556	844	1667	2058	2490	3087	18-22	3.3	5.5	12.0	15.6	19.5	25.1
18 - 23	550	835	1650	2037	2465	3056	18-23	1.7	2.9	6.3	8.2	10.3	13.2
19 - 00	545	827	1634	2017	2441	3026	19-0	1.1	1.9	4.1	5.3	6.6	8.6
19 - 01	539	819	1618	1997	2416	2995	19-1	0.8	1.3	2.8	3.6	4.5	5.8
19 - 02	534	810	1601	1977	2392	2965	19-2	0.6	0.9	2.0	2.6	3.3	4.2
19 - 03	528	802	1584	1955	2366	2933	19-3	0.4	0.7	1.6	2.0	2.6	3.3
19 - 04	522	792	1565	1933	2339	2899	19-4	0.4	0.6	1.3	1.7	2.2	2.8
19 - 05	517	784	1550	1913	2315	2870	19-5	0.3	0.5	1.2	1.6	2.0	2.5
19 - 06	511	777	1534	1894	2292	2841	19-6	0.3	0.5	1.2	1.5	1.9	2.4
19 - 07	506	769	1519	1875	2269	2813	19-7	0.3	0.5	1.2	1.5	1.9	2.4
19 - 08	501	761	1504	1856	2246	2785	19-8	0.3	0.5	1.1	1.5	1.9	2.4
19 - 09	496	754	1489	1838	2224	2757	19-9	0.3	0.5	1.1	1.5	1.8	2.4
19 - 10	491	746	1474	1819	2201	2729	19-10	0.3	0.5	1.1	1.4	1.8	2.3
19 - 11	486	738	1459	1801	2179	2702	19-11	0.3	0.5	1.1	1.4	1.8	2.3
19 - 12	481	731	1444	1783	2157	2675	19-12	0.3	0.5	1.1	1.4	1.8	2.3
19 - 13	477	724	1430	1765	2136	2648	19-13	0.3	0.5	1.1	1.4	1.8	2.3
19 - 14	472	717	1416	1748	2115	2622	19-14	0.3	0.5	1.1	1.4	1.7	2.2
19 - 15	467	709	1402	1730	2094	2595	19-15	0.3	0.5	1.1	1.4	1.7	2.2
19 - 16	463	702	1388	1713	2073	2570	19-16	0.3	0.5	1.0	1.4	1.7	2.2
19 - 17	458	695	1374	1696	2052	2544	19-17	0.3	0.5	1.0	1.3	1.7	2.2
19 - 18	453	688	1360	1679	2032	2519	19-18	0.3	0.5	1.0	1.3	1.7	2.1
19 - 19	449	682	1347	1662	2011	2494	19-19	0.3	0.5	1.0	1.3	1.6	2.1
19 - 20	444	675	1333	1646	1991	2469	19-20	0.3	0.5	1.0	1.3	1.6	2.1
19 - 21	440	668	1320	1629	1972	2444	19-21	0.3	0.4	1.0	1.3	1.6	2.0
19 - 22	436	661	1307	1613	1952	2420	19-22	0.3	0.4	1.0	1.3	1.6	2.0
19 - 23	431	655	1294	1597	1933	2396	19-23	0.3	0.4	1.0	1.2	1.6	2.0
20 - 00	427	648	1281	1581	1913	2372	20-0	0.3	0.4	0.9	1.2	1.5	2.0
20 - 01	423	642	1268	1566	1894	2348	20-1	0.3	0.4	0.9	1.2	1.5	1.9
20 - 02	419	636	1256	1550	1876	2325	20-2	0.3	0.4	0.9	1.2	1.5	1.9
20 - 03	414	629	1243	1535	1857	2302	20-3	0.2	0.4	0.9	1.2	1.5	1.9
20 - 04	410	623	1231	1519	1838	2279	20-4	0.2	0.4	0.9	1.2	1.5	1.9
20 - 05	406	617	1218	1504	1820	2256	20-5	0.2	0.4	0.9	1.2	1.4	1.9
20 - 06	402	611	1206	1489	1802	2234	20-6	0.2	0.4	0.9	1.1	1.4	1.8
20 - 07	398	605	1194	1474	1784	2212	20-7	0.2	0.4	0.9	1.1	1.4	1.8
20 - 08	394	599	1182	1460	1766	2190	20-8	0.2	0.4	0.9	1.1	1.4	1.8
20 - 09	390	593	1171	1445	1749	2168	20-9	0.2	0.4	0.8	1.1	1.4	1.8
20 - 10	386	587	1159	1431	1731	2146	20-10	0.2	0.4	0.8	1.1	1.4	1.8
20 - 11	383	581	1148	1417	1714	2125	20-11	0.2	0.4	0.8	1.1	1.3	1.7

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
20 - 12	379	575	1136	1403	1697	2104	20-12	0.2	0.4	0.8	1.1	1.3	1.7
20 - 13	375	569	1125	1389	1680	2083	20-13	0.2	0.4	0.8	1.0	1.3	1.7
20 - 14	371	564	1114	1375	1664	2062	20-14	0.2	0.4	0.8	1.0	1.3	1.7
20 - 15	368	558	1103	1361	1647	2042	20-15	0.2	0.4	0.8	1.0	1.3	1.6
20 - 16	364	553	1092	1348	1631	2022	20-16	0.2	0.4	0.8	1.0	1.3	1.6
20 - 17	360	547	1081	1334	1615	2002	20-17	0.2	0.4	0.8	1.0	1.3	1.6
20 - 18	357	542	1070	1321	1599	1982	20-18	0.2	0.3	0.8	1.0	1.2	1.6
20 - 19	353	536	1059	1308	1583	1962	20-19	0.2	0.3	0.8	1.0	1.2	1.6
20 - 20	350	531	1049	1295	1567	1943	20-20	0.2	0.3	0.7	1.0	1.2	1.5
20 - 21	346	526	1039	1282	1552	1923	20-21	0.2	0.3	0.7	1.0	1.2	1.5
20 - 22	343	521	1028	1270	1536	1904	20-22	0.2	0.3	0.7	0.9	1.2	1.5
20 - 23	339	515	1018	1257	1521	1885	20-23	0.2	0.3	0.7	0.9	1.2	1.5
21 - 00	54	82	134	148	184	228	21-0	0.2	0.3	0.7	0.9	1.1	1.5
21 - 01	53	81	134	147	183	227	21-1	0.2	0.3	0.7	0.9	1.1	1.5
21 - 02	53	81	132	146	181	225	21-2	0.2	0.3	0.7	0.9	1.1	1.4
21 - 03	52	80	131	144	179	222	21-3	0.2	0.3	0.7	0.9	1.1	1.4
21 - 04	52	79	130	143	178	220	21-4	0.2	0.3	0.7	0.9	1.1	1.4
21 - 05	51	78	128	141	176	218	21-5	0.2	0.3	0.7	0.9	1.1	1.4
21 - 06	51	77	127	140	174	216	21-6	0.2	0.3	0.7	0.8	1.1	1.4
21 - 07	50	77	126	139	172	214	21-7	0.2	0.3	0.6	0.8	1.1	1.4
21 - 08	50	76	124	137	171	211	21-8	0.2	0.3	0.6	0.8	1.0	1.3
21 - 09	49	75	123	136	169	209	21-9	0.2	0.3	0.6	0.8	1.0	1.3
21 - 10	49	74	122	134	167	207	21-10	0.2	0.3	0.6	0.8	1.0	1.3
21 - 11	48	74	121	133	165	205	21-11	0.2	0.3	0.6	0.8	1.0	1.3
21 - 12	48	73	119	132	164	203	21-12	0.2	0.3	0.6	0.8	1.0	1.3
21 - 13	47	72	118	130	162	201	21-13	0.2	0.3	0.6	0.8	1.0	1.3
21 - 14	47	71	117	129	160	199	21-14	0.2	0.3	0.6	0.8	1.0	1.2
21 - 15	46	71	116	128	159	197	21-15	0.2	0.3	0.6	0.8	1.0	1.2
21 - 16	46	70	115	126	157	195	21-16	0.2	0.3	0.6	0.8	0.9	1.2
21 - 17	45	69	114	125	156	193	21-17	0.2	0.3	0.6	0.7	0.9	1.2
21 - 18	45	68	112	124	154	191	21-18	0.2	0.3	0.6	0.7	0.9	1.2
21 - 19	44	68	111	123	152	189	21-19	0.2	0.3	0.6	0.7	0.9	1.2
21 - 20	44	67	110	121	151	187	21-20	0.2	0.3	0.6	0.7	0.9	1.2
21 - 21	44	66	109	120	149	185	21-21	0.1	0.2	0.5	0.7	0.9	1.1
21 - 22	43	66	108	119	148	183	21-22	0.1	0.2	0.5	0.7	0.9	1.1
21 - 23	45	68	112	123	153	190	21-23	0.1	0.2	0.5	0.7	0.9	1.1
22 - 00	36	55	90	99	124	153	22-0	0.1	0.2	0.5	0.7	0.9	1.1
22 - 01	36	54	89	98	122	152	22-1	0.1	0.2	0.5	0.7	0.8	1.1
22 - 02	35	54	88	97	121	150	22-2	0.1	0.2	0.5	0.7	0.8	1.1
22 - 03	35	53	87	96	120	149	22-3	0.1	0.2	0.5	0.7	0.8	1.1
22 - 04	35	53	87	95	119	147	22-4	0.1	0.2	0.5	0.7	0.8	1.1
22 - 05	34	52	86	94	117	146	22-5	0.1	0.2	0.5	0.6	0.8	1.0
22 - 06	34	52	85	94	116	144	22-6	0.1	0.2	0.5	0.6	0.8	1.0
22 - 07	34	51	84	93	115	143	22-7	0.1	0.2	0.5	0.6	0.8	1.0
22 - 08	33	51	83	92	114	141	22-8	0.1	0.2	0.5	0.6	0.8	1.0
22 - 09	33	50	82	91	113	140	22-9	0.1	0.2	0.5	0.6	0.8	1.0
22 - 10	33	50	81	90	112	138	22-10	0.1	0.2	0.5	0.6	0.8	1.0
22 - 11	32	49	81	89	110	137	22-11	0.1	0.2	0.5	0.6	0.8	1.0
22 - 12	32	49	80	88	109	136	22-12	0.1	0.2	0.5	0.6	0.7	1.0
22 - 13	32	49	80	88	110	136	22-13	0.1	0.2	0.5	0.6	0.7	0.9
22 - 14	35	53	87	96	119	148	22-14	0.1	0.2	0.4	0.6	0.7	0.9
22 - 15	43	66	108	119	148	183	22-15	0.1	0.2	0.4	0.6	0.7	0.9

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
22 - 16	59	90	148	163	202	251	22-16	0.1	0.2	0.4	0.6	0.7	0.9
22 - 17	109	166	273	301	374	463	22-17	0.1	0.2	0.4	0.6	0.7	0.9
22 - 18	130	198	325	359	446	553	22-18	0.2	0.3	0.6	0.8	1.0	1.2
22 - 19	142	216	355	391	486	603	22-19	0.4	0.6	1.4	1.8	2.3	2.9
22 - 20	153	233	383	422	525	651	22-20	1.0	1.7	3.7	4.7	5.9	7.6
22 - 21	170	259	426	469	583	723	22-21	2.3	3.8	8.3	10.8	13.5	17.3
22 - 22	184	280	460	507	631	782	22-22	4.4	7.4	16.3	21.1	26.4	34.0
22 - 23	205	312	512	565	702	871	22-23	7.9	13.1	28.8	37.4	46.8	60.2
23 - 00	248	378	620	684	850	1054	23-0	13.3	22.2	48.9	63.5	79.4	102.3
23 - 01	335	511	838	924	1148	1424	23-1	23.2	38.7	85.2	110.7	138.4	178.2
23 - 02	486	742	1217	1342	1668	2068	23-2	37.8	62.9	138.4	179.8	224.7	289.4
23 - 03	685	1044	1714	1890	2349	2912	23-3	52.8	88.0	193.6	251.4	314.2	404.7
23 - 04	865	1319	2164	2387	2966	3677	23-4	63.1	105.2	231.5	300.7	375.8	484.1
23 - 05	897	1373	2253	2484	3087	3827	23-5	65.4	108.9	239.7	311.3	389.1	501.1
23 - 06	898	1408	2309	2545	3129	3828	23-6	59.8	99.6	219.2	284.7	355.9	458.4
23 - 07	878	1339	2198	2423	3012	3734	23-7	50.6	84.3	185.6	241.0	301.2	388.0
23 - 08	734	1119	1836	2025	2516	3120	23-8	41.5	69.2	152.2	197.6	247.0	318.1
23 - 09	589	898	1474	1625	2020	2504	23-9	33.2	55.3	121.7	158.0	197.5	254.4
23 - 10	472	719	1180	1301	1618	2005	23-10	26.0	43.3	95.2	123.6	154.5	199.0
23 - 11	386	589	966	1066	1325	1642	23-11	19.9	33.2	73.0	94.8	118.5	152.7
23 - 12	327	498	818	902	1121	1389	23-12	15.1	25.1	55.3	71.8	89.7	115.6
23 - 13	283	432	708	781	971	1203	23-13	11.3	18.9	41.6	54.0	67.5	87.0
23 - 14	245	373	612	675	839	1041	23-14	8.5	14.2	31.3	40.6	50.8	65.4
23 - 15	207	315	518	571	710	880	23-15	6.4	10.7	23.5	30.6	38.2	49.2
23 - 16	169	257	422	465	578	717	23-16	4.8	8.1	17.7	23.0	28.8	37.1
23 - 17	147	224	367	405	503	624	23-17	3.6	6.1	13.3	17.3	21.7	27.9
23 - 18	140	214	350	386	480	595	23-18	2.7	4.6	10.0	13.0	16.3	21.0
23 - 19	142	216	355	392	487	603	23-19	2.1	3.4	7.5	9.8	12.2	15.8
23 - 20	140	213	350	386	480	595	23-20	1.5	2.6	5.6	7.3	9.1	11.7
23 - 21	139	211	347	382	475	589	23-21	1.1	1.9	4.1	5.3	6.7	8.6
23 - 22	137	209	343	379	471	583	23-22	0.8	1.3	2.8	3.7	4.6	5.9
23 - 23	136	207	340	375	466	578	23-23	0.4	0.7	1.5	1.9	2.4	3.1
24 - 00	135	205	337	371	461	572	24-0	0.3	0.4	1.0	1.3	1.6	2.0
24 - 01	133	203	333	367	457	566	24-1	0.2	0.3	0.7	0.9	1.1	1.4
24 - 02	132	201	330	364	452	560	24-2	0.1	0.2	0.5	0.6	0.8	1.0
24 - 03	130	199	326	360	447	554	24-3	0.1	0.2	0.4	0.5	0.6	0.8
24 - 04	129	197	322	356	442	548	24-4	0.1	0.1	0.3	0.4	0.5	0.7
24 - 05	128	195	319	352	438	542	24-5	0.1	0.1	0.3	0.4	0.5	0.6
24 - 06	126	193	316	349	433	537	24-6	0.1	0.1	0.3	0.4	0.4	0.6
24 - 07	125	191	313	345	429	532	24-7	0.1	0.1	0.3	0.4	0.4	0.6
24 - 08	124	189	310	342	425	526	24-8	0.1	0.1	0.3	0.4	0.4	0.6
24 - 09	123	187	307	338	420	521	24-9	0.1	0.1	0.3	0.3	0.4	0.6
24 - 10	121	185	304	335	416	516	24-10	0.1	0.1	0.3	0.3	0.4	0.6
24 - 11	120	183	301	331	412	511	24-11	0.1	0.1	0.3	0.3	0.4	0.5
24 - 12	119	181	298	328	408	505	24-12	0.1	0.1	0.3	0.3	0.4	0.5
24 - 13	118	179	295	325	404	500	24-13	0.1	0.1	0.3	0.3	0.4	0.5
24 - 14	117	178	292	322	400	495	24-14	0.1	0.1	0.3	0.3	0.4	0.5
24 - 15	115	176	289	318	396	491	24-15	0.1	0.1	0.2	0.3	0.4	0.5
24 - 16	114	174	286	315	392	486	24-16	0.1	0.1	0.2	0.3	0.4	0.5
24 - 17	113	172	283	312	388	481	24-17	0.1	0.1	0.2	0.3	0.4	0.5
24 - 18	112	171	280	309	384	476	24-18	0.1	0.1	0.2	0.3	0.4	0.5
24 - 19	111	169	277	306	380	471	24-19	0.1	0.1	0.2	0.3	0.4	0.5

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
24 - 20	110	167	275	303	376	467	24-20	0.1	0.1	0.2	0.3	0.4	0.5
24 - 21	109	166	272	300	373	462	24-21	0.1	0.1	0.2	0.3	0.4	0.5
24 - 22	108	164	269	297	369	457	24-22	0.1	0.1	0.2	0.3	0.4	0.5
24 - 23	107	162	267	294	365	453	24-23	0.1	0.1	0.2	0.3	0.4	0.5
25 - 00	105	161	264	291	362	448	25-0	0.1	0.1	0.2	0.3	0.4	0.5
25 - 01	104	159	261	288	358	444	25-1	0.1	0.1	0.2	0.3	0.4	0.5
25 - 02	103	158	259	285	354	439	25-2	0.1	0.1	0.2	0.3	0.4	0.5
25 - 03	102	156	256	282	351	435	25-3	0.1	0.1	0.2	0.3	0.3	0.4
25 - 04	101	154	254	280	347	431	25-4	0.1	0.1	0.2	0.3	0.3	0.4
25 - 05	100	153	251	277	344	426	25-5	0.1	0.1	0.2	0.3	0.3	0.4
25 - 06	99	151	249	274	341	422	25-6	0.1	0.1	0.2	0.3	0.3	0.4
25 - 07	98	150	246	271	337	418	25-7	0.1	0.1	0.2	0.3	0.3	0.4
25 - 08	97	148	244	269	334	414	25-8	0.1	0.1	0.2	0.3	0.3	0.4
25 - 09	96	147	241	266	331	410	25-9	0.1	0.1	0.2	0.3	0.3	0.4
25 - 10	95	145	239	263	327	406	25-10	0.1	0.1	0.2	0.3	0.3	0.4
25 - 11	94	144	236	261	324	402	25-11	0.1	0.1	0.2	0.3	0.3	0.4
25 - 12	94	143	234	258	321	398	25-12	0.1	0.1	0.2	0.3	0.3	0.4
25 - 13	93	141	232	256	318	394	25-13	0.1	0.1	0.2	0.2	0.3	0.4
25 - 14	92	140	229	253	314	390	25-14	0.1	0.1	0.2	0.2	0.3	0.4
25 - 15	91	138	227	250	311	386	25-15	0.1	0.1	0.2	0.2	0.3	0.4
25 - 16	90	137	225	248	308	382	25-16	0.0	0.1	0.2	0.2	0.3	0.4
25 - 17	89	136	223	246	305	378	25-17	0.0	0.1	0.2	0.2	0.3	0.4
25 - 18	88	134	220	243	302	375	25-18	0.0	0.1	0.2	0.2	0.3	0.4
25 - 19	87	133	218	241	299	371	25-19	0.0	0.1	0.2	0.2	0.3	0.4
25 - 20	86	132	216	238	296	367	25-20	0.0	0.1	0.2	0.2	0.3	0.4
25 - 21	86	130	214	236	293	364	25-21	0.0	0.1	0.2	0.2	0.3	0.4
25 - 22	85	129	212	234	290	360	25-22	0.0	0.1	0.2	0.2	0.3	0.4
25 - 23	84	128	210	231	287	356	25-23	0.0	0.1	0.2	0.2	0.3	0.4
26 - 00	33	51	107	134	161	198	26-0	0.1	0.2	0.5	0.7	0.8	1.1
26 - 01	33	51	106	133	160	197	26-1	0.1	0.2	0.5	0.7	0.8	1.1
26 - 02	33	50	105	132	158	195	26-2	0.1	0.2	0.5	0.7	0.8	1.1
26 - 03	33	50	104	130	157	193	26-3	0.1	0.2	0.5	0.6	0.8	1.0
26 - 04	32	49	103	129	155	191	26-4	0.1	0.2	0.5	0.6	0.8	1.0
26 - 05	32	49	102	128	153	189	26-5	0.1	0.2	0.5	0.6	0.8	1.0
26 - 06	32	48	101	126	152	187	26-6	0.1	0.2	0.5	0.6	0.8	1.0
26 - 07	31	48	100	125	150	185	26-7	0.1	0.2	0.5	0.6	0.8	1.0
26 - 08	31	47	99	124	149	183	26-8	0.1	0.2	0.5	0.6	0.8	1.0
26 - 09	31	47	98	123	147	182	26-9	0.1	0.2	0.5	0.6	0.8	1.0
26 - 10	30	46	97	121	146	180	26-10	0.1	0.2	0.5	0.6	0.7	1.0
26 - 11	30	46	96	120	144	178	26-11	0.1	0.2	0.5	0.6	0.7	0.9
26 - 12	30	45	95	119	143	176	26-12	0.1	0.2	0.4	0.6	0.7	0.9
26 - 13	29	45	94	118	141	174	26-13	0.1	0.2	0.4	0.6	0.7	0.9
26 - 14	29	44	93	116	140	173	26-14	0.1	0.2	0.4	0.6	0.7	0.9
26 - 15	29	44	92	115	139	171	26-15	0.1	0.2	0.4	0.6	0.7	0.9
26 - 16	29	43	91	114	137	169	26-16	0.1	0.2	0.4	0.6	0.7	0.9
26 - 17	28	43	90	113	136	167	26-17	0.1	0.2	0.4	0.5	0.7	0.9
26 - 18	28	43	89	112	134	166	26-18	0.1	0.2	0.4	0.5	0.7	0.9
26 - 19	28	42	89	111	133	164	26-19	0.1	0.2	0.4	0.5	0.7	0.9
26 - 20	27	42	88	110	132	162	26-20	0.1	0.2	0.4	0.5	0.7	0.8
26 - 21	27	41	87	108	130	161	26-21	0.1	0.2	0.4	0.5	0.6	0.8
26 - 22	27	41	86	107	129	159	26-22	0.1	0.2	0.4	0.5	0.6	0.8
26 - 23	28	42	89	111	134	165	26-23	0.1	0.2	0.4	0.5	0.6	0.8

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
27 - 00	22	34	72	90	108	133	27-0	0.1	0.2	0.4	0.5	0.6	0.8
27 - 01	22	34	71	89	107	132	27-1	0.1	0.2	0.4	0.5	0.6	0.8
27 - 02	22	33	70	88	106	130	27-2	0.1	0.2	0.4	0.5	0.6	0.8
27 - 03	22	33	70	87	105	129	27-3	0.1	0.2	0.4	0.5	0.6	0.8
27 - 04	22	33	69	86	104	128	27-4	0.1	0.2	0.4	0.5	0.6	0.8
27 - 05	21	32	68	85	102	126	27-5	0.1	0.2	0.4	0.5	0.6	0.8
27 - 06	21	32	68	84	101	125	27-6	0.1	0.2	0.4	0.5	0.6	0.8
27 - 07	21	32	67	84	100	124	27-7	0.1	0.2	0.4	0.5	0.6	0.7
27 - 08	21	31	66	83	99	122	27-8	0.1	0.2	0.4	0.5	0.6	0.7
27 - 09	20	31	65	82	98	121	27-9	0.1	0.2	0.3	0.5	0.6	0.7
27 - 10	20	31	65	81	97	120	27-10	0.1	0.2	0.3	0.4	0.6	0.7
27 - 11	20	30	64	80	96	119	27-11	0.1	0.2	0.3	0.4	0.5	0.7
27 - 12	20	30	64	79	95	118	27-12	0.1	0.2	0.3	0.4	0.5	0.7
27 - 13	20	30	64	80	96	118	27-13	0.1	0.2	0.3	0.4	0.5	0.7
27 - 14	22	33	69	86	104	128	27-14	0.1	0.1	0.3	0.4	0.5	0.7
27 - 15	27	41	86	107	129	159	27-15	0.1	0.1	0.3	0.4	0.5	0.7
27 - 16	37	56	118	147	177	218	27-16	0.1	0.1	0.3	0.4	0.5	0.7
27 - 17	68	103	217	271	326	402	27-17	0.1	0.1	0.3	0.4	0.5	0.7
27 - 18	81	123	259	324	389	480	27-18	0.1	0.2	0.4	0.6	0.7	0.9
27 - 19	88	134	282	353	424	523	27-19	0.3	0.5	1.0	1.3	1.7	2.1
27 - 20	95	145	305	381	458	565	27-20	0.7	1.2	2.7	3.5	4.3	5.6
27 - 21	106	161	339	423	509	628	27-21	1.7	2.8	6.1	7.9	9.8	12.7
27 - 22	115	174	366	458	551	678	27-22	3.2	5.4	11.9	15.4	19.3	24.9
27 - 23	128	194	408	510	613	755	27-23	5.7	9.6	21.1	27.4	34.2	44.1
28 - 00	155	235	494	617	742	915	28-0	9.8	16.3	35.8	46.5	58.1	74.8
28 - 01	209	317	667	834	1003	1235	28-1	17.0	28.3	62.3	81.0	101.2	130.3
28 - 02	303	461	969	1211	1456	1794	28-2	27.6	46.0	101.3	131.5	164.4	211.7
28 - 03	427	648	1364	1705	2050	2526	28-3	38.6	64.4	141.6	183.9	229.8	296.0
28 - 04	539	819	1723	2153	2590	3191	28-4	46.2	77.0	169.3	219.9	274.9	354.1
28 - 05	559	852	1793	2241	2695	3321	28-5	47.8	79.7	175.3	227.7	284.6	366.5
28 - 06	560	875	1838	2296	2731	3322	28-6	43.7	72.9	160.3	208.2	260.3	335.3
28 - 07	548	832	1750	2186	2629	3240	28-7	37.0	61.7	135.7	176.3	220.3	283.8
28 - 08	458	695	1462	1827	2197	2707	28-8	30.4	50.6	111.3	144.5	180.7	232.7
28 - 09	367	558	1173	1466	1764	2173	28-9	24.3	40.5	89.0	115.6	144.5	186.1
28 - 10	294	447	940	1174	1412	1740	28-10	19.0	31.6	69.6	90.4	113.0	145.5
28 - 11	241	366	769	961	1156	1425	28-11	14.6	24.3	53.4	69.4	86.7	111.7
28 - 12	204	309	651	814	979	1206	28-12	11.0	18.4	40.4	52.5	65.6	84.5
28 - 13	176	268	564	705	847	1044	28-13	8.3	13.8	30.4	39.5	49.4	63.6
28 - 14	153	232	488	609	733	903	28-14	6.2	10.4	22.9	29.7	37.1	47.8
28 - 15	129	196	412	515	619	763	28-15	4.7	7.8	17.2	22.4	27.9	36.0
28 - 16	105	160	336	420	505	622	28-16	3.5	5.9	13.0	16.8	21.0	27.1
28 - 17	91	139	292	365	439	541	28-17	2.7	4.4	9.8	12.7	15.8	20.4
28 - 18	87	133	279	349	419	517	28-18	2.0	3.3	7.3	9.5	11.9	15.4
28 - 19	88	134	283	353	425	523	28-19	1.5	2.5	5.5	7.2	8.9	11.5
28 - 20	87	133	279	349	419	517	28-20	1.1	1.9	4.1	5.3	6.7	8.6
28 - 21	86	131	276	345	415	511	28-21	0.8	1.4	3.0	3.9	4.9	6.3
28 - 22	86	130	273	342	411	506	28-22	0.6	0.9	2.1	2.7	3.4	4.3
28 - 23	85	129	271	338	407	501	28-23	0.3	0.5	1.1	1.4	1.8	2.3
29 - 00	84	127	268	335	403	496	29-0	0.2	0.3	0.7	0.9	1.1	1.5
29 - 01	83	126	265	331	399	491	29-1	0.1	0.2	0.5	0.6	0.8	1.0
29 - 02	82	125	263	328	395	486	29-2	0.1	0.2	0.3	0.5	0.6	0.7
29 - 03	81	123	260	325	390	481	29-3	0.1	0.1	0.3	0.4	0.4	0.6

Table A1 Orestimba Creek Flood Hydrographs, ORES1 Specific Centering above Near Newman Gage							Table A2 Crow Creek above Canal Flow, CROW1 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
29 - 04	80	122	257	321	386	475	29-4	0.1	0.1	0.2	0.3	0.4	0.5
29 - 05	80	121	254	318	382	471	29-5	0.1	0.1	0.2	0.3	0.3	0.4
29 - 06	79	120	252	314	378	466	29-6	0.1	0.1	0.2	0.3	0.3	0.4
29 - 07	78	118	249	311	374	461	29-7	0.1	0.1	0.2	0.3	0.3	0.4
29 - 08	77	117	247	308	371	457	29-8	0.1	0.1	0.2	0.3	0.3	0.4
29 - 09	76	116	244	305	367	452	29-9	0.1	0.1	0.2	0.3	0.3	0.4
29 - 10	76	115	242	302	363	448	29-10	0.1	0.1	0.2	0.3	0.3	0.4
29 - 11	75	114	239	299	360	443	29-11	0.1	0.1	0.2	0.2	0.3	0.4
29 - 12	74	113	237	296	356	439	29-12	0.1	0.1	0.2	0.2	0.3	0.4
29 - 13	73	111	234	293	352	434	29-13	0.1	0.1	0.2	0.2	0.3	0.4
29 - 14	73	110	232	290	349	430	29-14	0.1	0.1	0.2	0.2	0.3	0.4
29 - 15	72	109	230	287	345	426	29-15	0.0	0.1	0.2	0.2	0.3	0.4
29 - 16	71	108	228	284	342	421	29-16	0.0	0.1	0.2	0.2	0.3	0.4
29 - 17	71	107	225	282	339	417	29-17	0.0	0.1	0.2	0.2	0.3	0.4
29 - 18	70	106	223	279	335	413	29-18	0.0	0.1	0.2	0.2	0.3	0.4
29 - 19	69	105	221	276	332	409	29-19	0.0	0.1	0.2	0.2	0.3	0.4
29 - 20	68	104	219	273	329	405	29-20	0.0	0.1	0.2	0.2	0.3	0.4
29 - 21	68	103	216	270	325	401	29-21	0.0	0.1	0.2	0.2	0.3	0.4
29 - 22	67	102	214	268	322	397	29-22	0.0	0.1	0.2	0.2	0.3	0.3
29 - 23	66	101	212	265	319	393	29-23	0.0	0.1	0.2	0.2	0.3	0.3
30 - 00	66	100	210	262	316	389	30-0	0.0	0.1	0.2	0.2	0.3	0.3
30 - 01	65	99	208	260	313	385	30-1	0.0	0.1	0.2	0.2	0.3	0.3
30 - 02	64	98	206	257	309	381	30-2	0.0	0.1	0.2	0.2	0.3	0.3
30 - 03	64	97	204	255	306	378	30-3	0.0	0.1	0.2	0.2	0.3	0.3
30 - 04	63	96	202	252	303	374	30-4	0.0	0.1	0.2	0.2	0.3	0.3
30 - 05	63	95	200	250	300	370	30-5	0.0	0.1	0.2	0.2	0.2	0.3
30 - 06	62	94	198	247	297	366	30-6	0.0	0.1	0.2	0.2	0.2	0.3
30 - 07	61	93	196	245	294	363	30-7	0.0	0.1	0.1	0.2	0.2	0.3
30 - 08	61	92	194	242	291	359	30-8	0.0	0.1	0.1	0.2	0.2	0.3
30 - 09	60	91	192	240	289	356	30-9	0.0	0.1	0.1	0.2	0.2	0.3
30 - 10	59	90	190	238	286	352	30-10	0.0	0.1	0.1	0.2	0.2	0.3
30 - 11	59	89	188	235	283	349	30-11	0.0	0.1	0.1	0.2	0.2	0.3
30 - 12	58	89	186	233	280	345	30-12	0.0	0.1	0.1	0.2	0.2	0.3
30 - 13	58	88	184	231	277	342	30-13	0.0	0.1	0.1	0.2	0.2	0.3
30 - 14	57	87	183	228	275	338	30-14	0.0	0.1	0.1	0.2	0.2	0.3
30 - 15	57	86	181	226	272	335	30-15	0.0	0.1	0.1	0.2	0.2	0.3
30 - 16	56	85	179	224	269	332	30-16	0.0	0.1	0.1	0.2	0.2	0.3
30 - 17	55	84	177	222	266	328	30-17	0.0	0.1	0.1	0.2	0.2	0.3
30 - 18	55	83	176	219	264	325	30-18	0.0	0.1	0.1	0.2	0.2	0.3
30 - 19	54	83	174	217	261	322	30-19	0.0	0.1	0.1	0.2	0.2	0.3
30 - 20	54	82	172	215	259	319	30-20	0.0	0.1	0.1	0.2	0.2	0.3
30 - 21	53	81	170	213	256	315	30-21	0.0	0.1	0.1	0.2	0.2	0.3
30 - 22	53	80	169	211	253	312	30-22	0.0	0.1	0.1	0.2	0.2	0.3
30 - 23	52	79	167	209	251	309	30-23	0.0	0.1	0.1	0.2	0.2	0.3

Table A3 Crow Creek Local Flow CRSUB2 Concurrent Centering						
Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
There are no flows for the first six days.						
7 - 00	0.0	0.0	0.0	0.0	0.0	0.0
7 - 01	0.0	0.0	0.0	0.0	0.0	0.0
7 - 02	0.0	0.0	0.0	0.0	0.0	0.0
7 - 03	0.0	0.0	0.0	0.0	0.0	0.0
7 - 04	0.0	0.0	0.0	0.0	0.0	0.0
7 - 05	0.0	0.0	0.0	0.0	0.0	0.0
7 - 06	0.0	0.0	0.0	0.0	0.0	0.0
7 - 07	0.0	0.0	0.0	0.0	0.0	0.0
7 - 08	0.0	0.0	0.0	0.0	0.0	0.0
7 - 09	0.0	0.0	0.0	0.0	0.0	0.0
7 - 10	0.0	0.0	0.0	0.0	0.0	0.0
7 - 11	0.0	0.0	0.0	0.0	0.0	0.0
7 - 12	0.0	0.0	0.0	0.0	0.0	0.0
7 - 13	0.0	0.0	0.0	0.0	0.0	0.0
7 - 14	0.0	0.0	0.0	0.0	0.0	0.0
7 - 15	0.0	0.0	0.0	0.0	0.0	0.0
7 - 16	0.0	0.0	0.0	0.0	0.0	0.0
7 - 17	0.0	0.0	0.0	0.0	0.0	0.0
7 - 18	0.0	0.0	0.0	0.0	0.0	0.0
7 - 19	0.0	0.0	0.0	0.0	0.0	0.0
7 - 20	0.0	0.0	0.0	0.0	0.0	0.0
7 - 21	0.0	0.0	0.0	0.0	0.0	0.0
7 - 22	0.0	0.0	0.0	0.0	0.0	0.0
7 - 23	0.0	0.0	0.0	0.0	0.0	0.0
8 - 00	0.2	0.3	0.7	0.8	1.1	1.4
8 - 01	0.5	0.9	2.0	2.6	1.1	1.4
8 - 02	0.8	1.3	2.9	3.7	1.1	1.4
8 - 03	0.8	1.4	3.0	3.9	1.1	1.4
8 - 04	0.8	1.3	3.0	3.8	1.1	1.4
8 - 05	0.8	1.3	2.8	3.7	1.1	1.4
8 - 06	0.7	1.2	2.7	3.4	1.1	1.4
8 - 07	0.7	1.1	2.5	3.3	1.1	1.4
8 - 08	0.6	1.1	2.4	3.1	1.1	1.4
8 - 09	0.6	1.0	2.3	2.9	1.1	1.4
8 - 10	0.6	1.0	2.2	2.8	1.1	1.4
8 - 11	0.6	0.9	2.1	2.7	1.1	1.4
8 - 12	0.5	0.9	2.0	2.6	1.1	1.4
8 - 13	0.5	0.9	1.9	2.5	1.1	1.4
8 - 14	0.5	0.8	1.8	2.4	1.1	1.4
8 - 15	0.5	0.8	1.8	2.3	1.1	1.4
8 - 16	0.5	0.8	1.7	2.2	1.1	1.4
8 - 17	0.5	0.8	1.7	2.2	1.1	1.4
8 - 18	0.4	0.7	1.6	2.1	1.1	1.4
8 - 19	0.4	0.7	1.6	2.0	1.1	1.4
8 - 20	0.4	0.7	1.5	2.0	1.1	1.4
8 - 21	0.4	0.7	1.5	1.9	1.1	1.4
8 - 22	0.4	0.7	1.5	1.9	1.1	1.4
8 - 23	0.4	0.6	1.4	1.8	1.1	1.4

Table A4 Orestimba Creek Local Flow from Subarea 4, ORSUB4 Concurrent Centering						
Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
There are no flows for the first six days.						
7 - 00	0.0	0.0	0.0	0.0	0.0	0.0
7 - 01	0.0	0.0	0.0	0.0	0.0	0.0
7 - 02	0.0	0.0	0.0	0.0	0.0	0.0
7 - 03	0.0	0.0	0.0	0.0	0.0	0.0
7 - 04	0.0	0.0	0.0	0.0	0.0	0.0
7 - 05	0.0	0.0	0.0	0.0	0.0	0.0
7 - 06	0.0	0.0	0.0	0.0	0.0	0.0
7 - 07	0.0	0.0	0.0	0.0	0.0	0.0
7 - 08	0.0	0.0	0.0	0.0	0.0	0.0
7 - 09	0.0	0.0	0.0	0.0	0.0	0.0
7 - 10	0.0	0.0	0.0	0.0	0.0	0.0
7 - 11	0.0	0.0	0.0	0.0	0.0	0.0
7 - 12	0.0	0.0	0.0	0.0	0.0	0.0
7 - 13	0.0	0.0	0.0	0.0	0.0	0.0
7 - 14	0.0	0.0	0.0	0.0	0.0	0.0
7 - 15	0.0	0.0	0.0	0.0	0.0	0.0
7 - 16	0.0	0.0	0.0	0.0	0.0	0.0
7 - 17	0.0	0.0	0.0	0.0	0.0	0.0
7 - 18	0.0	0.0	0.0	0.0	0.0	0.0
7 - 19	0.0	0.0	0.0	0.0	0.0	0.0
7 - 20	0.0	0.0	0.0	0.0	0.0	0.0
7 - 21	0.0	0.0	0.0	0.0	0.0	0.0
7 - 22	0.0	0.0	0.0	0.0	0.0	0.0
7 - 23	0.0	0.0	0.0	0.0	0.0	0.0
8 - 00	0.9	1.4	2.7	3.3	4.0	5.0
8 - 01	1.6	2.4	4.8	5.9	7.1	8.8
8 - 02	4.8	7.4	14.5	17.9	21.7	26.9
8 - 03	7.0	10.6	20.9	25.8	31.2	38.7
8 - 04	7.4	11.2	22.2	27.4	33.1	41.1
8 - 05	7.2	10.9	21.6	26.7	32.3	40.0
8 - 06	6.8	10.4	20.5	25.4	30.7	38.0
8 - 07	6.5	9.8	19.4	23.9	29.0	35.9
8 - 08	6.1	9.3	18.3	22.6	27.4	33.9
8 - 09	5.8	8.8	17.4	21.4	26.0	32.2
8 - 10	5.5	8.4	16.5	20.4	24.7	30.6
8 - 11	5.3	8.0	15.8	19.5	23.6	29.2
8 - 12	5.0	7.7	15.1	18.7	22.6	28.0
8 - 13	4.8	7.3	14.5	17.9	21.7	26.9
8 - 14	4.7	7.1	14.0	17.2	20.9	25.9
8 - 15	4.5	6.8	13.5	16.6	20.1	24.9
8 - 16	4.3	6.6	13.0	16.1	19.4	24.1
8 - 17	4.2	6.4	12.6	15.5	18.8	23.3
8 - 18	4.1	6.2	12.2	15.1	18.2	22.6
8 - 19	3.9	6.0	11.8	14.6	17.7	21.9
8 - 20	3.8	5.8	11.5	14.2	17.2	21.3
8 - 21	3.7	5.7	11.2	13.8	16.7	20.7
8 - 22	3.6	5.5	10.9	13.5	16.3	20.2
8 - 23	3.5	5.4	10.6	13.1	15.9	19.7

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
9 - 00	0.4	0.6	1.4	1.8	1.1	1.4
9 - 01	0.4	0.6	1.4	1.8	1.1	1.4
9 - 02	0.4	0.6	1.3	1.7	1.1	1.4
9 - 03	0.4	0.6	1.3	1.7	1.1	1.4
9 - 04	0.3	0.6	1.3	1.6	1.1	1.4
9 - 05	0.3	0.6	1.2	1.6	1.1	1.4
9 - 06	0.3	0.6	1.2	1.6	1.1	1.4
9 - 07	0.3	0.5	1.2	1.6	1.1	1.4
9 - 08	0.3	0.5	1.2	1.5	1.1	1.4
9 - 09	0.3	0.5	1.2	1.5	1.1	1.4
9 - 10	0.3	0.5	1.1	1.5	1.1	1.4
9 - 11	0.3	0.5	1.1	1.4	1.1	1.4
9 - 12	0.3	0.5	1.1	1.4	1.1	1.4
9 - 13	0.3	0.5	1.1	1.4	1.1	1.4
9 - 14	0.3	0.5	1.1	1.4	1.1	1.4
9 - 15	0.3	0.5	1.0	1.3	1.1	1.4
9 - 16	0.3	0.5	1.0	1.3	1.1	1.4
9 - 17	0.3	0.5	1.0	1.3	1.1	1.4
9 - 18	0.3	0.5	1.0	1.3	1.1	1.4
9 - 19	0.3	0.4	1.0	1.3	1.1	1.4
9 - 20	0.3	0.4	1.0	1.2	1.1	1.4
9 - 21	0.3	0.4	0.9	1.2	1.1	1.4
9 - 22	0.3	0.4	0.9	1.2	1.1	1.4
9 - 23	0.3	0.4	0.9	1.2	1.1	1.4
10 - 00	0.2	0.4	0.9	1.2	1.1	1.4
10 - 01	0.2	0.4	0.9	1.2	1.1	1.4
10 - 02	0.2	0.4	0.9	1.1	1.1	1.4
10 - 03	0.2	0.4	0.9	1.1	1.1	1.4
10 - 04	0.2	0.4	0.9	1.1	1.1	1.4
10 - 05	0.2	0.4	0.8	1.1	1.1	1.4
10 - 06	0.2	0.4	0.8	1.1	1.1	1.4
10 - 07	0.2	0.4	0.8	1.1	1.1	1.4
10 - 08	0.2	0.4	0.8	1.1	1.1	1.4
10 - 09	0.2	0.4	0.8	1.0	1.1	1.4
10 - 10	0.2	0.4	0.8	1.0	1.1	1.4
10 - 11	0.2	0.4	0.8	1.0	1.1	1.4
10 - 12	0.2	0.4	0.8	1.0	1.1	1.4
10 - 13	0.2	0.3	0.8	1.0	1.1	1.4
10 - 14	0.2	0.3	0.8	1.0	1.1	1.4
10 - 15	0.2	0.3	0.8	1.0	1.1	1.4
10 - 16	0.2	0.3	0.7	1.0	1.1	1.4
10 - 17	0.2	0.3	0.7	1.0	1.1	1.4
10 - 18	0.2	0.3	0.7	0.9	1.1	1.4
10 - 19	0.2	0.3	0.7	0.9	1.1	1.4
10 - 20	0.2	0.3	0.7	0.9	1.1	1.4
10 - 21	0.2	0.3	0.7	0.9	1.1	1.4
10 - 22	0.2	0.3	0.7	0.9	1.1	1.4
10 - 23	0.2	0.3	0.7	0.9	1.1	1.4
11 - 00	0.2	0.3	0.7	0.9	1.1	1.4
11 - 01	0.2	0.3	0.7	0.9	1.1	1.4
11 - 02	0.2	0.3	0.7	0.9	1.1	1.4

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
9 - 00	3.5	5.2	10.4	12.8	15.5	19.2
9 - 01	3.4	5.1	10.1	12.5	15.1	18.7
9 - 02	3.3	5.0	9.9	12.2	14.8	18.3
9 - 03	3.2	4.9	9.7	11.9	14.4	17.9
9 - 04	3.2	4.8	9.5	11.7	14.1	17.5
9 - 05	3.1	4.7	9.3	11.4	13.8	17.1
9 - 06	3.0	4.6	9.1	11.2	13.6	16.8
9 - 07	3.0	4.5	8.9	11.0	13.3	16.5
9 - 08	2.9	4.4	8.7	10.8	13.0	16.1
9 - 09	2.9	4.3	8.6	10.6	12.8	15.8
9 - 10	2.8	4.3	8.4	10.4	12.5	15.6
9 - 11	2.7	4.2	8.2	10.2	12.3	15.3
9 - 12	2.7	4.1	8.1	10.0	12.1	15.0
9 - 13	2.7	4.0	8.0	9.8	11.9	14.7
9 - 14	2.6	4.0	7.8	9.7	11.7	14.5
9 - 15	2.6	3.9	7.7	9.5	11.5	14.3
9 - 16	2.5	3.8	7.6	9.4	11.3	14.0
9 - 17	2.5	3.8	7.5	9.2	11.1	13.8
9 - 18	2.4	3.7	7.3	9.1	11.0	13.6
9 - 19	2.4	3.7	7.2	8.9	10.8	13.4
9 - 20	2.4	3.6	7.1	8.8	10.6	13.2
9 - 21	2.3	3.6	7.0	8.7	10.5	13.0
9 - 22	2.3	3.5	6.9	8.5	10.3	12.8
9 - 23	2.3	3.5	6.8	8.4	10.2	12.6
10 - 00	2.2	3.4	6.7	8.3	10.0	12.5
10 - 01	2.2	3.3	6.6	8.1	9.8	12.2
10 - 02	2.2	3.3	6.5	8.0	9.7	12.0
10 - 03	2.1	3.2	6.4	7.9	9.6	11.9
10 - 04	2.1	3.2	6.3	7.8	9.5	11.7
10 - 05	2.1	3.2	6.3	7.7	9.4	11.6
10 - 06	2.1	3.1	6.2	7.6	9.2	11.5
10 - 07	2.0	3.1	6.1	7.5	9.1	11.3
10 - 08	2.0	3.1	6.0	7.4	9.0	11.2
10 - 09	2.0	3.0	6.0	7.4	8.9	11.0
10 - 10	2.0	3.0	5.9	7.3	8.8	10.9
10 - 11	1.9	2.9	5.8	7.2	8.7	10.8
10 - 12	1.9	2.9	5.8	7.1	8.6	10.7
10 - 13	1.9	2.9	5.7	7.0	8.5	10.5
10 - 14	1.9	2.8	5.6	6.9	8.4	10.4
10 - 15	1.8	2.8	5.5	6.8	8.3	10.3
10 - 16	1.8	2.8	5.5	6.8	8.2	10.2
10 - 17	1.8	2.7	5.4	6.7	8.1	10.0
10 - 18	1.8	2.7	5.4	6.6	8.0	9.9
10 - 19	1.8	2.7	5.3	6.5	7.9	9.8
10 - 20	1.7	2.6	5.2	6.5	7.8	9.7
10 - 21	1.7	2.6	5.2	6.4	7.7	9.6
10 - 22	1.7	2.6	5.1	6.3	7.6	9.4
10 - 23	1.7	2.6	5.0	6.2	7.5	9.3
11 - 00	1.7	2.5	5.0	6.1	7.4	9.2
11 - 01	1.6	2.5	4.9	6.1	7.4	9.1
11 - 02	1.6	2.5	4.9	6.0	7.3	9.0

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
11 - 03	0.2	0.3	0.7	0.8	1.1	1.4
11 - 04	0.2	0.3	0.6	0.8	1.1	1.4
11 - 05	0.2	0.3	0.6	0.8	1.1	1.4
11 - 06	0.2	0.3	0.6	0.8	1.1	1.4
11 - 07	0.2	0.3	0.6	0.8	1.1	1.4
11 - 08	0.2	0.3	0.6	0.8	1.1	1.4
11 - 09	0.2	0.3	0.6	0.8	1.1	1.4
11 - 10	0.2	0.3	0.6	0.8	1.1	1.4
11 - 11	0.2	0.3	0.6	0.8	1.1	1.4
11 - 12	0.2	0.3	0.6	0.8	1.1	1.4
11 - 13	0.2	0.3	0.6	0.7	1.1	1.4
11 - 14	0.2	0.3	0.6	0.7	1.1	1.4
11 - 15	0.2	0.3	0.6	0.7	1.1	1.4
11 - 16	0.2	0.3	0.6	0.7	1.1	1.4
11 - 17	0.1	0.2	0.5	0.7	1.1	1.4
11 - 18	0.1	0.2	0.5	0.7	1.1	1.4
11 - 19	0.1	0.2	0.5	0.7	1.1	1.4
11 - 20	0.1	0.2	0.5	0.7	1.1	1.4
11 - 21	0.1	0.2	0.5	0.7	1.1	1.4
11 - 22	0.1	0.2	0.5	0.7	1.1	1.4
11 - 23	0.1	0.2	0.5	0.7	1.1	1.4
12 - 00	0.1	0.2	0.5	0.7	1.1	1.4
12 - 01	0.1	0.2	0.5	0.6	1.1	1.4
12 - 02	0.1	0.2	0.5	0.6	1.1	1.4
12 - 03	0.1	0.2	0.5	0.6	1.1	1.4
12 - 04	0.1	0.2	0.5	0.6	1.1	1.4
12 - 05	0.1	0.2	0.5	0.6	1.1	1.4
12 - 06	0.1	0.2	0.5	0.6	1.1	1.4
12 - 07	0.1	0.2	0.5	0.6	1.1	1.4
12 - 08	0.1	0.2	0.5	0.6	1.1	1.4
12 - 09	0.1	0.2	0.5	0.6	1.1	1.4
12 - 10	0.1	0.2	0.4	0.6	1.1	1.4
12 - 11	0.1	0.2	0.4	0.6	1.1	1.4
12 - 12	0.1	0.2	0.4	0.6	1.1	1.4
12 - 13	0.1	0.2	0.4	0.6	1.1	1.4
12 - 14	0.1	0.2	0.4	0.6	1.1	1.4
12 - 15	0.1	0.2	0.4	0.5	1.1	1.4
12 - 16	0.1	0.2	0.4	0.5	1.1	1.4
12 - 17	0.1	0.2	0.4	0.5	1.1	1.4
12 - 18	0.1	0.2	0.4	0.5	1.1	1.4
12 - 19	0.1	0.2	0.4	0.5	1.1	1.4
12 - 20	0.1	0.2	0.4	0.5	1.1	1.4
12 - 21	0.1	0.2	0.4	0.5	1.1	1.4
12 - 22	0.1	0.2	0.4	0.5	1.1	1.4
12 - 23	0.2	0.3	0.6	0.8	1.1	1.4
13 - 00	0.9	1.6	3.4	4.4	5.6	7.2
13 - 01	2.8	4.7	10.4	13.5	16.9	21.8
13 - 02	4.1	6.8	15.0	19.5	24.3	31.3
13 - 03	4.3	7.2	15.9	20.6	25.8	33.2
13 - 04	4.2	7.0	15.5	20.1	25.2	32.4
13 - 05	4.0	6.7	14.7	19.1	23.9	30.8

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
11 - 03	1.6	2.4	4.8	5.9	7.2	8.9
11 - 04	1.6	2.4	4.7	5.9	7.1	8.8
11 - 05	1.6	2.4	4.7	5.8	7.0	8.7
11 - 06	1.5	2.3	4.6	5.7	6.9	8.6
11 - 07	1.5	2.3	4.6	5.7	6.8	8.5
11 - 08	1.5	2.3	4.5	5.6	6.8	8.4
11 - 09	1.5	2.3	4.5	5.5	6.7	8.3
11 - 10	1.5	2.2	4.4	5.5	6.6	8.2
11 - 11	1.5	2.2	4.4	5.4	6.5	8.1
11 - 12	1.4	2.2	4.3	5.3	6.4	8.0
11 - 13	1.4	2.2	4.3	5.3	6.4	7.9
11 - 14	1.4	2.1	4.2	5.2	6.3	7.8
11 - 15	1.4	2.1	4.2	5.1	6.2	7.7
11 - 16	1.4	2.1	4.1	5.1	6.1	7.6
11 - 17	1.4	2.1	4.1	5.0	6.1	7.5
11 - 18	1.3	2.0	4.0	5.0	6.0	7.4
11 - 19	1.3	2.0	4.0	4.9	5.9	7.3
11 - 20	1.3	2.0	3.9	4.8	5.9	7.3
11 - 21	1.3	2.0	3.9	4.8	5.8	7.2
11 - 22	1.3	1.9	3.8	4.7	5.7	7.1
11 - 23	1.3	1.9	3.8	4.7	5.6	7.0
12 - 00	1.2	1.9	3.7	4.6	5.6	6.9
12 - 01	1.2	1.9	3.7	4.6	5.5	6.8
12 - 02	1.2	1.8	3.6	4.5	5.4	6.8
12 - 03	1.2	1.8	3.6	4.4	5.4	6.7
12 - 04	1.2	1.8	3.6	4.4	5.3	6.6
12 - 05	1.2	1.8	3.5	4.3	5.3	6.5
12 - 06	1.2	1.8	3.5	4.3	5.2	6.4
12 - 07	1.1	1.7	3.4	4.2	5.1	6.4
12 - 08	1.1	1.7	3.4	4.2	5.1	6.3
12 - 09	1.1	1.7	3.4	4.1	5.0	6.2
12 - 10	1.1	1.7	3.3	4.1	5.0	6.1
12 - 11	1.1	1.7	3.3	4.0	4.9	6.1
12 - 12	1.1	1.6	3.2	4.0	4.8	6.0
12 - 13	1.1	1.6	3.2	3.9	4.8	5.9
12 - 14	1.1	1.6	3.2	3.9	4.7	5.8
12 - 15	1.0	1.6	3.1	3.9	4.7	5.8
12 - 16	1.0	1.6	3.1	3.8	4.6	5.7
12 - 17	1.0	1.5	3.0	3.8	4.6	5.6
12 - 18	1.0	1.5	3.0	3.7	4.5	5.6
12 - 19	1.0	1.5	3.0	3.7	4.4	5.5
12 - 20	1.0	1.5	2.9	3.6	4.4	5.4
12 - 21	1.0	1.5	2.9	3.6	4.3	5.4
12 - 22	1.0	1.5	2.9	3.5	4.3	5.3
12 - 23	0.9	1.4	2.8	3.5	4.2	5.3
13 - 00	3.2	4.9	9.7	12.0	14.5	18.0
13 - 01	7.9	12.0	23.8	29.3	35.5	44.0
13 - 02	11.4	17.3	34.1	42.2	51.0	63.2
13 - 03	12.1	18.3	36.2	44.7	54.1	67.1
13 - 04	11.8	17.9	35.3	43.6	52.8	65.4
13 - 05	11.2	17.0	33.6	41.4	50.2	62.2

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
13 - 06	3.8	6.3	13.9	18.1	22.6	29.1
13 - 07	3.6	6.0	13.1	17.1	21.3	27.5
13 - 08	3.4	5.7	12.5	16.2	20.2	26.0
13 - 09	3.2	5.4	11.9	15.4	19.2	24.8
13 - 10	3.1	5.1	11.3	14.7	18.4	23.7
13 - 11	3.0	4.9	10.8	14.1	17.6	22.7
13 - 12	2.8	4.7	10.4	13.5	16.9	21.8
13 - 13	2.7	4.6	10.0	13.0	16.3	20.9
13 - 14	2.6	4.4	9.7	12.5	15.7	20.2
13 - 15	2.5	4.2	9.3	12.1	15.1	19.5
13 - 16	2.5	4.1	9.0	11.7	14.7	18.9
13 - 17	2.4	4.0	8.8	11.4	14.2	18.3
13 - 18	2.3	3.9	8.5	11.0	13.8	17.8
13 - 19	2.3	3.8	8.3	10.7	13.4	17.3
13 - 20	2.2	3.6	8.0	10.4	13.0	16.8
13 - 21	2.1	3.6	7.8	10.2	12.7	16.3
13 - 22	2.1	3.5	7.6	9.9	12.4	15.9
13 - 23	2.0	3.4	7.4	9.7	12.1	15.5
14 - 00	2.0	3.3	7.3	9.4	11.8	15.2
14 - 01	1.9	3.2	7.1	9.2	11.5	14.8
14 - 02	1.9	3.2	6.9	9.0	11.3	14.5
14 - 03	1.8	3.1	6.8	8.8	11.0	14.2
14 - 04	1.8	3.0	6.6	8.6	10.8	13.9
14 - 05	1.8	3.0	6.5	8.4	10.6	13.6
14 - 06	1.7	2.9	6.4	8.3	10.3	13.3
14 - 07	1.7	2.8	6.3	8.1	10.2	13.1
14 - 08	1.7	2.8	6.1	8.0	10.0	12.8
14 - 09	1.6	2.7	6.0	7.8	9.8	12.6
14 - 10	1.6	2.7	5.9	7.7	9.6	12.4
14 - 11	1.6	2.6	5.8	7.5	9.4	12.1
14 - 12	1.6	2.6	5.7	7.4	9.3	11.9
14 - 13	1.5	2.6	5.6	7.3	9.1	11.7
14 - 14	1.5	2.5	5.5	7.2	9.0	11.5
14 - 15	1.5	2.5	5.4	7.1	8.8	11.4
14 - 16	1.5	2.4	5.3	6.9	8.7	11.2
14 - 17	1.4	2.4	5.3	6.8	8.5	11.0
14 - 18	1.4	2.4	5.2	6.7	8.4	10.8
14 - 19	1.4	2.3	5.1	6.6	8.3	10.7
14 - 20	1.4	2.3	5.0	6.5	8.2	10.5
14 - 21	1.4	2.3	5.0	6.4	8.0	10.4
14 - 22	1.3	2.2	4.9	6.4	7.9	10.2
14 - 23	1.3	2.2	4.8	6.3	7.8	10.1
15 - 00	1.3	2.1	4.7	6.1	7.7	9.9
15 - 01	1.3	2.1	4.7	6.0	7.6	9.7
15 - 02	1.3	2.1	4.6	6.0	7.5	9.6
15 - 03	1.2	2.1	4.5	5.9	7.4	9.5
15 - 04	1.2	2.0	4.5	5.8	7.3	9.4
15 - 05	1.2	2.0	4.4	5.8	7.2	9.3
15 - 06	1.2	2.0	4.4	5.7	7.1	9.2
15 - 07	1.2	2.0	4.3	5.6	7.0	9.0
15 - 08	1.2	1.9	4.3	5.6	6.9	8.9

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
13 - 06	10.6	16.0	31.7	39.1	47.4	58.7
13 - 07	10.0	15.2	30.0	37.0	44.8	55.5
13 - 08	9.5	14.4	28.4	35.1	42.4	52.6
13 - 09	9.0	13.7	27.0	33.4	40.4	50.0
13 - 10	8.6	13.1	25.8	31.9	38.5	47.8
13 - 11	8.2	12.5	24.7	30.5	36.9	45.8
13 - 12	7.9	12.0	23.7	29.3	35.4	43.9
13 - 13	7.6	11.6	22.8	28.2	34.1	42.3
13 - 14	7.3	11.1	22.0	27.2	32.9	40.8
13 - 15	7.1	10.8	21.3	26.3	31.8	39.4
13 - 16	6.9	10.4	20.6	25.4	30.8	38.1
13 - 17	6.7	10.1	20.0	24.6	29.8	37.0
13 - 18	6.5	9.8	19.4	23.9	28.9	35.9
13 - 19	6.3	9.5	18.8	23.2	28.1	34.8
13 - 20	6.1	9.3	18.3	22.6	27.3	33.9
13 - 21	5.9	9.0	17.8	22.0	26.6	33.0
13 - 22	5.8	8.8	17.4	21.4	25.9	32.2
13 - 23	5.6	8.6	16.9	20.9	25.3	31.4
14 - 00	5.5	8.4	16.5	20.4	24.7	30.6
14 - 01	5.4	8.2	16.2	20.0	24.1	29.9
14 - 02	5.3	8.0	15.8	19.5	23.6	29.3
14 - 03	5.2	7.8	15.5	19.1	23.1	28.6
14 - 04	5.0	7.7	15.1	18.7	22.6	28.0
14 - 05	4.9	7.5	14.8	18.3	22.2	27.5
14 - 06	4.8	7.4	14.5	17.9	21.7	26.9
14 - 07	4.8	7.2	14.3	17.6	21.3	26.4
14 - 08	4.7	7.1	14.0	17.3	20.9	25.9
14 - 09	4.6	6.9	13.7	16.9	20.5	25.4
14 - 10	4.5	6.8	13.5	16.6	20.1	25.0
14 - 11	4.4	6.7	13.2	16.3	19.8	24.5
14 - 12	4.3	6.6	13.0	16.1	19.4	24.1
14 - 13	4.3	6.5	12.8	15.8	19.1	23.7
14 - 14	4.2	6.4	12.6	15.5	18.8	23.3
14 - 15	4.1	6.3	12.4	15.3	18.5	22.9
14 - 16	4.1	6.2	12.2	15.0	18.2	22.6
14 - 17	4.0	6.1	12.0	14.8	17.9	22.2
14 - 18	3.9	6.0	11.8	14.6	17.7	21.9
14 - 19	3.9	5.9	11.6	14.4	17.4	21.6
14 - 20	3.8	5.8	11.5	14.2	17.1	21.2
14 - 21	3.8	5.7	11.3	14.0	16.9	20.9
14 - 22	3.7	5.6	11.1	13.8	16.7	20.6
14 - 23	3.7	5.6	11.0	13.6	16.4	20.4
15 - 00	3.6	5.4	10.7	13.3	16.1	19.9
15 - 01	3.5	5.4	10.6	13.1	15.9	19.7
15 - 02	3.5	5.3	10.5	13.0	15.7	19.4
15 - 03	3.5	5.2	10.4	12.8	15.5	19.2
15 - 04	3.4	5.2	10.2	12.6	15.3	19.0
15 - 05	3.4	5.1	10.1	12.5	15.1	18.7
15 - 06	3.3	5.1	10.0	12.3	14.9	18.5
15 - 07	3.3	5.0	9.9	12.2	14.7	18.3
15 - 08	3.2	4.9	9.7	12.0	14.6	18.0

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
15 - 09	1.2	1.9	4.2	5.5	6.9	8.8
15 - 10	1.1	1.9	4.2	5.4	6.8	8.7
15 - 11	1.1	1.9	4.1	5.4	6.7	8.6
15 - 12	1.1	1.9	4.1	5.3	6.6	8.5
15 - 13	1.1	1.8	4.0	5.2	6.5	8.4
15 - 14	1.1	1.8	4.0	5.2	6.5	8.3
15 - 15	1.1	1.8	3.9	5.1	6.4	8.2
15 - 16	1.1	1.8	3.9	5.0	6.3	8.1
15 - 17	1.0	1.7	3.8	5.0	6.2	8.0
15 - 18	1.0	1.7	3.8	4.9	6.2	7.9
15 - 19	1.0	1.7	3.7	4.9	6.1	7.8
15 - 20	1.0	1.7	3.7	4.8	6.0	7.7
15 - 21	1.0	1.7	3.7	4.8	5.9	7.6
15 - 22	1.0	1.6	3.6	4.7	5.9	7.6
15 - 23	1.0	1.6	3.6	4.6	5.8	7.5
16 - 00	1.0	1.6	3.5	4.6	5.7	7.4
16 - 01	1.0	1.6	3.5	4.5	5.7	7.3
16 - 02	0.9	1.6	3.4	4.5	5.6	7.2
16 - 03	0.9	1.5	3.4	4.4	5.5	7.1
16 - 04	0.9	1.5	3.4	4.4	5.5	7.0
16 - 05	0.9	1.5	3.3	4.3	5.4	6.9
16 - 06	0.9	1.5	3.3	4.3	5.3	6.9
16 - 07	0.9	1.5	3.2	4.2	5.3	6.8
16 - 08	0.9	1.5	3.2	4.2	5.2	6.7
16 - 09	0.9	1.4	3.2	4.1	5.1	6.6
16 - 10	0.9	1.4	3.1	4.1	5.1	6.5
16 - 11	0.8	1.4	3.1	4.0	5.0	6.5
16 - 12	0.8	1.4	3.1	4.0	5.0	6.4
16 - 13	0.8	1.4	3.0	3.9	4.9	6.3
16 - 14	0.8	1.4	3.0	3.9	4.8	6.2
16 - 15	0.8	1.3	2.9	3.8	4.8	6.2
16 - 16	0.8	1.3	2.9	3.8	4.7	6.1
16 - 17	0.8	1.3	2.9	3.7	4.7	6.0
16 - 18	0.8	1.3	2.8	3.7	4.6	5.9
16 - 19	0.8	1.3	2.8	3.7	4.6	5.9
16 - 20	0.8	1.3	2.8	3.6	4.5	5.8
16 - 21	0.7	1.2	2.7	3.6	4.5	5.7
16 - 22	0.7	1.2	2.7	3.5	4.4	5.7
16 - 23	0.7	1.2	2.7	3.5	4.3	5.6
17 - 00	0.7	1.2	2.6	3.4	4.3	5.5
17 - 01	0.7	1.2	2.6	3.4	4.2	5.5
17 - 02	0.7	1.2	2.6	3.4	4.2	5.4
17 - 03	0.7	1.2	2.6	3.3	4.1	5.3
17 - 04	0.7	1.1	2.5	3.3	4.1	5.3
17 - 05	0.7	1.1	2.5	3.2	4.0	5.2
17 - 06	0.7	1.1	2.5	3.2	4.0	5.1
17 - 07	0.7	1.1	2.4	3.2	4.0	5.1
17 - 08	0.7	1.1	2.4	3.1	3.9	5.0
17 - 09	0.6	1.1	2.4	3.1	3.9	5.0
17 - 10	0.6	1.1	2.3	3.0	3.8	4.9
17 - 11	0.6	1.1	2.3	3.0	3.8	4.9

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
15 - 09	3.2	4.9	9.6	11.9	14.4	17.8
15 - 10	3.2	4.8	9.5	11.7	14.2	17.6
15 - 11	3.1	4.8	9.4	11.6	14.0	17.4
15 - 12	3.1	4.7	9.3	11.5	13.9	17.2
15 - 13	3.1	4.6	9.2	11.3	13.7	17.0
15 - 14	3.0	4.6	9.1	11.2	13.5	16.8
15 - 15	3.0	4.5	9.0	11.1	13.4	16.6
15 - 16	3.0	4.5	8.9	10.9	13.2	16.4
15 - 17	2.9	4.4	8.8	10.8	13.1	16.2
15 - 18	2.9	4.4	8.6	10.7	12.9	16.0
15 - 19	2.8	4.3	8.5	10.5	12.8	15.8
15 - 20	2.8	4.3	8.4	10.4	12.6	15.6
15 - 21	2.8	4.2	8.3	10.3	12.5	15.4
15 - 22	2.7	4.2	8.2	10.2	12.3	15.3
15 - 23	2.7	4.1	8.1	10.1	12.2	15.1
16 - 00	2.7	4.1	8.0	9.9	12.0	14.9
16 - 01	2.6	4.0	7.9	9.8	11.9	14.7
16 - 02	2.6	4.0	7.9	9.7	11.7	14.5
16 - 03	2.6	3.9	7.8	9.6	11.6	14.4
16 - 04	2.6	3.9	7.7	9.5	11.5	14.2
16 - 05	2.5	3.8	7.6	9.4	11.3	14.0
16 - 06	2.5	3.8	7.5	9.2	11.2	13.9
16 - 07	2.5	3.7	7.4	9.1	11.0	13.7
16 - 08	2.4	3.7	7.3	9.0	10.9	13.5
16 - 09	2.4	3.7	7.2	8.9	10.8	13.4
16 - 10	2.4	3.6	7.1	8.8	10.7	13.2
16 - 11	2.4	3.6	7.1	8.7	10.5	13.1
16 - 12	2.3	3.5	7.0	8.6	10.4	12.9
16 - 13	2.3	3.5	6.9	8.5	10.3	12.7
16 - 14	2.3	3.4	6.8	8.4	10.2	12.6
16 - 15	2.2	3.4	6.7	8.3	10.0	12.4
16 - 16	2.2	3.4	6.6	8.2	9.9	12.3
16 - 17	2.2	3.3	6.6	8.1	9.8	12.1
16 - 18	2.2	3.3	6.5	8.0	9.7	12.0
16 - 19	2.1	3.2	6.4	7.9	9.6	11.9
16 - 20	2.1	3.2	6.3	7.8	9.5	11.7
16 - 21	2.1	3.2	6.3	7.7	9.3	11.6
16 - 22	2.1	3.1	6.2	7.6	9.2	11.4
16 - 23	2.0	3.1	6.1	7.5	9.1	11.3
17 - 00	2.0	3.1	6.0	7.5	9.0	11.2
17 - 01	2.0	3.0	6.0	7.4	8.9	11.0
17 - 02	2.0	3.0	5.9	7.3	8.8	10.9
17 - 03	1.9	2.9	5.8	7.2	8.7	10.8
17 - 04	1.9	2.9	5.8	7.1	8.6	10.7
17 - 05	1.9	2.9	5.7	7.0	8.5	10.5
17 - 06	1.9	2.8	5.6	6.9	8.4	10.4
17 - 07	1.8	2.8	5.5	6.8	8.3	10.3
17 - 08	1.8	2.8	5.5	6.8	8.2	10.2
17 - 09	1.8	2.7	5.4	6.7	8.1	10.0
17 - 10	1.8	2.7	5.4	6.6	8.0	9.9
17 - 11	1.8	2.7	5.3	6.5	7.9	9.8

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
17 - 12	0.6	1.0	2.3	3.0	3.7	4.8
17 - 13	0.6	1.0	2.3	2.9	3.7	4.7
17 - 14	0.6	1.0	2.2	2.9	3.6	4.7
17 - 15	0.6	1.0	2.2	2.9	3.6	4.6
17 - 16	0.6	1.0	2.2	2.8	3.5	4.6
17 - 17	0.6	1.0	2.2	2.8	3.5	4.5
17 - 18	0.6	1.0	2.1	2.8	3.5	4.5
17 - 19	0.6	1.0	2.1	2.7	3.4	4.4
17 - 20	0.6	0.9	2.1	2.7	3.4	4.4
17 - 21	0.6	0.9	2.1	2.7	3.3	4.3
17 - 22	0.6	0.9	2.0	2.6	3.3	4.3
17 - 23	0.8	1.4	3.1	4.0	5.0	6.4
18 - 00	1.7	2.8	6.2	8.0	10.0	12.9
18 - 01	3.1	5.2	11.5	14.9	18.6	24.0
18 - 02	9.5	15.9	35.0	45.4	56.8	73.1
18 - 03	13.7	22.8	50.3	65.3	81.6	105.1
18 - 04	14.5	24.2	53.3	69.3	86.6	111.5
18 - 05	14.2	23.6	52.0	67.5	84.4	108.7
18 - 06	13.5	22.5	49.4	64.2	80.2	103.3
18 - 07	12.7	21.2	46.7	60.6	75.8	97.6
18 - 08	12.0	20.0	44.1	57.3	71.6	92.2
18 - 09	11.4	19.0	41.8	54.3	67.9	87.4
18 - 10	10.8	18.1	39.8	51.7	64.6	83.2
18 - 11	10.4	17.3	38.0	49.3	61.7	79.4
18 - 12	9.9	16.5	36.4	47.2	59.1	76.1
18 - 13	9.5	15.9	34.9	45.4	56.7	73.0
18 - 14	9.2	15.3	33.6	43.7	54.6	70.3
18 - 15	8.8	14.7	32.4	42.1	52.6	67.8
18 - 16	8.5	14.2	31.3	40.7	50.8	65.5
18 - 17	8.3	13.8	30.3	39.4	49.2	63.4
18 - 18	8.0	13.3	29.4	38.1	47.7	61.4
18 - 19	7.8	13.0	28.5	37.0	46.3	59.6
18 - 20	7.6	12.6	27.7	36.0	45.0	57.9
18 - 21	7.3	12.2	26.9	35.0	43.7	56.3
18 - 22	7.2	11.9	26.2	34.1	42.6	54.9
18 - 23	7.0	11.6	25.6	33.2	41.5	53.5
19 - 00	6.8	11.3	24.9	32.4	40.5	52.1
19 - 01	6.6	11.1	24.4	31.6	39.5	50.9
19 - 02	6.5	10.8	23.8	30.9	38.6	49.7
19 - 03	6.3	10.6	23.3	30.2	37.8	48.6
19 - 04	6.2	10.3	22.8	29.6	37.0	47.6
19 - 05	6.1	10.1	22.3	28.9	36.2	46.6
19 - 06	6.0	9.9	21.8	28.4	35.4	45.6
19 - 07	5.8	9.7	21.4	27.8	34.7	44.7
19 - 08	5.7	9.5	21.0	27.3	34.1	43.9
19 - 09	5.6	9.4	20.6	26.7	33.4	43.0
19 - 10	5.5	9.2	20.2	26.2	32.8	42.2
19 - 11	5.4	9.0	19.8	25.8	32.2	41.5
19 - 12	5.3	8.9	19.5	25.3	31.6	40.7
19 - 13	5.2	8.7	19.2	24.9	31.1	40.1
19 - 14	5.1	8.6	18.8	24.5	30.6	39.4

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
17 - 12	1.7	2.6	5.2	6.5	7.8	9.7
17 - 13	1.7	2.6	5.2	6.4	7.7	9.6
17 - 14	1.7	2.6	5.1	6.3	7.6	9.4
17 - 15	1.7	2.6	5.0	6.2	7.5	9.3
17 - 16	1.7	2.5	5.0	6.1	7.4	9.2
17 - 17	1.6	2.5	4.9	6.1	7.4	9.1
17 - 18	1.6	2.5	4.9	6.0	7.3	9.0
17 - 19	1.6	2.4	4.8	5.9	7.2	8.9
17 - 20	1.6	2.4	4.7	5.9	7.1	8.8
17 - 21	1.6	2.4	4.7	5.8	7.0	8.7
17 - 22	1.5	2.3	4.6	5.7	6.9	8.6
17 - 23	2.7	4.1	8.1	10.0	12.1	15.0
18 - 00	5.4	8.2	16.2	20.0	24.2	30.0
18 - 01	9.5	14.5	28.6	35.3	42.7	52.9
18 - 02	29.0	44.1	87.0	107.4	130.0	161.2
18 - 03	41.7	63.3	125.1	154.4	186.8	231.6
18 - 04	44.2	67.2	132.7	163.9	198.3	245.8
18 - 05	43.1	65.5	129.4	159.8	193.3	239.7
18 - 06	41.0	62.2	123.0	151.8	183.7	227.7
18 - 07	38.7	58.8	116.1	143.4	173.5	215.1
18 - 08	36.6	55.6	109.8	135.5	164.0	203.3
18 - 09	34.7	52.7	104.0	128.4	155.4	192.7
18 - 10	33.0	50.1	99.0	122.2	147.9	183.3
18 - 11	31.5	47.8	94.5	116.7	141.2	175.0
18 - 12	30.2	45.8	90.5	111.8	135.2	167.6
18 - 13	29.0	44.0	86.9	107.3	129.8	161.0
18 - 14	27.9	42.3	83.6	103.3	124.9	154.9
18 - 15	26.9	40.8	80.7	99.6	120.5	149.4
18 - 16	26.0	39.4	77.9	96.2	116.4	144.3
18 - 17	25.1	38.2	75.4	93.1	112.7	139.7
18 - 18	24.4	37.0	73.1	90.2	109.2	135.4
18 - 19	23.6	35.9	70.9	87.6	106.0	131.4
18 - 20	23.0	34.9	68.9	85.1	103.0	127.6
18 - 21	22.3	33.9	67.0	82.8	100.2	124.2
18 - 22	21.8	33.0	65.3	80.6	97.5	120.9
18 - 23	21.2	32.2	63.6	78.6	95.0	117.8
19 - 00	20.7	31.4	62.1	76.6	92.7	114.9
19 - 01	20.2	30.7	60.6	74.8	90.5	112.2
19 - 02	19.7	30.0	59.2	73.1	88.5	109.7
19 - 03	19.3	29.3	57.9	71.5	86.5	107.2
19 - 04	18.9	28.7	56.6	69.9	84.6	104.9
19 - 05	18.5	28.1	55.5	68.5	82.8	102.7
19 - 06	18.1	27.5	54.3	67.1	81.1	100.6
19 - 07	17.7	26.9	53.2	65.7	79.5	98.6
19 - 08	17.4	26.4	52.2	64.5	78.0	96.7
19 - 09	17.1	25.9	51.2	63.2	76.5	94.9
19 - 10	16.8	25.5	50.3	62.1	75.1	93.1
19 - 11	16.5	25.0	49.4	61.0	73.8	91.4
19 - 12	16.2	24.6	48.5	59.9	72.5	89.8
19 - 13	15.9	24.1	47.7	58.9	71.2	88.3
19 - 14	15.6	23.7	46.9	57.9	70.0	86.8

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
19 - 15	5.1	8.4	18.5	24.1	30.1	38.7
19 - 16	5.0	8.3	18.2	23.7	29.6	38.1
19 - 17	4.9	8.2	17.9	23.3	29.1	37.5
19 - 18	4.8	8.0	17.7	22.9	28.7	36.9
19 - 19	4.7	7.9	17.4	22.6	28.2	36.4
19 - 20	4.7	7.8	17.1	22.3	27.8	35.8
19 - 21	4.6	7.7	16.9	21.9	27.4	35.3
19 - 22	4.5	7.6	16.6	21.6	27.0	34.8
19 - 23	4.5	7.5	16.4	21.3	26.6	34.3
20 - 00	4.4	7.4	16.2	21.0	26.3	33.8
20 - 01	4.3	7.2	15.8	20.5	25.7	33.1
20 - 02	4.3	7.1	15.6	20.3	25.4	32.7
20 - 03	4.2	7.0	15.4	20.1	25.1	32.3
20 - 04	4.2	6.9	15.3	19.8	24.8	31.9
20 - 05	4.1	6.9	15.1	19.6	24.5	31.5
20 - 06	4.1	6.8	14.9	19.4	24.2	31.2
20 - 07	4.0	6.7	14.7	19.1	23.9	30.7
20 - 08	4.0	6.6	14.5	18.9	23.6	30.3
20 - 09	3.9	6.5	14.3	18.6	23.3	30.0
20 - 10	3.9	6.4	14.2	18.4	23.0	29.6
20 - 11	3.8	6.4	14.0	18.2	22.7	29.3
20 - 12	3.8	6.3	13.8	18.0	22.5	28.9
20 - 13	3.7	6.2	13.7	17.8	22.2	28.6
20 - 14	3.7	6.1	13.5	17.6	21.9	28.3
20 - 15	3.6	6.1	13.4	17.3	21.7	27.9
20 - 16	3.6	6.0	13.2	17.1	21.4	27.6
20 - 17	3.6	5.9	13.0	16.9	21.2	27.3
20 - 18	3.5	5.9	12.9	16.7	20.9	26.9
20 - 19	3.5	5.8	12.7	16.5	20.7	26.6
20 - 20	3.4	5.7	12.6	16.3	20.4	26.3
20 - 21	3.4	5.6	12.4	16.1	20.2	26.0
20 - 22	3.3	5.6	12.3	15.9	19.9	25.7
20 - 23	3.3	5.5	12.1	15.8	19.7	25.4
21 - 00	3.3	5.4	12.0	15.6	19.5	25.1
21 - 01	3.2	5.4	11.8	15.4	19.2	24.8
21 - 02	3.2	5.3	11.7	15.2	19.0	24.5
21 - 03	3.2	5.3	11.6	15.0	18.8	24.2
21 - 04	3.1	5.2	11.4	14.8	18.6	23.9
21 - 05	3.1	5.1	11.3	14.7	18.3	23.6
21 - 06	3.0	5.1	11.1	14.5	18.1	23.3
21 - 07	3.0	5.0	11.0	14.3	17.9	23.0
21 - 08	3.0	4.9	10.9	14.1	17.7	22.8
21 - 09	2.9	4.9	10.8	14.0	17.5	22.5
21 - 10	2.9	4.8	10.6	13.8	17.3	22.2
21 - 11	2.9	4.8	10.5	13.6	17.1	22.0
21 - 12	2.8	4.7	10.4	13.5	16.9	21.7
21 - 13	2.8	4.7	10.3	13.3	16.7	21.4
21 - 14	2.8	4.6	10.1	13.2	16.5	21.2
21 - 15	2.7	4.6	10.0	13.0	16.3	20.9
21 - 16	2.7	4.5	9.9	12.9	16.1	20.7
21 - 17	2.7	4.4	9.8	12.7	15.9	20.4

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
19 - 15	15.4	23.3	46.1	56.9	68.9	85.4
19 - 16	15.1	23.0	45.4	56.0	67.8	84.0
19 - 17	14.9	22.6	44.6	55.1	66.7	82.7
19 - 18	14.7	22.2	44.0	54.3	65.7	81.4
19 - 19	14.4	21.9	43.3	53.4	64.7	80.2
19 - 20	14.2	21.6	42.6	52.6	63.7	79.0
19 - 21	14.0	21.3	42.0	51.9	62.8	77.8
19 - 22	13.8	21.0	41.4	51.1	61.9	76.7
19 - 23	13.6	20.7	40.8	50.4	61.0	75.6
20 - 00	13.4	20.4	40.3	49.7	60.1	74.6
20 - 01	13.1	19.9	39.4	48.6	58.8	72.9
20 - 02	13.0	19.7	38.9	48.0	58.1	72.0
20 - 03	12.8	19.5	38.4	47.4	57.4	71.2
20 - 04	12.7	19.2	38.0	46.9	56.7	70.3
20 - 05	12.5	19.0	37.5	46.3	56.0	69.5
20 - 06	12.4	18.8	37.1	45.8	55.4	68.7
20 - 07	12.2	18.5	36.6	45.1	54.6	67.7
20 - 08	12.0	18.3	36.1	44.6	54.0	66.9
20 - 09	11.9	18.1	35.7	44.1	53.3	66.1
20 - 10	11.8	17.9	35.3	43.6	52.7	65.3
20 - 11	11.6	17.6	34.9	43.0	52.1	64.5
20 - 12	11.5	17.4	34.4	42.5	51.4	63.8
20 - 13	11.3	17.2	34.0	42.0	50.8	63.0
20 - 14	11.2	17.0	33.6	41.5	50.2	62.3
20 - 15	11.1	16.8	33.2	41.0	49.6	61.5
20 - 16	10.9	16.6	32.8	40.5	49.0	60.8
20 - 17	10.8	16.4	32.4	40.0	48.4	60.1
20 - 18	10.7	16.2	32.1	39.6	47.9	59.4
20 - 19	10.6	16.0	31.7	39.1	47.3	58.6
20 - 20	10.4	15.8	31.3	38.6	46.7	57.9
20 - 21	10.3	15.6	30.9	38.2	46.2	57.3
20 - 22	10.2	15.5	30.5	37.7	45.6	56.6
20 - 23	10.1	15.3	30.2	37.3	45.1	55.9
21 - 00	9.9	15.1	29.8	36.8	44.6	55.2
21 - 01	9.8	14.9	29.5	36.4	44.0	54.6
21 - 02	9.7	14.7	29.1	36.0	43.5	53.9
21 - 03	9.6	14.6	28.8	35.5	43.0	53.3
21 - 04	9.5	14.4	28.4	35.1	42.5	52.7
21 - 05	9.4	14.2	28.1	34.7	42.0	52.0
21 - 06	9.3	14.0	27.8	34.3	41.5	51.4
21 - 07	9.1	13.9	27.4	33.9	41.0	50.8
21 - 08	9.0	13.7	27.1	33.5	40.5	50.2
21 - 09	8.9	13.6	26.8	33.1	40.0	49.6
21 - 10	8.8	13.4	26.5	32.7	39.5	49.0
21 - 11	8.7	13.2	26.1	32.3	39.0	48.4
21 - 12	8.6	13.1	25.8	31.9	38.6	47.8
21 - 13	8.5	12.9	25.5	31.5	38.1	47.3
21 - 14	8.4	12.8	25.2	31.1	37.7	46.7
21 - 15	8.3	12.6	24.9	30.8	37.2	46.1
21 - 16	8.2	12.5	24.6	30.4	36.8	45.6
21 - 17	8.1	12.3	24.3	30.0	36.3	45.0

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
21 - 18	2.6	4.4	9.7	12.5	15.7	20.2
21 - 19	2.6	4.3	9.5	12.4	15.5	19.9
21 - 20	2.6	4.3	9.4	12.3	15.3	19.7
21 - 21	2.5	4.2	9.3	12.1	15.1	19.5
21 - 22	2.5	4.2	9.2	12.0	15.0	19.3
21 - 23	2.5	4.1	9.1	11.8	14.8	19.0
22 - 00	2.5	4.1	9.0	11.7	14.6	18.8
22 - 01	2.4	4.0	8.9	11.5	14.4	18.6
22 - 02	2.4	4.0	8.8	11.4	14.3	18.4
22 - 03	2.4	3.9	8.7	11.3	14.1	18.1
22 - 04	2.3	3.9	8.6	11.1	13.9	17.9
22 - 05	2.3	3.8	8.5	11.0	13.7	17.7
22 - 06	2.3	3.8	8.4	10.9	13.6	17.5
22 - 07	2.3	3.8	8.3	10.7	13.4	17.3
22 - 08	2.2	3.7	8.2	10.6	13.3	17.1
22 - 09	2.2	3.7	8.1	10.5	13.1	16.9
22 - 10	2.2	3.6	8.0	10.4	12.9	16.7
22 - 11	2.1	3.6	7.9	10.2	12.8	16.5
22 - 12	2.1	3.5	7.8	10.1	12.6	16.3
22 - 13	2.1	3.5	7.7	10.0	12.5	16.1
22 - 14	2.1	3.5	7.6	9.9	12.3	15.9
22 - 15	2.0	3.4	7.5	9.8	12.2	15.7
22 - 16	2.0	3.4	7.4	9.6	12.1	15.5
22 - 17	2.0	3.3	7.3	9.5	11.9	15.3
22 - 18	2.0	3.3	7.2	9.4	11.8	15.2
22 - 19	2.0	3.3	7.2	9.3	11.6	15.0
22 - 20	1.9	3.2	7.1	9.2	11.5	14.8
22 - 21	1.9	3.2	7.0	9.1	11.4	14.6
22 - 22	1.9	3.1	6.9	9.0	11.2	14.4
22 - 23	1.9	3.1	6.8	8.9	11.1	14.3
23 - 00	0.7	1.2	2.7	10.7	4.4	5.7
23 - 01	2.3	3.8	8.3	15.4	13.4	17.3
23 - 02	3.2	5.4	11.9	16.3	19.3	24.8
23 - 03	3.4	5.7	12.6	15.9	20.4	26.3
23 - 04	3.3	5.6	12.3	15.1	19.9	25.7
23 - 05	3.2	5.3	11.7	14.3	18.9	24.4
23 - 06	3.0	5.0	11.0	13.5	17.9	23.0
23 - 07	2.8	4.7	10.4	12.8	16.9	21.8
23 - 08	2.7	4.5	9.9	12.2	16.0	20.6
23 - 09	2.6	4.3	9.4	11.6	15.2	19.6
23 - 10	2.4	4.1	9.0	11.1	14.5	18.7
23 - 11	2.3	3.9	8.6	10.7	13.9	17.9
23 - 12	2.2	3.7	8.2	10.3	13.4	17.2
23 - 13	2.2	3.6	7.9	9.9	12.9	16.6
23 - 14	2.1	3.5	7.7	9.6	12.4	16.0
23 - 15	2.0	3.4	7.4	9.3	12.0	15.5
23 - 16	2.0	3.3	7.2	9.0	11.6	15.0
23 - 17	1.9	3.2	6.9	8.7	11.3	14.5
23 - 18	1.8	3.1	6.7	8.5	10.9	14.1
23 - 19	1.8	3.0	6.5	8.3	10.6	13.7
23 - 20	1.7	2.9	6.4	8.0	10.3	13.3

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
21 - 18	8.0	12.2	24.0	29.7	35.9	44.5
21 - 19	7.9	12.0	23.7	29.3	35.5	44.0
21 - 20	7.8	11.9	23.5	29.0	35.1	43.5
21 - 21	7.7	11.7	23.2	28.6	34.6	42.9
21 - 22	7.6	11.6	22.9	28.3	34.2	42.4
21 - 23	7.5	11.5	22.6	28.0	33.8	41.9
22 - 00	7.5	11.3	22.4	27.6	33.4	41.4
22 - 01	7.4	11.2	22.1	27.3	33.0	40.9
22 - 02	7.3	11.1	21.8	27.0	32.6	40.4
22 - 03	7.2	10.9	21.6	26.6	32.2	40.0
22 - 04	7.1	10.8	21.3	26.3	31.8	39.5
22 - 05	7.0	10.7	21.1	26.0	31.5	39.0
22 - 06	6.9	10.5	20.8	25.7	31.1	38.6
22 - 07	6.9	10.4	20.6	25.4	30.7	38.1
22 - 08	6.8	10.3	20.3	25.1	30.4	37.6
22 - 09	6.7	10.2	20.1	24.8	30.0	37.2
22 - 10	6.6	10.0	19.8	24.5	29.6	36.8
22 - 11	6.5	9.9	19.6	24.2	29.3	36.3
22 - 12	6.5	9.8	19.4	23.9	28.9	35.9
22 - 13	6.4	9.7	19.1	23.6	28.6	35.4
22 - 14	6.3	9.6	18.9	23.4	28.3	35.0
22 - 15	6.2	9.5	18.7	23.1	27.9	34.6
22 - 16	6.2	9.3	18.5	22.8	27.6	34.2
22 - 17	6.1	9.2	18.2	22.5	27.2	33.8
22 - 18	6.0	9.1	18.0	22.3	26.9	33.4
22 - 19	5.9	9.0	17.8	22.0	26.6	33.0
22 - 20	5.9	8.9	17.6	21.7	26.3	32.6
22 - 21	5.8	8.8	17.4	21.5	26.0	32.2
22 - 22	5.7	8.7	17.2	21.2	25.7	31.8
22 - 23	5.7	8.6	17.0	21.0	25.4	31.4
23 - 00	1.6	2.4	4.7	5.7	7.0	8.6
23 - 01	6.8	10.3	20.4	25.2	30.5	37.8
23 - 02	7.2	11.0	21.6	26.7	32.3	40.1
23 - 03	7.0	10.7	21.1	26.0	31.5	39.1
23 - 04	6.7	10.1	20.0	24.7	29.9	37.1
23 - 05	6.3	9.6	18.9	23.4	28.3	35.1
23 - 06	6.0	9.1	17.9	22.1	26.7	33.1
23 - 07	5.7	8.6	17.0	20.9	25.3	31.4
23 - 08	5.4	8.2	16.1	19.9	24.1	29.9
23 - 09	5.1	7.8	15.4	19.0	23.0	28.5
23 - 10	4.9	7.5	14.8	18.2	22.0	27.3
23 - 11	4.7	7.2	14.2	17.5	21.2	26.2
23 - 12	4.5	6.9	13.6	16.8	20.4	25.2
23 - 13	4.4	6.7	13.1	16.2	19.6	24.3
23 - 14	4.2	6.4	12.7	15.7	19.0	23.5
23 - 15	4.1	6.2	12.3	15.2	18.4	22.8
23 - 16	4.0	6.0	11.9	14.7	17.8	22.1
23 - 17	3.9	5.9	11.6	14.3	17.3	21.4
23 - 18	3.7	5.7	11.2	13.9	16.8	20.8
23 - 19	3.6	5.5	10.9	13.5	16.3	20.2
23 - 20	3.5	5.4	10.6	13.1	15.9	19.7

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
23 - 21	1.7	2.8	6.2	7.8	10.1	12.9
23 - 22	1.6	2.7	6.0	7.6	9.8	12.6
23 - 23	1.6	2.7	5.9	7.5	9.6	12.3
24 - 00	1.6	2.6	5.7	7.3	9.3	12.0
24 - 01	1.5	2.6	5.6	7.1	9.1	11.7
24 - 02	1.5	2.5	5.5	7.0	8.9	11.5
24 - 03	1.5	2.4	5.4	6.8	8.7	11.2
24 - 04	1.4	2.4	5.3	6.7	8.5	11.0
24 - 05	1.4	2.3	5.2	6.6	8.4	10.8
24 - 06	1.4	2.3	5.0	6.4	8.2	10.6
24 - 07	1.4	2.3	5.0	6.3	8.0	10.4
24 - 08	1.3	2.2	4.9	6.2	7.9	10.2
24 - 09	1.3	2.2	4.8	6.1	7.7	10.0
24 - 10	1.3	2.1	4.7	6.0	7.6	9.8
24 - 11	1.3	2.1	4.6	5.9	7.5	9.6
24 - 12	1.2	2.1	4.5	5.8	7.3	9.5
24 - 13	1.2	2.0	4.4	5.7	7.2	9.3
24 - 14	1.2	2.0	4.4	5.6	7.1	9.1
24 - 15	1.2	2.0	4.3	5.5	7.0	9.0
24 - 16	1.2	1.9	4.2	5.4	6.9	8.9
24 - 17	1.1	1.9	4.2	5.3	6.8	8.7
24 - 18	1.1	1.9	4.1	5.3	6.7	8.6
24 - 19	1.1	1.8	4.0	5.2	6.6	8.5
24 - 20	1.1	1.8	4.0	5.1	6.5	8.3
24 - 21	1.1	1.8	3.9	5.0	6.4	8.2
24 - 22	1.1	1.8	3.9	5.0	6.3	8.1
24 - 23	1.0	1.7	3.8	4.8	6.2	8.0
25 - 00	1.0	1.7	3.7	4.8	6.1	7.8
25 - 01	1.0	1.7	3.7	4.7	6.0	7.7
25 - 02	1.0	1.7	3.6	4.7	5.9	7.6
25 - 03	1.0	1.6	3.6	4.6	5.8	7.5
25 - 04	1.0	1.6	3.6	4.6	5.8	7.4
25 - 05	1.0	1.6	3.5	4.5	5.7	7.4
25 - 06	0.9	1.6	3.5	4.4	5.6	7.2
25 - 07	0.9	1.6	3.4	4.4	5.6	7.2
25 - 08	0.9	1.5	3.4	4.3	5.5	7.1
25 - 09	0.9	1.5	3.3	4.3	5.4	7.0
25 - 10	0.9	1.5	3.3	4.2	5.4	6.9
25 - 11	0.9	1.5	3.3	4.2	5.3	6.8
25 - 12	0.9	1.5	3.2	4.1	5.2	6.7
25 - 13	0.9	1.4	3.2	4.1	5.2	6.7
25 - 14	0.9	1.4	3.2	4.0	5.1	6.6
25 - 15	0.8	1.4	3.1	4.0	5.1	6.5
25 - 16	0.8	1.4	3.1	3.9	5.0	6.4
25 - 17	0.8	1.4	3.0	3.9	4.9	6.4
25 - 18	0.8	1.4	3.0	3.9	4.9	6.3
25 - 19	0.8	1.3	3.0	3.8	4.8	6.2
25 - 20	0.8	1.3	2.9	3.8	4.8	6.1
25 - 21	0.8	1.3	2.9	3.7	4.7	6.1
25 - 22	0.8	1.3	2.9	3.7	4.6	6.0
25 - 23	0.8	1.3	2.8	3.6	4.6	5.9

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
23 - 21	3.5	5.2	10.4	12.8	15.5	19.2
23 - 22	3.4	5.1	10.1	12.5	15.1	18.7
23 - 23	3.3	5.0	9.9	12.2	14.8	18.3
24 - 00	3.2	4.9	9.7	11.9	14.4	17.9
24 - 01	3.1	4.8	9.4	11.6	14.1	17.5
24 - 02	3.1	4.7	9.2	11.4	13.8	17.1
24 - 03	3.0	4.6	9.0	11.2	13.5	16.7
24 - 04	3.0	4.5	8.9	10.9	13.2	16.4
24 - 05	2.9	4.4	8.7	10.7	13.0	16.1
24 - 06	2.8	4.3	8.5	10.5	12.7	15.8
24 - 07	2.8	4.2	8.3	10.3	12.5	15.5
24 - 08	2.7	4.1	8.2	10.1	12.2	15.2
24 - 09	2.7	4.1	8.0	9.9	12.0	14.9
24 - 10	2.6	4.0	7.9	9.8	11.8	14.6
24 - 11	2.6	3.9	7.8	9.6	11.6	14.4
24 - 12	2.5	3.9	7.6	9.4	11.4	14.1
24 - 13	2.5	3.8	7.5	9.3	11.2	13.9
24 - 14	2.5	3.7	7.4	9.1	11.0	13.7
24 - 15	2.4	3.7	7.3	9.0	10.9	13.5
24 - 16	2.4	3.6	7.2	8.8	10.7	13.3
24 - 17	2.4	3.6	7.1	8.7	10.5	13.1
24 - 18	2.3	3.5	7.0	8.6	10.4	12.9
24 - 19	2.3	3.5	6.8	8.5	10.2	12.7
24 - 20	2.3	3.4	6.8	8.3	10.1	12.5
24 - 21	2.2	3.4	6.7	8.2	9.9	12.3
24 - 22	2.2	3.3	6.6	8.1	9.8	12.2
24 - 23	2.1	3.2	6.4	7.9	9.6	11.9
25 - 00	2.1	3.2	6.3	7.8	9.5	11.7
25 - 01	2.1	3.2	6.3	7.7	9.4	11.6
25 - 02	2.1	3.1	6.2	7.6	9.2	11.5
25 - 03	2.0	3.1	6.1	7.6	9.1	11.3
25 - 04	2.0	3.1	6.0	7.5	9.0	11.2
25 - 05	2.0	3.0	6.0	7.4	8.9	11.0
25 - 06	2.0	3.0	5.9	7.3	8.8	10.9
25 - 07	1.9	2.9	5.8	7.2	8.7	10.8
25 - 08	1.9	2.9	5.7	7.1	8.6	10.6
25 - 09	1.9	2.9	5.7	7.0	8.5	10.5
25 - 10	1.9	2.8	5.6	6.9	8.4	10.4
25 - 11	1.8	2.8	5.5	6.8	8.3	10.3
25 - 12	1.8	2.8	5.5	6.8	8.2	10.1
25 - 13	1.8	2.7	5.4	6.7	8.1	10.0
25 - 14	1.8	2.7	5.4	6.6	8.0	9.9
25 - 15	1.8	2.7	5.3	6.5	7.9	9.8
25 - 16	1.7	2.6	5.2	6.4	7.8	9.7
25 - 17	1.7	2.6	5.2	6.4	7.7	9.6
25 - 18	1.7	2.6	5.1	6.3	7.6	9.4
25 - 19	1.7	2.6	5.0	6.2	7.5	9.3
25 - 20	1.7	2.5	5.0	6.1	7.4	9.2
25 - 21	1.6	2.5	4.9	6.1	7.3	9.1
25 - 22	1.6	2.5	4.9	6.0	7.3	9.0
25 - 23	1.6	2.4	4.8	5.9	7.2	8.9

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
26 - 00	0.8	1.3	2.8	3.6	4.5	5.8
26 - 01	0.8	1.3	2.8	3.5	4.5	5.8
26 - 02	0.7	1.2	2.7	3.5	4.4	5.7
26 - 03	0.7	1.2	2.7	3.5	4.4	5.6
26 - 04	0.7	1.2	2.7	3.4	4.3	5.6
26 - 05	0.7	1.2	2.6	3.4	4.3	5.5
26 - 06	0.7	1.2	2.6	3.3	4.2	5.4
26 - 07	0.7	1.2	2.6	3.3	4.2	5.4
26 - 08	0.7	1.2	2.5	3.3	4.1	5.3
26 - 09	0.7	1.1	2.5	3.2	4.1	5.2
26 - 10	0.7	1.1	2.5	3.2	4.0	5.2
26 - 11	0.7	1.1	2.4	3.1	4.0	5.1
26 - 12	0.7	1.1	2.4	3.1	3.9	5.1
26 - 13	0.7	1.1	2.4	3.1	3.9	5.0
26 - 14	0.6	1.1	2.4	3.0	3.8	4.9
26 - 15	0.6	1.1	2.3	3.0	3.8	4.9
26 - 16	0.6	1.0	2.3	3.0	3.7	4.8
26 - 17	0.6	1.0	2.3	2.9	3.7	4.8
26 - 18	0.6	1.0	2.3	2.9	3.7	4.7
26 - 19	0.6	1.0	2.2	2.9	3.6	4.7
26 - 20	0.6	1.0	2.2	2.8	3.6	4.6
26 - 21	0.6	1.0	2.2	2.8	3.5	4.5
26 - 22	0.6	1.0	2.1	2.8	3.5	4.5
26 - 23	0.6	1.0	2.1	2.7	3.4	4.4
27 - 00	0.6	1.0	2.1	2.7	3.4	4.4
27 - 01	0.6	0.9	2.1	2.7	3.4	4.3
27 - 02	0.6	0.9	2.0	2.6	3.3	4.3
27 - 03	0.6	0.9	2.0	2.6	3.3	4.2
27 - 04	0.5	0.9	2.0	2.6	3.2	4.2
27 - 05	0.5	0.9	2.0	2.5	3.2	4.1
27 - 06	0.5	0.9	1.9	2.5	3.2	4.1
27 - 07	0.5	0.9	1.9	2.5	3.1	4.0
27 - 08	0.5	0.9	1.9	2.4	3.1	4.0
27 - 09	0.5	0.9	1.9	2.4	3.1	3.9
27 - 10	0.5	0.8	1.9	2.4	3.0	3.9
27 - 11	0.5	0.8	1.8	2.4	3.0	3.8
27 - 12	0.5	0.8	1.8	2.3	2.9	3.8
27 - 13	0.5	0.8	1.8	2.3	2.9	3.8
27 - 14	0.5	0.8	1.8	2.3	2.9	3.7
27 - 15	0.5	0.8	1.8	2.2	2.8	3.7
27 - 16	0.5	0.8	1.7	2.2	2.8	3.6
27 - 17	0.5	0.8	1.7	2.2	2.8	3.6
27 - 18	0.5	0.8	1.7	2.2	2.7	3.5
27 - 19	0.5	0.8	1.7	2.1	2.7	3.5
27 - 20	0.5	0.8	1.7	2.1	2.7	3.5
27 - 21	0.4	0.7	1.6	2.1	2.6	3.4
27 - 22	0.4	0.7	1.6	0.6	2.6	3.4
27 - 23	0.1	0.2	0.5	1.9	0.8	1.0
28 - 00	0.4	0.6	1.4	2.7	2.3	3.0
28 - 01	0.6	0.9	2.1	2.8	3.3	4.3
28 - 02	0.6	1.0	2.2	2.8	3.5	4.6

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
26 - 00	1.6	2.4	4.7	5.9	7.1	8.8
26 - 01	1.6	2.4	4.7	5.8	7.0	8.7
26 - 02	1.5	2.3	4.6	5.7	6.9	8.6
26 - 03	1.5	2.3	4.6	5.7	6.8	8.5
26 - 04	1.5	2.3	4.5	5.6	6.8	8.4
26 - 05	1.5	2.3	4.5	5.5	6.7	8.3
26 - 06	1.5	2.2	4.4	5.5	6.6	8.2
26 - 07	1.5	2.2	4.4	5.4	6.5	8.1
26 - 08	1.4	2.2	4.3	5.3	6.4	8.0
26 - 09	1.4	2.2	4.3	5.3	6.4	7.9
26 - 10	1.4	2.1	4.2	5.2	6.3	7.8
26 - 11	1.4	2.1	4.2	5.1	6.2	7.7
26 - 12	1.4	2.1	4.1	5.1	6.1	7.6
26 - 13	1.4	2.1	4.1	5.0	6.1	7.5
26 - 14	1.3	2.0	4.0	5.0	6.0	7.4
26 - 15	1.3	2.0	4.0	4.9	5.9	7.3
26 - 16	1.3	2.0	3.9	4.8	5.9	7.3
26 - 17	1.3	2.0	3.9	4.8	5.8	7.2
26 - 18	1.3	1.9	3.8	4.7	5.7	7.1
26 - 19	1.3	1.9	3.8	4.7	5.6	7.0
26 - 20	1.2	1.9	3.7	4.6	5.6	6.9
26 - 21	1.2	1.9	3.7	4.6	5.5	6.8
26 - 22	1.2	1.8	3.6	4.5	5.4	6.8
26 - 23	1.2	1.8	3.6	4.4	5.4	6.7
27 - 00	1.2	1.8	3.6	4.4	5.3	6.6
27 - 01	1.2	1.8	3.5	4.3	5.3	6.5
27 - 02	1.2	1.8	3.5	4.3	5.2	6.4
27 - 03	1.1	1.7	3.4	4.2	5.1	6.4
27 - 04	1.1	1.7	3.4	4.2	5.1	6.3
27 - 05	1.1	1.7	3.4	4.1	5.0	6.2
27 - 06	1.1	1.7	3.3	4.1	4.9	6.1
27 - 07	1.1	1.7	3.3	4.0	4.9	6.1
27 - 08	1.1	1.6	3.2	4.0	4.8	6.0
27 - 09	1.1	1.6	3.2	3.9	4.8	5.9
27 - 10	1.1	1.6	3.2	3.9	4.7	5.8
27 - 11	1.0	1.6	3.1	3.9	4.7	5.8
27 - 12	1.0	1.6	3.1	3.8	4.6	5.7
27 - 13	1.0	1.5	3.0	3.8	4.6	5.6
27 - 14	1.0	1.5	3.0	3.7	4.5	5.6
27 - 15	1.0	1.5	3.0	3.7	4.4	5.5
27 - 16	1.0	1.5	2.9	3.6	4.4	5.4
27 - 17	1.0	1.5	2.9	3.6	4.3	5.4
27 - 18	1.0	1.5	2.9	3.5	4.3	5.3
27 - 19	0.9	1.4	2.8	3.5	4.2	5.2
27 - 20	0.9	1.4	2.8	3.5	4.2	5.2
27 - 21	0.9	1.4	2.8	3.4	4.1	5.1
27 - 22	0.3	0.4	0.8	0.9	1.1	1.4
27 - 23	0.8	1.2	2.5	3.0	3.7	4.5
28 - 00	1.2	1.8	3.5	4.4	5.3	6.5
28 - 01	1.2	1.9	3.7	4.6	5.6	6.9
28 - 02	1.2	1.8	3.6	4.5	5.5	6.8

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
28 - 03	0.6	1.0	2.1	2.6	3.4	4.4
28 - 04	0.6	0.9	2.0	2.5	3.3	4.2
28 - 05	0.5	0.9	1.9	2.3	3.1	4.0
28 - 06	0.5	0.8	1.8	2.2	2.9	3.8
28 - 07	0.5	0.8	1.7	2.1	2.8	3.6
28 - 08	0.4	0.7	1.6	2.0	2.6	3.4
28 - 09	0.4	0.7	1.6	1.9	2.5	3.2
28 - 10	0.4	0.7	1.5	1.9	2.4	3.1
28 - 11	0.4	0.6	1.4	1.8	2.3	3.0
28 - 12	0.4	0.6	1.4	1.7	2.2	2.9
28 - 13	0.4	0.6	1.3	1.7	2.1	2.8
28 - 14	0.3	0.6	1.3	1.6	2.1	2.7
28 - 15	0.3	0.6	1.2	1.6	2.0	2.6
28 - 16	0.3	0.5	1.2	1.5	1.9	2.5
28 - 17	0.3	0.5	1.2	1.5	1.9	2.4
28 - 18	0.3	0.5	1.1	1.4	1.8	2.4
28 - 19	0.3	0.5	1.1	1.4	1.8	2.3
28 - 20	0.3	0.5	1.1	1.4	1.7	2.2
28 - 21	0.3	0.5	1.0	1.3	1.7	2.2
28 - 22	0.3	0.5	1.0	1.3	1.7	2.1
28 - 23	0.3	0.5	1.0	1.3	1.6	2.1
29 - 00	0.3	0.4	1.0	1.2	1.6	2.0
29 - 01	0.3	0.4	0.9	1.2	1.5	2.0
29 - 02	0.3	0.4	0.9	1.2	1.5	1.9
29 - 03	0.2	0.4	0.9	1.2	1.5	1.9
29 - 04	0.2	0.4	0.9	1.1	1.4	1.9
29 - 05	0.2	0.4	0.9	1.1	1.4	1.8
29 - 06	0.2	0.4	0.9	1.1	1.4	1.8
29 - 07	0.2	0.4	0.8	1.1	1.4	1.8
29 - 08	0.2	0.4	0.8	1.1	1.3	1.7
29 - 09	0.2	0.4	0.8	1.0	1.3	1.7
29 - 10	0.2	0.4	0.8	1.0	1.3	1.7
29 - 11	0.2	0.4	0.8	1.0	1.3	1.6
29 - 12	0.2	0.3	0.8	1.0	1.2	1.6
29 - 13	0.2	0.3	0.8	1.0	1.2	1.6
29 - 14	0.2	0.3	0.7	1.0	1.2	1.6
29 - 15	0.2	0.3	0.7	0.9	1.2	1.5
29 - 16	0.2	0.3	0.7	0.9	1.2	1.5
29 - 17	0.2	0.3	0.7	0.9	1.2	1.5
29 - 18	0.2	0.3	0.7	0.9	1.1	1.5
29 - 19	0.2	0.3	0.7	0.9	1.1	1.4
29 - 20	0.2	0.3	0.7	0.9	1.1	1.4
29 - 21	0.2	0.3	0.7	0.9	1.1	1.4
29 - 22	0.2	0.3	0.7	0.8	1.1	1.4
29 - 23	0.2	0.3	0.6	0.8	1.0	1.4
30 - 00	0.2	0.3	0.6	0.8	1.0	1.3
30 - 01	0.2	0.3	0.6	0.8	1.0	1.3
30 - 02	0.2	0.3	0.6	0.8	1.0	1.3
30 - 03	0.2	0.3	0.6	0.8	1.0	1.3
30 - 04	0.2	0.3	0.6	0.8	1.0	1.3
30 - 05	0.2	0.3	0.6	0.8	1.0	1.3

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
28 - 03	1.2	1.8	3.5	4.3	5.2	6.4
28 - 04	1.1	1.7	3.3	4.0	4.9	6.1
28 - 05	1.0	1.6	3.1	3.8	4.6	5.7
28 - 06	1.0	1.5	2.9	3.6	4.4	5.4
28 - 07	0.9	1.4	2.8	3.4	4.2	5.2
28 - 08	0.9	1.3	2.7	3.3	4.0	4.9
28 - 09	0.9	1.3	2.6	3.2	3.8	4.7
28 - 10	0.8	1.2	2.5	3.0	3.7	4.5
28 - 11	0.8	1.2	2.4	2.9	3.5	4.4
28 - 12	0.8	1.2	2.3	2.8	3.4	4.2
28 - 13	0.7	1.1	2.2	2.7	3.3	4.1
28 - 14	0.7	1.1	2.1	2.6	3.2	3.9
28 - 15	0.7	1.0	2.1	2.5	3.1	3.8
28 - 16	0.7	1.0	2.0	2.5	3.0	3.7
28 - 17	0.6	1.0	1.9	2.4	2.9	3.6
28 - 18	0.6	1.0	1.9	2.3	2.8	3.5
28 - 19	0.6	0.9	1.8	2.3	2.8	3.4
28 - 20	0.6	0.9	1.8	2.2	2.7	3.3
28 - 21	0.6	0.9	1.8	2.2	2.6	3.2
28 - 22	0.6	0.9	1.7	2.1	2.6	3.2
28 - 23	0.6	0.8	1.7	2.1	2.5	3.1
29 - 00	0.5	0.8	1.6	2.0	2.4	3.0
29 - 01	0.5	0.8	1.6	2.0	2.4	3.0
29 - 02	0.5	0.8	1.6	1.9	2.3	2.9
29 - 03	0.5	0.8	1.5	1.9	2.3	2.8
29 - 04	0.5	0.8	1.5	1.9	2.2	2.8
29 - 05	0.5	0.7	1.5	1.8	2.2	2.7
29 - 06	0.5	0.7	1.4	1.8	2.2	2.7
29 - 07	0.5	0.7	1.4	1.8	2.1	2.6
29 - 08	0.5	0.7	1.4	1.7	2.1	2.6
29 - 09	0.5	0.7	1.4	1.7	2.0	2.5
29 - 10	0.4	0.7	1.3	1.7	2.0	2.5
29 - 11	0.4	0.7	1.3	1.6	2.0	2.4
29 - 12	0.4	0.7	1.3	1.6	1.9	2.4
29 - 13	0.4	0.6	1.3	1.6	1.9	2.4
29 - 14	0.4	0.6	1.3	1.6	1.9	2.3
29 - 15	0.4	0.6	1.2	1.5	1.9	2.3
29 - 16	0.4	0.6	1.2	1.5	1.8	2.3
29 - 17	0.4	0.6	1.2	1.5	1.8	2.2
29 - 18	0.4	0.6	1.2	1.5	1.8	2.2
29 - 19	0.4	0.6	1.2	1.4	1.7	2.2
29 - 20	0.4	0.6	1.2	1.4	1.7	2.1
29 - 21	0.4	0.6	1.1	1.4	1.7	2.1
29 - 22	0.4	0.6	1.1	1.4	1.7	2.1
29 - 23	0.4	0.6	1.1	1.4	1.6	2.0
30 - 00	0.4	0.5	1.1	1.3	1.6	2.0
30 - 01	0.4	0.5	1.1	1.3	1.6	2.0
30 - 02	0.4	0.5	1.1	1.3	1.6	2.0
30 - 03	0.3	0.5	1.0	1.3	1.6	1.9
30 - 04	0.3	0.5	1.0	1.3	1.5	1.9
30 - 05	0.3	0.5	1.0	1.3	1.5	1.9

Table A3
Crow Creek Local Flow
CRSUB2
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
30 - 06	0.2	0.3	0.6	0.8	1.0	1.2
30 - 07	0.2	0.3	0.6	0.8	1.0	1.2
30 - 08	0.2	0.3	0.6	0.7	0.9	1.2
30 - 09	0.2	0.3	0.6	0.7	0.9	1.2
30 - 10	0.2	0.3	0.6	0.7	0.9	1.2
30 - 11	0.2	0.3	0.6	0.7	0.9	1.2
30 - 12	0.2	0.3	0.6	0.7	0.9	1.2
30 - 13	0.1	0.2	0.5	0.7	0.9	1.1
30 - 14	0.1	0.2	0.5	0.7	0.9	1.1
30 - 15	0.1	0.2	0.5	0.7	0.9	1.1
30 - 16	0.1	0.2	0.5	0.7	0.9	1.1
30 - 17	0.1	0.2	0.5	0.7	0.8	1.1
30 - 18	0.1	0.2	0.5	0.7	0.8	1.1
30 - 19	0.1	0.2	0.5	0.7	0.8	1.1
30 - 20	0.1	0.2	0.5	0.6	0.8	1.0
30 - 21	0.1	0.2	0.5	0.6	0.8	1.0
30 - 22	0.1	0.2	0.5	0.6	0.8	1.0
30 - 23	0.1	0.2	0.5	0.6	0.8	1.0

Table A4
Orestimba Creek Local Flow
from Subarea 4, ORSUB4
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
30 - 06	0.3	0.5	1.0	1.2	1.5	1.9
30 - 07	0.3	0.5	1.0	1.2	1.5	1.8
30 - 08	0.3	0.5	1.0	1.2	1.5	1.8
30 - 09	0.3	0.5	1.0	1.2	1.5	1.8
30 - 10	0.3	0.5	1.0	1.2	1.4	1.8
30 - 11	0.3	0.5	0.9	1.2	1.4	1.8
30 - 12	0.3	0.5	0.9	1.2	1.4	1.7
30 - 13	0.3	0.5	0.9	1.1	1.4	1.7
30 - 14	0.3	0.5	0.9	1.1	1.4	1.7
30 - 15	0.3	0.5	0.9	1.1	1.4	1.7
30 - 16	0.3	0.5	0.9	1.1	1.3	1.7
30 - 17	0.3	0.4	0.9	1.1	1.3	1.6
30 - 18	0.3	0.4	0.9	1.1	1.3	1.6
30 - 19	0.3	0.4	0.9	1.1	1.3	1.6
30 - 20	0.3	0.4	0.9	1.1	1.3	1.6
30 - 21	0.3	0.4	0.8	1.0	1.3	1.6
30 - 22	0.3	0.4	0.8	1.0	1.2	1.5
30 - 23	0.3	0.4	0.8	1.0	1.2	1.5

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
There are no flows for the first six days						
7 - 00	0.0	0.0	0.0	0.0	0.0	0.0
7 - 01	0.0	0.0	0.0	0.0	0.0	0.0
7 - 02	0.0	0.0	0.0	0.0	0.0	0.0
7 - 03	0.0	0.0	0.0	0.0	0.0	0.0
7 - 04	0.0	0.0	0.0	0.0	0.0	0.0
7 - 05	0.0	0.0	0.0	0.0	0.0	0.0
7 - 06	0.0	0.0	0.0	0.0	0.0	0.0
7 - 07	0.0	0.0	0.0	0.0	0.0	0.0
7 - 08	0.0	0.0	0.0	0.0	0.0	0.0
7 - 09	0.0	0.0	0.0	0.0	0.0	0.0
7 - 10	0.0	0.0	0.0	0.0	0.0	0.0
7 - 11	0.0	0.0	0.0	0.0	0.0	0.0
7 - 12	0.0	0.0	0.0	0.0	0.0	0.0
7 - 13	0.0	0.0	0.0	0.0	0.0	0.0
7 - 14	0.0	0.0	0.0	0.0	0.0	0.0
7 - 15	0.0	0.0	0.0	0.0	0.0	0.0
7 - 16	0.0	0.0	0.0	0.0	0.0	0.0
7 - 17	0.0	0.0	0.0	0.0	0.0	0.0
7 - 18	0.0	0.0	0.0	0.0	0.0	0.0
7 - 19	0.0	0.0	0.0	0.0	0.0	0.0
7 - 20	0.0	0.0	0.0	0.0	0.0	0.0
7 - 21	0.0	0.0	0.0	0.0	0.0	0.0
7 - 22	0.0	0.0	0.0	0.0	0.0	0.0
7 - 23	0.0	0.0	0.0	0.0	0.0	0.0
8 - 00	0.0	0.1	0.1	0.2	0.2	0.3
8 - 01	0.0	0.1	0.1	0.2	0.2	0.2
8 - 02	0.3	0.5	0.9	1.1	1.3	1.7
8 - 03	0.3	0.5	0.9	1.1	1.3	1.7
8 - 04	0.9	1.4	2.7	3.4	4.1	5.1
8 - 05	1.3	2.0	3.9	4.8	5.9	7.3
8 - 06	1.4	2.1	4.2	5.1	6.2	7.7
8 - 07	1.4	2.1	4.1	5.0	6.1	7.5
8 - 08	1.3	2.0	3.9	4.8	5.8	7.1
8 - 09	1.2	1.8	3.6	4.5	5.4	6.7
8 - 10	1.1	1.7	3.4	4.3	5.1	6.4
8 - 11	1.1	1.7	3.3	4.0	4.9	6.0
8 - 12	1.0	1.6	3.1	3.8	4.6	5.8
8 - 13	1.0	1.5	3.0	3.7	4.4	5.5
8 - 14	0.9	1.4	2.8	3.5	4.2	5.3
8 - 15	0.9	1.4	2.7	3.4	4.1	5.0
8 - 16	0.9	1.3	2.6	3.2	3.9	4.9
8 - 17	0.8	1.3	2.5	3.1	3.8	4.7
8 - 18	0.8	1.2	2.4	3.0	3.7	4.5
8 - 19	0.8	1.2	2.4	2.9	3.5	4.4
8 - 20	0.8	1.2	2.3	2.8	3.4	4.2
8 - 21	0.7	1.1	2.2	2.7	3.3	4.1
8 - 22	0.7	1.1	2.2	2.7	3.2	4.0
8 - 23	0.7	1.1	2.1	2.6	3.1	3.9
9 - 00	0.7	1.0	2.0	2.5	3.1	3.8

Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
There are no flows for the first six days						
7 - 00	0.0	0.0	0.0	0.0	0.0	0.0
7 - 01	0.0	0.0	0.0	0.0	0.0	0.0
7 - 02	0.0	0.0	0.0	0.0	0.0	0.0
7 - 03	0.0	0.0	0.0	0.0	0.0	0.0
7 - 04	0.0	0.0	0.0	0.0	0.0	0.0
7 - 05	0.0	0.0	0.0	0.0	0.0	0.0
7 - 06	0.0	0.0	0.0	0.0	0.0	0.0
7 - 07	0.0	0.0	0.0	0.0	0.0	0.0
7 - 08	0.0	0.0	0.0	0.0	0.0	0.0
7 - 09	0.0	0.0	0.0	0.0	0.0	0.0
7 - 10	0.0	0.0	0.0	0.0	0.0	0.0
7 - 11	0.0	0.0	0.0	0.0	0.0	0.0
7 - 12	0.0	0.0	0.0	0.0	0.0	0.0
7 - 13	0.0	0.0	0.0	0.0	0.0	0.0
7 - 14	0.0	0.0	0.0	0.0	0.0	0.0
7 - 15	0.0	0.0	0.0	0.0	0.0	0.0
7 - 16	0.0	0.0	0.0	0.0	0.0	0.0
7 - 17	0.0	0.0	0.0	0.0	0.0	0.0
7 - 18	0.0	0.0	0.0	0.0	0.0	0.0
7 - 19	0.0	0.0	0.0	0.0	0.0	0.0
7 - 20	0.0	0.0	0.0	0.0	0.0	0.0
7 - 21	0.0	0.0	0.0	0.0	0.0	0.0
7 - 22	0.0	0.0	0.0	0.0	0.0	0.0
7 - 23	0.0	0.0	0.0	0.0	0.0	0.0
8 - 00	0.9	1.4	2.7	3.3	4.0	5.0
8 - 01	0.9	1.5	2.9	3.6	4.3	5.3
8 - 02	2.8	4.4	8.9	10.8	13.1	16.3
8 - 03	4.1	6.4	12.8	15.6	18.9	23.4
8 - 04	4.3	6.8	13.6	16.5	20.0	24.8
8 - 05	4.2	6.6	13.2	16.1	19.5	24.2
8 - 06	4.0	6.3	12.6	15.3	18.5	23.0
8 - 07	3.8	5.9	11.9	14.5	17.5	21.7
8 - 08	3.6	5.6	11.2	13.7	16.5	20.5
8 - 09	3.4	5.3	10.6	13.0	15.7	19.4
8 - 10	3.2	5.1	10.1	12.3	14.9	18.5
8 - 11	3.1	4.8	9.7	11.8	14.2	17.7
8 - 12	2.9	4.6	9.2	11.3	13.6	16.9
8 - 13	2.8	4.4	8.9	10.8	13.1	16.2
8 - 14	2.7	4.3	8.5	10.4	12.6	15.6
8 - 15	2.6	4.1	8.2	10.1	12.2	15.1
8 - 16	2.5	4.0	8.0	9.7	11.7	14.6
8 - 17	2.4	3.9	7.7	9.4	11.4	14.1
8 - 18	2.4	3.7	7.5	9.1	11.0	13.7
8 - 19	2.3	3.6	7.2	8.8	10.7	13.3
8 - 20	2.2	3.5	7.0	8.6	10.4	12.9
8 - 21	2.2	3.4	6.8	8.4	10.1	12.5
8 - 22	2.1	3.3	6.7	8.1	9.8	12.2
8 - 23	2.1	3.3	6.5	7.9	9.6	11.9
9 - 00	2.0	3.2	6.3	7.7	9.4	11.6

Table A5
Orestimba Creek Local Flow
from Subarea 5, ORSUB5
Concurrent Centering

Period	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
9 - 01	0.7	1.0	2.0	2.5	3.0	3.7
9 - 02	0.6	1.0	1.9	2.4	2.9	3.6
9 - 03	0.6	1.0	1.9	2.3	2.8	3.5
9 - 04	0.6	0.9	1.9	2.3	2.8	3.4
9 - 05	0.6	0.9	1.8	2.2	2.7	3.4
9 - 06	0.6	0.9	1.8	2.2	2.7	3.3
9 - 07	0.6	0.9	1.7	2.1	2.6	3.2
9 - 08	0.6	0.9	1.7	2.1	2.5	3.2
9 - 09	0.6	0.8	1.7	2.1	2.5	3.1
9 - 10	0.5	0.8	1.6	2.0	2.4	3.0
9 - 11	0.5	0.8	1.6	2.0	2.4	3.0
9 - 12	0.5	0.8	1.6	1.9	2.4	2.9
9 - 13	0.5	0.8	1.5	1.9	2.3	2.9
9 - 14	0.5	0.8	1.5	1.9	2.3	2.8
9 - 15	0.5	0.8	1.5	1.8	2.2	2.8
9 - 16	0.5	0.7	1.5	1.8	2.2	2.7
9 - 17	0.5	0.7	1.4	1.8	2.2	2.7
9 - 18	0.5	0.7	1.4	1.8	2.1	2.6
9 - 19	0.5	0.7	1.4	1.7	2.1	2.6
9 - 20	0.5	0.7	1.4	1.7	2.1	2.6
9 - 21	0.5	0.7	1.4	1.7	2.0	2.5
9 - 22	0.4	0.7	1.3	1.7	2.0	2.5
9 - 23	0.4	0.7	1.3	1.6	2.0	2.4
10 - 00	0.4	0.7	1.3	1.6	1.9	2.4
10 - 01	0.4	0.6	1.3	1.6	1.9	2.4
10 - 02	0.4	0.6	1.3	1.6	1.9	2.3
10 - 03	0.4	0.6	1.2	1.5	1.8	2.3
10 - 04	0.4	0.6	1.2	1.5	1.8	2.3
10 - 05	0.4	0.6	1.2	1.5	1.8	2.2
10 - 06	0.4	0.6	1.2	1.5	1.8	2.2
10 - 07	0.4	0.6	1.2	1.5	1.8	2.2
10 - 08	0.4	0.6	1.2	1.4	1.7	2.2
10 - 09	0.4	0.6	1.1	1.4	1.7	2.1
10 - 10	0.4	0.6	1.1	1.4	1.7	2.1
10 - 11	0.4	0.6	1.1	1.4	1.7	2.1
10 - 12	0.4	0.6	1.1	1.4	1.7	2.0
10 - 13	0.4	0.6	1.1	1.3	1.6	2.0
10 - 14	0.4	0.5	1.1	1.3	1.6	2.0
10 - 15	0.4	0.5	1.1	1.3	1.6	2.0
10 - 16	0.4	0.5	1.1	1.3	1.6	2.0
10 - 17	0.3	0.5	1.0	1.3	1.6	1.9
10 - 18	0.3	0.5	1.0	1.3	1.5	1.9
10 - 19	0.3	0.5	1.0	1.3	1.5	1.9
10 - 20	0.3	0.5	1.0	1.2	1.5	1.9
10 - 21	0.3	0.5	1.0	1.2	1.5	1.8
10 - 22	0.3	0.5	1.0	1.2	1.5	1.8
10 - 23	0.3	0.5	1.0	1.2	1.4	1.8
11 - 00	0.3	0.5	1.0	1.2	1.4	1.8
11 - 01	0.3	0.5	0.9	1.2	1.4	1.8
11 - 02	0.3	0.5	0.9	1.2	1.4	1.7
11 - 03	0.3	0.5	0.9	1.1	1.4	1.7

Table A6
Orestimba Creek Local Flow
from Subarea 6, ORSUB6
Concurrent Centering

Period	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
9 - 01	2.0	3.1	6.2	7.6	9.1	11.3
9 - 02	1.9	3.0	6.1	7.4	8.9	11.1
9 - 03	1.9	3.0	5.9	7.2	8.7	10.8
9 - 04	1.8	2.9	5.8	7.1	8.5	10.6
9 - 05	1.8	2.8	5.7	6.9	8.4	10.4
9 - 06	1.8	2.8	5.6	6.8	8.2	10.2
9 - 07	1.7	2.7	5.4	6.6	8.0	9.9
9 - 08	1.7	2.7	5.3	6.5	7.9	9.8
9 - 09	1.7	2.6	5.2	6.4	7.7	9.6
9 - 10	1.6	2.6	5.1	6.3	7.6	9.4
9 - 11	1.6	2.5	5.0	6.2	7.4	9.2
9 - 12	1.6	2.5	5.0	6.0	7.3	9.1
9 - 13	1.5	2.4	4.9	5.9	7.2	8.9
9 - 14	1.5	2.4	4.8	5.8	7.1	8.8
9 - 15	1.5	2.4	4.7	5.7	7.0	8.6
9 - 16	1.5	2.3	4.6	5.7	6.8	8.5
9 - 17	1.4	2.3	4.6	5.6	6.7	8.3
9 - 18	1.4	2.2	4.5	5.5	6.6	8.2
9 - 19	1.4	2.2	4.4	5.4	6.5	8.1
9 - 20	1.4	2.2	4.4	5.3	6.4	8.0
9 - 21	1.4	2.1	4.3	5.2	6.3	7.9
9 - 22	1.3	2.1	4.2	5.2	6.2	7.7
9 - 23	1.3	2.1	4.2	5.1	6.2	7.6
10 - 00	1.3	2.1	4.1	5.0	6.1	7.5
10 - 01	1.3	2.0	4.0	4.9	5.9	7.4
10 - 02	1.3	2.0	4.0	4.8	5.9	7.3
10 - 03	1.2	2.0	3.9	4.8	5.8	7.2
10 - 04	1.2	1.9	3.9	4.7	5.7	7.1
10 - 05	1.2	1.9	3.8	4.7	5.7	7.0
10 - 06	1.2	1.9	3.8	4.6	5.6	6.9
10 - 07	1.2	1.9	3.7	4.6	5.5	6.8
10 - 08	1.2	1.8	3.7	4.5	5.4	6.8
10 - 09	1.2	1.8	3.6	4.4	5.4	6.7
10 - 10	1.1	1.8	3.6	4.4	5.3	6.6
10 - 11	1.1	1.8	3.6	4.3	5.3	6.5
10 - 12	1.1	1.8	3.5	4.3	5.2	6.4
10 - 13	1.1	1.7	3.5	4.2	5.1	6.4
10 - 14	1.1	1.7	3.4	4.2	5.1	6.3
10 - 15	1.1	1.7	3.4	4.1	5.0	6.2
10 - 16	1.1	1.7	3.4	4.1	4.9	6.1
10 - 17	1.1	1.7	3.3	4.0	4.9	6.1
10 - 18	1.0	1.6	3.3	4.0	4.8	6.0
10 - 19	1.0	1.6	3.2	3.9	4.8	5.9
10 - 20	1.0	1.6	3.2	3.9	4.7	5.8
10 - 21	1.0	1.6	3.2	3.9	4.7	5.8
10 - 22	1.0	1.6	3.1	3.8	4.6	5.7
10 - 23	1.0	1.5	3.1	3.8	4.6	5.6
11 - 00	1.0	1.6	3.1	3.8	4.6	5.7
11 - 01	1.0	1.5	3.1	3.7	4.5	5.6
11 - 02	1.0	1.5	3.0	3.7	4.5	5.5
11 - 03	1.0	1.5	3.0	3.7	4.4	5.5

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering							Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
11 - 04	0.3	0.5	0.9	1.1	1.4	1.7	11 - 04	0.9	1.5	3.0	3.6	4.4	5.4
11 - 05	0.3	0.5	0.9	1.1	1.3	1.7	11 - 05	0.9	1.5	2.9	3.6	4.3	5.4
11 - 06	0.3	0.5	0.9	1.1	1.3	1.7	11 - 06	0.9	1.4	2.9	3.5	4.3	5.3
11 - 07	0.3	0.4	0.9	1.1	1.3	1.6	11 - 07	0.9	1.4	2.9	3.5	4.2	5.2
11 - 08	0.3	0.4	0.9	1.1	1.3	1.6	11 - 08	0.9	1.4	2.8	3.4	4.2	5.2
11 - 09	0.3	0.4	0.9	1.1	1.3	1.6	11 - 09	0.9	1.4	2.8	3.4	4.1	5.1
11 - 10	0.3	0.4	0.9	1.0	1.3	1.6	11 - 10	0.9	1.4	2.8	3.4	4.1	5.0
11 - 11	0.3	0.4	0.8	1.0	1.3	1.6	11 - 11	0.9	1.4	2.7	3.3	4.0	5.0
11 - 12	0.3	0.4	0.8	1.0	1.2	1.5	11 - 12	0.9	1.3	2.7	3.3	4.0	4.9
11 - 13	0.3	0.4	0.8	1.0	1.2	1.5	11 - 13	0.8	1.3	2.7	3.2	3.9	4.9
11 - 14	0.3	0.4	0.8	1.0	1.2	1.5	11 - 14	0.8	1.3	2.6	3.2	3.9	4.8
11 - 15	0.3	0.4	0.8	1.0	1.2	1.5	11 - 15	0.8	1.3	2.6	3.2	3.8	4.7
11 - 16	0.3	0.4	0.8	1.0	1.2	1.5	11 - 16	0.8	1.3	2.6	3.1	3.8	4.7
11 - 17	0.3	0.4	0.8	1.0	1.2	1.4	11 - 17	0.8	1.3	2.5	3.1	3.7	4.6
11 - 18	0.3	0.4	0.8	1.0	1.2	1.4	11 - 18	0.8	1.3	2.5	3.1	3.7	4.6
11 - 19	0.3	0.4	0.8	0.9	1.1	1.4	11 - 19	0.8	1.2	2.5	3.0	3.7	4.5
11 - 20	0.3	0.4	0.8	0.9	1.1	1.4	11 - 20	0.8	1.2	2.4	3.0	3.6	4.5
11 - 21	0.2	0.4	0.7	0.9	1.1	1.4	11 - 21	0.8	1.2	2.4	2.9	3.6	4.4
11 - 22	0.2	0.4	0.7	0.9	1.1	1.4	11 - 22	0.8	1.2	2.4	2.9	3.5	4.4
11 - 23	0.2	0.4	0.7	0.9	1.1	1.3	11 - 23	0.7	1.2	2.4	2.9	3.5	4.3
12 - 00	0.2	0.4	0.7	0.9	1.1	1.3	12 - 00	0.7	1.2	2.3	2.8	3.4	4.3
12 - 01	0.2	0.4	0.7	0.9	1.1	1.3	12 - 01	0.7	1.2	2.3	2.8	3.4	4.2
12 - 02	0.2	0.4	0.7	0.9	1.0	1.3	12 - 02	0.7	1.1	2.3	2.8	3.4	4.2
12 - 03	0.2	0.4	0.7	0.9	1.0	1.3	12 - 03	0.7	1.1	2.2	2.7	3.3	4.1
12 - 04	0.2	0.3	0.7	0.8	1.0	1.3	12 - 04	0.7	1.1	2.2	2.7	3.3	4.1
12 - 05	0.2	0.3	0.7	0.8	1.0	1.3	12 - 05	0.7	1.1	2.2	2.7	3.2	4.0
12 - 06	0.2	0.3	0.7	0.8	1.0	1.2	12 - 06	0.7	1.1	2.2	2.6	3.2	4.0
12 - 07	0.2	0.3	0.7	0.8	1.0	1.2	12 - 07	0.7	1.1	2.1	2.6	3.2	3.9
12 - 08	0.2	0.3	0.7	0.8	1.0	1.2	12 - 08	0.7	1.1	2.1	2.6	3.1	3.9
12 - 09	0.2	0.3	0.6	0.8	1.0	1.2	12 - 09	0.7	1.0	2.1	2.6	3.1	3.8
12 - 10	0.2	0.3	0.6	0.8	1.0	1.2	12 - 10	0.7	1.0	2.1	2.5	3.0	3.8
12 - 11	0.2	0.3	0.6	0.8	0.9	1.2	12 - 11	0.6	1.0	2.0	2.5	3.0	3.7
12 - 12	0.2	0.3	0.6	0.8	0.9	1.2	12 - 12	0.6	1.0	2.0	2.5	3.0	3.7
12 - 13	0.2	0.3	0.6	0.8	0.9	1.1	12 - 13	0.6	1.0	2.0	2.4	2.9	3.6
12 - 14	0.2	0.3	0.6	0.7	0.9	1.1	12 - 14	0.6	1.0	2.0	2.4	2.9	3.6
12 - 15	0.2	0.3	0.6	0.7	0.9	1.1	12 - 15	0.6	1.0	1.9	2.4	2.9	3.6
12 - 16	0.2	0.3	0.6	0.7	0.9	1.1	12 - 16	0.6	1.0	1.9	2.3	2.8	3.5
12 - 17	0.2	0.3	0.6	0.7	0.9	1.1	12 - 17	0.6	1.0	1.9	2.3	2.8	3.5
12 - 18	0.2	0.3	0.6	0.7	0.9	1.1	12 - 18	0.6	0.9	1.9	2.3	2.8	3.4
12 - 19	0.2	0.3	0.6	0.7	0.9	1.1	12 - 19	0.6	0.9	1.9	2.3	2.7	3.4
12 - 20	0.2	0.3	0.6	0.7	0.8	1.0	12 - 20	0.6	0.9	1.8	2.2	2.7	3.4
12 - 21	0.2	0.3	0.6	0.7	0.8	1.0	12 - 21	0.6	0.9	1.8	2.2	2.7	3.3
12 - 22	0.2	0.3	0.6	0.7	0.8	1.0	12 - 22	0.6	0.9	1.8	2.2	2.6	3.3
12 - 23	0.2	0.3	0.5	0.7	0.8	1.0	12 - 23	0.6	0.9	1.8	2.2	2.6	3.2
13 - 00	0.2	0.3	0.5	0.7	0.8	1.0	13 - 00	1.5	2.4	4.8	5.8	7.0	8.7
13 - 01	0.5	0.8	1.5	1.9	2.2	2.8	13 - 01	4.6	7.3	14.5	17.7	21.4	26.6
13 - 02	1.5	2.3	4.6	5.6	6.8	8.5	13 - 02	6.6	10.4	20.9	25.5	30.8	38.2
13 - 03	2.2	3.3	6.6	8.1	9.8	12.2	13 - 03	7.0	11.1	22.2	27.0	32.7	40.6
13 - 04	2.3	3.5	7.0	8.6	10.4	12.9	13 - 04	6.9	10.8	21.6	26.4	31.9	39.5
13 - 05	2.3	3.4	6.8	8.4	10.2	12.6	13 - 05	6.5	10.3	20.5	25.0	30.3	37.6
13 - 06	2.2	3.3	6.5	8.0	9.6	12.0	13 - 06	6.2	9.7	19.4	23.7	28.6	35.5

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering							Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
13 - 07	2.0	3.1	6.1	7.5	9.1	11.3	13 - 07	5.8	9.2	18.3	22.4	27.1	33.5
13 - 08	1.9	2.9	5.8	7.1	8.6	10.7	13 - 08	5.5	8.7	17.4	21.2	25.6	31.8
13 - 09	1.8	2.8	5.5	6.7	8.2	10.1	13 - 09	5.2	8.3	16.5	20.2	24.4	30.2
13 - 10	1.7	2.6	5.2	6.4	7.8	9.6	13 - 10	5.0	7.9	15.8	19.3	23.3	28.9
13 - 11	1.7	2.5	5.0	6.1	7.4	9.2	13 - 11	4.8	7.6	15.1	18.4	22.3	27.7
13 - 12	1.6	2.4	4.8	5.9	7.1	8.8	13 - 12	4.6	7.3	14.5	17.7	21.4	26.6
13 - 13	1.5	2.3	4.6	5.6	6.8	8.5	13 - 13	4.4	7.0	14.0	17.0	20.6	25.6
13 - 14	1.5	2.2	4.4	5.4	6.6	8.1	13 - 14	4.3	6.7	13.5	16.4	19.9	24.6
13 - 15	1.4	2.1	4.2	5.2	6.3	7.8	13 - 15	4.1	6.5	13.0	15.9	19.2	23.8
13 - 16	1.4	2.1	4.1	5.1	6.1	7.6	13 - 16	4.0	6.3	12.6	15.4	18.6	23.0
13 - 17	1.3	2.0	4.0	4.9	5.9	7.3	13 - 17	3.9	6.1	12.2	14.9	18.0	22.3
13 - 18	1.3	1.9	3.8	4.7	5.7	7.1	13 - 18	3.8	5.9	11.8	14.4	17.5	21.7
13 - 19	1.2	1.9	3.7	4.6	5.6	6.9	13 - 19	3.6	5.8	11.5	14.0	17.0	21.1
13 - 20	1.2	1.8	3.6	4.5	5.4	6.7	13 - 20	3.6	5.6	11.2	13.7	16.5	20.5
13 - 21	1.2	1.8	3.5	4.3	5.3	6.5	13 - 21	3.5	5.5	10.9	13.3	16.1	19.9
13 - 22	1.1	1.7	3.4	4.2	5.1	6.4	13 - 22	3.4	5.3	10.6	13.0	15.7	19.4
13 - 23	1.1	1.7	3.3	4.1	5.0	6.2	13 - 23	3.3	5.2	10.4	12.6	15.3	19.0
14 - 00	1.1	1.7	3.3	4.0	4.9	6.0	14 - 00	3.2	5.1	10.1	12.3	14.9	18.5
14 - 01	1.1	1.6	3.2	3.9	4.8	5.9	14 - 01	3.1	4.9	9.9	12.1	14.6	18.1
14 - 02	1.0	1.6	3.1	3.8	4.6	5.8	14 - 02	3.1	4.8	9.7	11.8	14.3	17.7
14 - 03	1.0	1.5	3.0	3.8	4.5	5.6	14 - 03	3.0	4.7	9.5	11.5	14.0	17.3
14 - 04	1.0	1.5	3.0	3.7	4.4	5.5	14 - 04	2.9	4.6	9.3	11.3	13.7	16.9
14 - 05	1.0	1.5	2.9	3.6	4.4	5.4	14 - 05	2.9	4.5	9.1	11.1	13.4	16.6
14 - 06	1.0	1.4	2.9	3.5	4.3	5.3	14 - 06	2.8	4.4	8.9	10.8	13.1	16.3
14 - 07	0.9	1.4	2.8	3.5	4.2	5.2	14 - 07	2.8	4.4	8.7	10.6	12.9	16.0
14 - 08	0.9	1.4	2.7	3.4	4.1	5.1	14 - 08	2.7	4.3	8.6	10.4	12.6	15.7
14 - 09	0.9	1.4	2.7	3.3	4.0	5.0	14 - 09	2.7	4.2	8.4	10.2	12.4	15.4
14 - 10	0.9	1.3	2.6	3.3	3.9	4.9	14 - 10	2.6	4.1	8.2	10.1	12.2	15.1
14 - 11	0.9	1.3	2.6	3.2	3.9	4.8	14 - 11	2.6	4.1	8.1	9.9	12.0	14.8
14 - 12	0.8	1.3	2.5	3.1	3.8	4.7	14 - 12	2.5	4.0	8.0	9.7	11.7	14.6
14 - 13	0.8	1.3	2.5	3.1	3.7	4.6	14 - 13	2.5	3.9	7.8	9.5	11.6	14.3
14 - 14	0.8	1.2	2.5	3.0	3.7	4.6	14 - 14	2.4	3.9	7.7	9.4	11.4	14.1
14 - 15	0.8	1.2	2.4	3.0	3.6	4.5	14 - 15	2.4	3.8	7.6	9.2	11.2	13.9
14 - 16	0.8	1.2	2.4	2.9	3.6	4.4	14 - 16	2.4	3.7	7.5	9.1	11.0	13.6
14 - 17	0.8	1.2	2.3	2.9	3.5	4.3	14 - 17	2.3	3.7	7.3	9.0	10.8	13.4
14 - 18	0.8	1.2	2.3	2.9	3.4	4.3	14 - 18	2.3	3.6	7.2	8.8	10.7	13.2
14 - 19	0.8	1.2	2.3	2.8	3.4	4.2	14 - 19	2.3	3.6	7.1	8.7	10.5	13.0
14 - 20	0.7	1.1	2.2	2.8	3.3	4.1	14 - 20	2.2	3.5	7.0	8.6	10.4	12.8
14 - 21	0.7	1.1	2.2	2.7	3.3	4.1	14 - 21	2.2	3.5	6.9	8.4	10.2	12.7
14 - 22	0.7	1.1	2.2	2.7	3.3	4.0	14 - 22	2.2	3.4	6.8	8.3	10.1	12.5
14 - 23	0.7	1.1	2.1	2.6	3.2	4.0	14 - 23	2.1	3.4	6.7	8.2	9.9	12.3
15 - 00	0.7	1.1	2.1	2.6	3.2	3.9	15 - 00	2.1	3.3	6.6	8.0	9.7	12.0
15 - 01	0.7	1.0	2.1	2.6	3.1	3.8	15 - 01	2.1	3.2	6.5	7.9	9.6	11.9
15 - 02	0.7	1.0	2.0	2.5	3.1	3.8	15 - 02	2.0	3.2	6.4	7.8	9.5	11.7
15 - 03	0.7	1.0	2.0	2.5	3.0	3.7	15 - 03	2.0	3.2	6.3	7.7	9.4	11.6
15 - 04	0.7	1.0	2.0	2.5	3.0	3.7	15 - 04	2.0	3.1	6.3	7.6	9.2	11.5
15 - 05	0.7	1.0	2.0	2.4	2.9	3.6	15 - 05	2.0	3.1	6.2	7.6	9.1	11.3
15 - 06	0.6	1.0	1.9	2.4	2.9	3.6	15 - 06	1.9	3.1	6.1	7.4	9.0	11.2
15 - 07	0.6	1.0	1.9	2.4	2.9	3.6	15 - 07	1.9	3.0	6.0	7.4	8.9	11.0
15 - 08	0.6	1.0	1.9	2.3	2.8	3.5	15 - 08	1.9	3.0	6.0	7.3	8.8	10.9
15 - 09	0.6	0.9	1.9	2.3	2.8	3.5	15 - 09	1.9	2.9	5.9	7.2	8.7	10.8

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
15 - 10	0.6	0.9	1.9	2.3	2.8	3.4
15 - 11	0.6	0.9	1.8	2.3	2.7	3.4
15 - 12	0.6	0.9	1.8	2.2	2.7	3.3
15 - 13	0.6	0.9	1.8	2.2	2.7	3.3
15 - 14	0.6	0.9	1.8	2.2	2.6	3.3
15 - 15	0.6	0.9	1.7	2.2	2.6	3.2
15 - 16	0.6	0.9	1.7	2.1	2.6	3.2
15 - 17	0.6	0.9	1.7	2.1	2.5	3.2
15 - 18	0.6	0.9	1.7	2.1	2.5	3.1
15 - 19	0.6	0.8	1.7	2.1	2.5	3.1
15 - 20	0.5	0.8	1.6	2.0	2.5	3.0
15 - 21	0.5	0.8	1.6	2.0	2.4	3.0
15 - 22	0.5	0.8	1.6	2.0	2.4	3.0
15 - 23	0.5	0.8	1.6	2.0	2.4	2.9
16 - 00	0.5	0.8	1.6	1.9	2.3	2.9
16 - 01	0.5	0.8	1.5	1.9	2.3	2.9
16 - 02	0.5	0.8	1.5	1.9	2.3	2.8
16 - 03	0.5	0.8	1.5	1.9	2.3	2.8
16 - 04	0.5	0.8	1.5	1.8	2.2	2.8
16 - 05	0.5	0.7	1.5	1.8	2.2	2.7
16 - 06	0.5	0.7	1.5	1.8	2.2	2.7
16 - 07	0.5	0.7	1.4	1.8	2.2	2.7
16 - 08	0.5	0.7	1.4	1.8	2.1	2.6
16 - 09	0.5	0.7	1.4	1.7	2.1	2.6
16 - 10	0.5	0.7	1.4	1.7	2.1	2.6
16 - 11	0.5	0.7	1.4	1.7	2.1	2.5
16 - 12	0.5	0.7	1.4	1.7	2.0	2.5
16 - 13	0.4	0.7	1.3	1.7	2.0	2.5
16 - 14	0.4	0.7	1.3	1.6	2.0	2.5
16 - 15	0.4	0.7	1.3	1.6	2.0	2.4
16 - 16	0.4	0.7	1.3	1.6	1.9	2.4
16 - 17	0.4	0.6	1.3	1.6	1.9	2.4
16 - 18	0.4	0.6	1.3	1.6	1.9	2.3
16 - 19	0.4	0.6	1.2	1.5	1.9	2.3
16 - 20	0.4	0.6	1.2	1.5	1.8	2.3
16 - 21	0.4	0.6	1.2	1.5	1.8	2.3
16 - 22	0.4	0.6	1.2	1.5	1.8	2.2
16 - 23	0.4	0.6	1.2	1.5	1.8	2.2
17 - 00	0.4	0.6	1.2	1.4	1.8	2.2
17 - 01	0.4	0.6	1.2	1.4	1.7	2.1
17 - 02	0.4	0.6	1.1	1.4	1.7	2.1
17 - 03	0.4	0.6	1.1	1.4	1.7	2.1
17 - 04	0.4	0.6	1.1	1.4	1.7	2.1
17 - 05	0.4	0.6	1.1	1.4	1.7	2.0
17 - 06	0.4	0.6	1.1	1.4	1.6	2.0
17 - 07	0.4	0.5	1.1	1.3	1.6	2.0
17 - 08	0.4	0.5	1.1	1.3	1.6	2.0
17 - 09	0.4	0.5	1.1	1.3	1.6	2.0
17 - 10	0.3	0.5	1.0	1.3	1.6	1.9
17 - 11	0.3	0.5	1.0	1.3	1.5	1.9
17 - 12	0.3	0.5	1.0	1.3	1.5	1.9

Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
15 - 10	1.8	2.9	5.8	7.1	8.6	10.6
15 - 11	1.8	2.9	5.8	7.0	8.5	10.5
15 - 12	1.8	2.8	5.7	6.9	8.4	10.4
15 - 13	1.8	2.8	5.6	6.8	8.3	10.3
15 - 14	1.8	2.8	5.5	6.8	8.2	10.2
15 - 15	1.7	2.7	5.5	6.7	8.1	10.0
15 - 16	1.7	2.7	5.4	6.6	8.0	9.9
15 - 17	1.7	2.7	5.4	6.5	7.9	9.8
15 - 18	1.7	2.6	5.3	6.5	7.8	9.7
15 - 19	1.7	2.6	5.2	6.4	7.7	9.6
15 - 20	1.6	2.6	5.2	6.3	7.6	9.4
15 - 21	1.6	2.6	5.1	6.2	7.5	9.3
15 - 22	1.6	2.5	5.0	6.1	7.4	9.2
15 - 23	1.6	2.5	5.1	6.2	7.5	9.3
16 - 00	1.6	2.5	5.0	6.1	7.4	9.2
16 - 01	1.6	2.5	5.0	6.0	7.3	9.1
16 - 02	1.6	2.5	4.9	6.0	7.2	9.0
16 - 03	1.5	2.4	4.8	5.9	7.1	8.9
16 - 04	1.5	2.4	4.8	5.8	7.1	8.8
16 - 05	1.5	2.4	4.7	5.8	7.0	8.6
16 - 06	1.5	2.3	4.7	5.7	6.9	8.5
16 - 07	1.5	2.3	4.6	5.6	6.8	8.4
16 - 08	1.4	2.3	4.6	5.6	6.7	8.3
16 - 09	1.4	2.3	4.5	5.5	6.6	8.2
16 - 10	1.4	2.2	4.5	5.4	6.6	8.1
16 - 11	1.4	2.2	4.4	5.4	6.5	8.0
16 - 12	1.4	2.2	4.3	5.3	6.4	7.9
16 - 13	1.4	2.1	4.3	5.2	6.3	7.9
16 - 14	1.3	2.1	4.2	5.2	6.3	7.8
16 - 15	1.3	2.1	4.2	5.1	6.2	7.7
16 - 16	1.3	2.1	4.1	5.1	6.1	7.6
16 - 17	1.3	2.0	4.1	5.0	6.0	7.5
16 - 18	1.3	2.0	4.0	4.9	6.0	7.4
16 - 19	1.3	2.0	4.0	4.9	5.9	7.3
16 - 20	1.3	2.0	3.9	4.8	5.8	7.2
16 - 21	1.2	2.0	3.9	4.8	5.8	7.1
16 - 22	1.2	1.9	3.9	4.7	5.7	7.1
16 - 23	1.2	1.9	3.8	4.6	5.6	7.0
17 - 00	1.2	1.9	3.8	4.6	5.6	6.9
17 - 01	1.2	1.9	3.7	4.5	5.5	6.8
17 - 02	1.2	1.8	3.7	4.5	5.4	6.7
17 - 03	1.2	1.8	3.6	4.4	5.4	6.6
17 - 04	1.1	1.8	3.6	4.4	5.3	6.6
17 - 05	1.1	1.8	3.5	4.3	5.2	6.5
17 - 06	1.1	1.8	3.5	4.3	5.2	6.4
17 - 07	1.1	1.7	3.5	4.2	5.1	6.3
17 - 08	1.1	1.7	3.4	4.2	5.0	6.3
17 - 09	1.1	1.7	3.4	4.1	5.0	6.2
17 - 10	1.1	1.7	3.3	4.1	4.9	6.1
17 - 11	1.0	1.6	3.3	4.0	4.9	6.0
17 - 12	1.0	1.6	3.3	4.0	4.8	6.0

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
17 - 13	0.3	0.5	1.0	1.2	1.5	1.9
17 - 14	0.3	0.5	1.0	1.2	1.5	1.8
17 - 15	0.3	0.5	1.0	1.2	1.5	1.8
17 - 16	0.3	0.5	1.0	1.2	1.5	1.8
17 - 17	0.3	0.5	1.0	1.2	1.4	1.8
17 - 18	0.3	0.5	0.9	1.2	1.4	1.8
17 - 19	0.3	0.5	0.9	1.2	1.4	1.7
17 - 20	0.3	0.5	0.9	1.1	1.4	1.7
17 - 21	0.3	0.5	0.9	1.1	1.4	1.7
17 - 22	0.3	0.5	0.9	1.1	1.3	1.7
17 - 23	0.3	0.5	0.9	1.1	1.3	1.7
18 - 00	1.8	2.8	5.5	1.0	1.2	1.5
18 - 01	5.6	8.5	16.8	6.8	8.2	10.2
18 - 02	8.0	12.2	24.1	20.7	8.2	31.0
18 - 03	8.0	12.2	24.1	29.7	25.0	44.6
18 - 04	8.5	12.9	25.5	31.5	35.9	47.3
18 - 05	8.3	12.6	24.9	30.8	38.2	46.1
18 - 06	7.9	12.0	23.7	29.2	37.2	43.8
18 - 07	7.4	11.3	22.3	27.6	35.3	41.4
18 - 08	7.0	10.7	21.1	26.1	33.4	39.1
18 - 09	6.7	10.1	20.0	24.7	31.6	37.1
18 - 10	6.4	9.6	19.1	23.5	29.9	35.3
18 - 11	6.1	9.2	18.2	22.5	28.5	33.7
18 - 12	5.8	8.8	17.4	21.5	27.2	32.3
18 - 13	5.6	8.5	16.7	20.7	26.0	31.0
18 - 14	5.4	8.1	16.1	19.9	25.0	29.8
18 - 15	5.2	7.9	15.5	19.2	24.0	28.7
18 - 16	5.0	7.6	15.0	18.5	23.2	27.8
18 - 17	4.8	7.3	14.5	17.9	22.4	26.9
18 - 18	4.7	7.1	14.1	17.4	21.7	26.0
18 - 19	4.5	6.9	13.6	16.9	21.0	25.3
18 - 20	4.4	6.7	13.3	16.4	20.4	24.6
18 - 21	4.3	6.5	12.9	15.9	19.8	23.9
18 - 22	4.2	6.4	12.6	15.5	19.3	23.3
18 - 23	4.1	6.2	12.2	15.1	18.8	22.7
19 - 00	4.0	6.0	11.9	14.8	18.3	22.1
19 - 01	3.9	5.9	11.7	14.4	17.8	21.6
19 - 02	3.8	5.8	11.4	14.1	17.4	21.1
19 - 03	3.7	5.6	11.1	13.8	17.0	20.6
19 - 04	3.6	5.5	10.9	13.5	16.6	20.2
19 - 05	3.6	5.4	10.7	13.2	16.3	19.8
19 - 06	3.5	5.3	10.5	12.9	15.9	19.4
19 - 07	3.4	5.2	10.2	12.7	15.6	19.0
19 - 08	3.3	5.1	10.0	12.4	15.3	18.6
19 - 09	3.3	5.0	9.9	12.2	15.0	18.3
19 - 10	3.2	4.9	9.7	12.0	14.7	17.9
19 - 11	3.2	4.8	9.5	11.7	14.5	17.6
19 - 12	3.1	4.7	9.3	11.5	14.2	17.3
19 - 13	3.1	4.6	9.2	11.3	13.9	17.0
19 - 14	3.0	4.6	9.0	11.1	13.7	16.7
19 - 15	3.0	4.5	8.9	11.0	13.5	16.4

Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
17 - 13	1.0	1.6	3.2	3.9	4.8	5.9
17 - 14	1.0	1.6	3.2	3.9	4.7	5.8
17 - 15	1.0	1.6	3.1	3.8	4.6	5.8
17 - 16	1.0	1.6	3.1	3.8	4.6	5.7
17 - 17	1.0	1.5	3.1	3.7	4.5	5.6
17 - 18	1.0	1.5	3.0	3.7	4.5	5.5
17 - 19	1.0	1.5	3.0	3.7	4.4	5.5
17 - 20	0.9	1.5	3.0	3.6	4.4	5.4
17 - 21	0.9	1.5	2.9	3.6	4.3	5.4
17 - 22	0.9	1.4	2.9	3.5	4.3	5.3
17 - 23	3.1	4.9	9.8	12.0	14.5	18.0
18 - 00	5.2	8.2	16.4	20.0	24.2	30.0
18 - 01	5.5	8.7	17.5	21.3	25.8	32.0
18 - 02	16.9	26.6	53.2	64.9	78.6	97.4
18 - 03	24.3	38.3	76.5	93.3	112.9	140.0
18 - 04	25.7	40.6	81.2	99.0	119.8	148.5
18 - 05	25.1	39.6	79.2	96.6	116.8	144.8
18 - 06	23.9	37.6	75.2	91.8	111.0	137.6
18 - 07	22.5	35.5	71.1	86.7	104.8	130.0
18 - 08	21.3	33.6	67.1	81.9	99.1	122.8
18 - 09	20.2	31.8	63.6	77.6	93.9	116.4
18 - 10	19.2	30.3	60.6	73.9	89.4	110.8
18 - 11	18.3	28.9	57.8	70.5	85.3	105.8
18 - 12	17.6	27.7	55.4	67.5	81.7	101.3
18 - 13	16.9	26.6	53.2	64.8	78.5	97.3
18 - 14	16.2	25.6	51.2	62.4	75.5	93.6
18 - 15	15.6	24.7	49.3	60.2	72.8	90.3
18 - 16	15.1	23.8	47.7	58.1	70.3	87.2
18 - 17	14.6	23.1	46.1	56.3	68.1	84.4
18 - 18	14.2	22.4	44.7	54.5	66.0	81.8
18 - 19	13.8	21.7	43.4	52.9	64.0	79.4
18 - 20	13.4	21.1	42.2	51.4	62.2	77.1
18 - 21	13.0	20.5	41.0	50.0	60.5	75.0
18 - 22	12.7	20.0	39.9	48.7	58.9	73.1
18 - 23	12.3	19.5	38.9	47.5	57.4	71.2
19 - 00	12.0	19.0	38.0	46.3	56.0	69.5
19 - 01	11.8	18.5	37.1	45.2	54.7	67.8
19 - 02	11.5	18.1	36.2	44.2	53.5	66.3
19 - 03	11.2	17.7	35.4	43.2	52.3	64.8
19 - 04	11.0	17.3	34.7	42.3	51.1	63.4
19 - 05	10.8	17.0	33.9	41.4	50.1	62.1
19 - 06	10.5	16.6	33.2	40.5	49.0	60.8
19 - 07	10.3	16.3	32.6	39.7	48.1	59.6
19 - 08	10.1	16.0	31.9	39.0	47.1	58.4
19 - 09	9.9	15.7	31.3	38.2	46.2	57.3
19 - 10	9.8	15.4	30.8	37.5	45.4	56.3
19 - 11	9.6	15.1	30.2	36.8	44.6	55.3
19 - 12	9.4	14.8	29.7	36.2	43.8	54.3
19 - 13	9.2	14.6	29.2	35.6	43.0	53.4
19 - 14	9.1	14.3	28.7	35.0	42.3	52.5
19 - 15	8.9	14.1	28.2	34.4	41.6	51.6

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
19 - 16	2.9	4.4	8.7	10.8	13.2	16.2
19 - 17	2.9	4.4	8.6	10.6	13.0	15.9
19 - 18	2.8	4.3	8.5	10.4	12.8	15.7
19 - 19	2.8	4.2	8.3	10.3	12.6	15.4
19 - 20	2.7	4.2	8.2	10.1	12.4	15.2
19 - 21	2.7	4.1	8.1	10.0	12.3	15.0
19 - 22	2.7	4.0	8.0	9.8	12.1	14.8
19 - 23	2.6	4.0	7.9	9.7	11.9	14.6
20 - 00	2.6	3.9	7.8	9.6	11.7	14.4
20 - 01	2.5	3.8	7.6	9.4	11.6	14.0
20 - 02	2.5	3.8	7.5	9.2	11.3	13.9
20 - 03	2.5	3.7	7.4	9.1	11.2	13.7
20 - 04	2.4	3.7	7.3	9.0	11.0	13.5
20 - 05	2.4	3.7	7.2	8.9	10.9	13.4
20 - 06	2.4	3.6	7.1	8.8	10.8	13.2
20 - 07	2.3	3.6	7.0	8.7	10.7	13.0
20 - 08	2.3	3.5	6.9	8.6	10.5	12.9
20 - 09	2.3	3.5	6.9	8.5	10.4	12.7
20 - 10	2.3	3.4	6.8	8.4	10.3	12.6
20 - 11	2.2	3.4	6.7	8.3	10.1	12.4
20 - 12	2.2	3.4	6.6	8.2	10.0	12.3
20 - 13	2.2	3.3	6.5	8.1	9.9	12.1
20 - 14	2.2	3.3	6.5	8.0	9.8	12.0
20 - 15	2.1	3.2	6.4	7.9	9.7	11.8
20 - 16	2.1	3.2	6.3	7.8	9.5	11.7
20 - 17	2.1	3.2	6.2	7.7	9.4	11.6
20 - 18	2.1	3.1	6.2	7.6	9.3	11.4
20 - 19	2.0	3.1	6.1	7.5	9.2	11.3
20 - 20	2.0	3.0	6.0	7.4	9.1	11.1
20 - 21	2.0	3.0	5.9	7.3	9.0	11.0
20 - 22	2.0	3.0	5.9	7.3	8.9	10.9
20 - 23	1.9	2.9	5.8	7.2	8.8	10.8
21 - 00	1.9	2.9	5.7	7.1	8.7	10.6
21 - 01	1.9	2.9	5.7	7.0	8.6	10.5
21 - 02	1.9	2.8	5.6	6.9	8.5	10.4
21 - 03	1.8	2.8	5.5	6.8	8.4	10.3
21 - 04	1.8	2.8	5.5	6.8	8.3	10.1
21 - 05	1.8	2.7	5.4	6.7	8.2	10.0
21 - 06	1.8	2.7	5.3	6.6	8.1	9.9
21 - 07	1.8	2.7	5.3	6.5	8.0	9.8
21 - 08	1.7	2.6	5.2	6.4	7.9	9.7
21 - 09	1.7	2.6	5.2	6.4	7.8	9.5
21 - 10	1.7	2.6	5.1	6.3	7.7	9.4
21 - 11	1.7	2.5	5.0	6.2	7.6	9.3
21 - 12	1.7	2.5	5.0	6.1	7.5	9.2
21 - 13	1.6	2.5	4.9	6.1	7.4	9.1
21 - 14	1.6	2.5	4.9	6.0	7.3	9.0
21 - 15	1.6	2.4	4.8	5.9	7.2	8.9
21 - 16	1.6	2.4	4.7	5.9	7.2	8.8
21 - 17	1.6	2.4	4.7	5.8	7.1	8.7
21 - 18	1.5	2.3	4.6	5.7	7.0	8.6

Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
19 - 16	8.8	13.9	27.7	33.8	40.9	50.8
19 - 17	8.7	13.7	27.3	33.3	40.3	50.0
19 - 18	8.5	13.4	26.9	32.8	39.7	49.2
19 - 19	8.4	13.2	26.5	32.3	39.1	48.4
19 - 20	8.3	13.0	26.1	31.8	38.5	47.7
19 - 21	8.2	12.9	25.7	31.4	37.9	47.0
19 - 22	8.0	12.7	25.3	30.9	37.4	46.4
19 - 23	7.9	12.5	25.0	30.5	36.9	45.7
20 - 00	7.8	12.3	24.6	30.0	36.3	45.1
20 - 01	7.6	12.0	24.1	29.4	35.5	44.1
20 - 02	7.5	11.9	23.8	29.0	35.1	43.5
20 - 03	7.5	11.8	23.5	28.7	34.7	43.0
20 - 04	7.4	11.6	23.2	28.3	34.3	42.5
20 - 05	7.3	11.5	23.0	28.0	33.9	42.0
20 - 06	7.2	11.3	22.7	27.7	33.5	41.5
20 - 07	7.1	11.2	22.4	27.3	33.0	40.9
20 - 08	7.0	11.1	22.1	27.0	32.6	40.4
20 - 09	6.9	10.9	21.8	26.6	32.2	39.9
20 - 10	6.8	10.8	21.6	26.3	31.8	39.5
20 - 11	6.8	10.7	21.3	26.0	31.5	39.0
20 - 12	6.7	10.5	21.1	25.7	31.1	38.5
20 - 13	6.6	10.4	20.8	25.4	30.7	38.1
20 - 14	6.5	10.3	20.6	25.1	30.3	37.6
20 - 15	6.4	10.2	20.3	24.8	30.0	37.2
20 - 16	6.4	10.0	20.1	24.5	29.6	36.7
20 - 17	6.3	9.9	19.8	24.2	29.3	36.3
20 - 18	6.2	9.8	19.6	23.9	28.9	35.9
20 - 19	6.1	9.7	19.4	23.6	28.6	35.4
20 - 20	6.1	9.6	19.1	23.3	28.2	35.0
20 - 21	6.0	9.5	18.9	23.1	27.9	34.6
20 - 22	5.9	9.3	18.7	22.8	27.6	34.2
20 - 23	5.9	9.2	18.5	22.5	27.2	33.8
21 - 00	5.9	9.3	18.6	22.7	27.5	34.0
21 - 01	5.8	9.2	18.4	22.4	27.1	33.6
21 - 02	5.8	9.1	18.2	22.2	26.8	33.2
21 - 03	5.7	9.0	17.9	21.9	26.5	32.8
21 - 04	5.6	8.9	17.7	21.6	26.2	32.4
21 - 05	5.6	8.8	17.5	21.4	25.9	32.1
21 - 06	5.5	8.7	17.3	21.1	25.5	31.7
21 - 07	5.4	8.6	17.1	20.9	25.2	31.3
21 - 08	5.4	8.5	16.9	20.6	24.9	30.9
21 - 09	5.3	8.4	16.7	20.4	24.6	30.6
21 - 10	5.2	8.3	16.5	20.1	24.4	30.2
21 - 11	5.2	8.2	16.3	19.9	24.1	29.8
21 - 12	5.1	8.1	16.1	19.7	23.8	29.5
21 - 13	5.0	8.0	15.9	19.4	23.5	29.1
21 - 14	5.0	7.9	15.7	19.2	23.2	28.8
21 - 15	4.9	7.8	15.5	19.0	22.9	28.4
21 - 16	4.9	7.7	15.4	18.7	22.7	28.1
21 - 17	4.8	7.6	15.2	18.5	22.4	27.8
21 - 18	4.8	7.5	15.0	18.3	22.1	27.4

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
21 - 19	1.5	2.3	4.6	5.6	6.9	8.5
21 - 20	1.5	2.3	4.5	5.6	6.8	8.4
21 - 21	1.5	2.3	4.5	5.5	6.7	8.3
21 - 22	1.5	2.2	4.4	5.4	6.7	8.2
21 - 23	1.5	2.2	4.4	5.4	6.6	8.1
22 - 00	1.4	2.2	4.3	5.3	6.5	8.0
22 - 01	1.4	2.2	4.3	5.3	6.4	7.9
22 - 02	1.4	2.1	4.2	5.2	6.4	7.8
22 - 03	1.4	2.1	4.2	5.1	6.3	7.7
22 - 04	1.4	2.1	4.1	5.1	6.2	7.6
22 - 05	1.4	2.1	4.1	5.0	6.1	7.5
22 - 06	1.3	2.0	4.0	5.0	6.1	7.4
22 - 07	1.3	2.0	4.0	4.9	6.0	7.3
22 - 08	1.3	2.0	3.9	4.8	5.9	7.2
22 - 09	1.3	2.0	3.9	4.8	5.8	7.2
22 - 10	1.3	1.9	3.8	4.7	5.8	7.1
22 - 11	1.3	1.9	3.8	4.7	5.7	7.0
22 - 12	1.2	1.9	3.7	4.6	5.6	6.9
22 - 13	1.2	1.9	3.7	4.6	5.6	6.8
22 - 14	1.2	1.8	3.6	4.5	5.5	6.7
22 - 15	1.2	1.8	3.6	4.4	5.4	6.7
22 - 16	1.2	1.8	3.6	4.4	5.4	6.6
22 - 17	1.2	1.8	3.5	4.3	5.3	6.5
22 - 18	1.2	1.8	3.5	4.3	5.2	6.4
22 - 19	1.1	1.7	3.4	4.2	5.2	6.3
22 - 20	1.1	1.7	3.4	4.2	5.1	6.3
22 - 21	1.1	1.7	3.3	4.1	5.1	6.2
22 - 22	1.1	1.7	3.3	4.1	5.0	6.1
22 - 23	1.1	1.7	3.3	4.0	4.9	6.0
23 - 00	0.3	0.5	0.9	1.1	1.3	1.7
23 - 01	0.3	0.5	0.9	1.1	0.0	1.7
23 - 02	0.9	1.4	2.8	3.5	1.4	5.2
23 - 03	1.3	2.0	4.0	5.0	4.2	7.4
23 - 04	1.4	2.2	4.3	5.3	6.0	7.9
23 - 05	1.4	2.1	4.2	5.1	6.4	7.7
23 - 06	1.3	2.0	4.0	4.9	6.2	7.3
23 - 07	1.2	1.9	3.7	4.6	5.9	6.9
23 - 08	1.2	1.8	3.5	4.4	5.6	6.5
23 - 09	1.1	1.7	3.3	4.1	5.3	6.2
23 - 10	1.1	1.6	3.2	3.9	5.0	5.9
23 - 11	1.0	1.5	3.0	3.7	4.8	5.6
23 - 12	1.0	1.5	2.9	3.6	4.5	5.4
23 - 13	0.9	1.4	2.8	3.4	4.3	5.2
23 - 14	0.9	1.4	2.7	3.3	4.2	5.0
23 - 15	0.9	1.3	2.6	3.2	4.0	4.8
23 - 16	0.8	1.3	2.5	3.1	3.9	4.6
23 - 17	0.8	1.2	2.4	3.0	3.7	4.5
23 - 18	0.8	1.2	2.3	2.9	3.6	4.3
23 - 19	0.8	1.2	2.3	2.8	3.5	4.2
23 - 20	0.7	1.1	2.2	2.7	3.4	4.1
23 - 21	0.7	1.1	2.2	2.7	3.3	4.0

Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
21 - 19	4.7	7.4	14.8	18.1	21.9	27.1
21 - 20	4.6	7.3	14.6	17.9	21.6	26.8
21 - 21	4.6	7.2	14.5	17.6	21.3	26.5
21 - 22	4.5	7.1	14.3	17.4	21.1	26.1
21 - 23	4.5	7.1	14.1	17.2	20.8	25.8
22 - 00	4.4	7.0	14.0	17.0	20.6	25.5
22 - 01	4.4	6.9	13.8	16.8	20.3	25.2
22 - 02	4.3	6.8	13.6	16.6	20.1	24.9
22 - 03	4.3	6.7	13.5	16.4	19.9	24.6
22 - 04	4.2	6.7	13.3	16.2	19.6	24.3
22 - 05	4.2	6.6	13.1	16.0	19.4	24.0
22 - 06	4.1	6.5	13.0	15.8	19.2	23.8
22 - 07	4.1	6.4	12.8	15.7	18.9	23.5
22 - 08	4.0	6.3	12.7	15.5	18.7	23.2
22 - 09	4.0	6.3	12.5	15.3	18.5	22.9
22 - 10	3.9	6.2	12.4	15.1	18.3	22.6
22 - 11	3.9	6.1	12.2	14.9	18.0	22.4
22 - 12	3.8	6.0	12.1	14.7	17.8	22.1
22 - 13	3.8	6.0	11.9	14.6	17.6	21.8
22 - 14	3.7	5.9	11.8	14.4	17.4	21.6
22 - 15	3.7	5.8	11.7	14.2	17.2	21.3
22 - 16	3.7	5.8	11.5	14.1	17.0	21.1
22 - 17	3.6	5.7	11.4	13.9	16.8	20.8
22 - 18	3.6	5.6	11.2	13.7	16.6	20.6
22 - 19	3.5	5.6	11.1	13.6	16.4	20.3
22 - 20	3.5	5.5	11.0	13.4	16.2	20.1
22 - 21	3.4	5.4	10.8	13.2	16.0	19.8
22 - 22	3.4	5.4	10.7	13.1	15.8	19.6
22 - 23	3.4	5.3	10.6	12.9	15.6	19.4
23 - 00	0.9	1.4	2.8	3.5	4.2	5.2
23 - 01	2.8	4.3	8.7	10.6	12.8	15.9
23 - 02	4.0	6.2	12.5	15.2	18.4	22.8
23 - 03	4.2	6.6	13.2	16.1	19.5	24.2
23 - 04	4.1	6.5	12.9	15.7	19.0	23.6
23 - 05	3.9	6.1	12.3	15.0	18.1	22.4
23 - 06	3.7	5.8	11.6	14.1	17.1	21.2
23 - 07	3.5	5.5	10.9	13.3	16.2	20.0
23 - 08	3.3	5.2	10.4	12.7	15.3	19.0
23 - 09	3.1	4.9	9.9	12.0	14.6	18.1
23 - 10	3.0	4.7	9.4	11.5	13.9	17.2
23 - 11	2.9	4.5	9.0	11.0	13.3	16.5
23 - 12	2.7	4.3	8.7	10.6	12.8	15.9
23 - 13	2.6	4.2	8.3	10.2	12.3	15.3
23 - 14	2.6	4.0	8.0	9.8	11.9	14.7
23 - 15	2.5	3.9	7.8	9.5	11.5	14.2
23 - 16	2.4	3.8	7.5	9.2	11.1	13.8
23 - 17	2.3	3.6	7.3	8.9	10.8	13.3
23 - 18	2.2	3.5	7.1	8.6	10.4	12.9
23 - 19	2.2	3.4	6.9	8.4	10.1	12.6
23 - 20	2.1	3.3	6.7	8.2	9.9	12.2
23 - 21	2.1	3.3	6.5	7.9	9.6	11.9

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
23 - 22	0.7	1.1	2.1	2.6	3.2	3.9
23 - 23	0.7	1.0	2.0	2.5	3.1	3.8
24 - 00	0.7	1.0	2.0	2.5	3.1	3.7
24 - 01	0.6	1.0	1.9	2.4	3.0	3.6
24 - 02	0.6	1.0	1.9	2.3	2.9	3.5
24 - 03	0.6	0.9	1.9	2.3	2.8	3.4
24 - 04	0.6	0.9	1.8	2.2	2.8	3.4
24 - 05	0.6	0.9	1.8	2.2	2.7	3.3
24 - 06	0.6	0.9	1.7	2.2	2.7	3.2
24 - 07	0.6	0.9	1.7	2.1	2.6	3.2
24 - 08	0.6	0.8	1.7	2.1	2.6	3.1
24 - 09	0.5	0.8	1.6	2.0	2.5	3.0
24 - 10	0.5	0.8	1.6	2.0	2.5	3.0
24 - 11	0.5	0.8	1.6	2.0	2.4	2.9
24 - 12	0.5	0.8	1.6	1.9	2.4	2.9
24 - 13	0.5	0.8	1.5	1.9	2.3	2.8
24 - 14	0.5	0.8	1.5	1.9	2.3	2.8
24 - 15	0.5	0.7	1.5	1.8	2.3	2.7
24 - 16	0.5	0.7	1.5	1.8	2.2	2.7
24 - 17	0.5	0.7	1.4	1.8	2.2	2.7
24 - 18	0.5	0.7	1.4	1.7	2.1	2.6
24 - 19	0.5	0.7	1.4	1.7	2.1	2.6
24 - 20	0.5	0.7	1.4	1.7	2.1	2.5
24 - 21	0.4	0.7	1.3	1.7	2.0	2.5
24 - 22	0.4	0.7	1.3	1.6	2.0	2.5
24 - 23	0.4	0.7	1.3	1.6	2.0	2.4
25 - 00	0.4	0.7	1.3	1.6	2.0	2.4
25 - 01	0.4	0.6	1.3	1.6	1.9	2.3
25 - 02	0.4	0.6	1.2	1.5	1.9	2.3
25 - 03	0.4	0.6	1.2	1.5	1.9	2.3
25 - 04	0.4	0.6	1.2	1.5	1.8	2.3
25 - 05	0.4	0.6	1.2	1.5	1.8	2.2
25 - 06	0.4	0.6	1.2	1.5	1.8	2.2
25 - 07	0.4	0.6	1.2	1.5	1.8	2.2
25 - 08	0.4	0.6	1.2	1.4	1.8	2.1
25 - 09	0.4	0.6	1.1	1.4	1.7	2.1
25 - 10	0.4	0.6	1.1	1.4	1.7	2.1
25 - 11	0.4	0.6	1.1	1.4	1.7	2.1
25 - 12	0.4	0.6	1.1	1.4	1.7	2.0
25 - 13	0.4	0.6	1.1	1.3	1.7	2.0
25 - 14	0.4	0.5	1.1	1.3	1.6	2.0
25 - 15	0.4	0.5	1.1	1.3	1.6	2.0
25 - 16	0.4	0.5	1.1	1.3	1.6	2.0
25 - 17	0.3	0.5	1.0	1.3	1.6	1.9
25 - 18	0.3	0.5	1.0	1.3	1.6	1.9
25 - 19	0.3	0.5	1.0	1.3	1.5	1.9
25 - 20	0.3	0.5	1.0	1.2	1.5	1.9
25 - 21	0.3	0.5	1.0	1.2	1.5	1.8
25 - 22	0.3	0.5	1.0	1.2	1.5	1.8
25 - 23	0.3	0.5	1.0	1.2	1.5	1.8
26 - 00	0.3	0.5	1.0	1.2	1.4	1.8

Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
23 - 22	2.0	3.2	6.3	7.7	9.4	11.6
23 - 23	2.0	3.1	6.2	7.5	9.1	11.3
24 - 00	1.9	3.0	6.0	7.4	8.9	11.1
24 - 01	1.9	3.0	5.9	7.2	8.7	10.8
24 - 02	1.8	2.9	5.8	7.0	8.5	10.6
24 - 03	1.8	2.8	5.6	6.9	8.3	10.3
24 - 04	1.8	2.8	5.5	6.7	8.2	10.1
24 - 05	1.7	2.7	5.4	6.6	8.0	9.9
24 - 06	1.7	2.7	5.3	6.5	7.8	9.7
24 - 07	1.7	2.6	5.2	6.3	7.7	9.5
24 - 08	1.6	2.6	5.1	6.2	7.5	9.3
24 - 09	1.6	2.5	5.0	6.1	7.4	9.2
24 - 10	1.6	2.5	4.9	6.0	7.3	9.0
24 - 11	1.5	2.4	4.8	5.9	7.1	8.8
24 - 12	1.5	2.4	4.8	5.8	7.0	8.7
24 - 13	1.5	2.3	4.7	5.7	6.9	8.6
24 - 14	1.5	2.3	4.6	5.6	6.8	8.4
24 - 15	1.4	2.3	4.5	5.5	6.7	8.3
24 - 16	1.4	2.2	4.5	5.4	6.6	8.1
24 - 17	1.4	2.2	4.4	5.3	6.5	8.0
24 - 18	1.4	2.2	4.3	5.3	6.4	7.9
24 - 19	1.3	2.1	4.3	5.2	6.3	7.8
24 - 20	1.3	2.1	4.2	5.1	6.2	7.7
24 - 21	1.3	2.1	4.1	5.0	6.1	7.6
24 - 22	1.3	2.0	4.1	5.0	6.0	7.4
24 - 23	1.3	2.0	4.0	4.9	5.9	7.3
25 - 00	1.2	2.0	3.9	4.8	5.8	7.2
25 - 01	1.2	1.9	3.9	4.7	5.7	7.1
25 - 02	1.2	1.9	3.8	4.7	5.7	7.0
25 - 03	1.2	1.9	3.8	4.6	5.6	6.9
25 - 04	1.2	1.9	3.7	4.6	5.5	6.8
25 - 05	1.2	1.8	3.7	4.5	5.5	6.8
25 - 06	1.2	1.8	3.6	4.4	5.4	6.7
25 - 07	1.1	1.8	3.6	4.4	5.3	6.6
25 - 08	1.1	1.8	3.6	4.3	5.3	6.5
25 - 09	1.1	1.8	3.5	4.3	5.2	6.4
25 - 10	1.1	1.7	3.5	4.2	5.1	6.4
25 - 11	1.1	1.7	3.4	4.2	5.1	6.3
25 - 12	1.1	1.7	3.4	4.1	5.0	6.2
25 - 13	1.1	1.7	3.4	4.1	4.9	6.1
25 - 14	1.1	1.7	3.3	4.0	4.9	6.1
25 - 15	1.0	1.6	3.3	4.0	4.8	6.0
25 - 16	1.0	1.6	3.2	3.9	4.8	5.9
25 - 17	1.0	1.6	3.2	3.9	4.7	5.8
25 - 18	1.0	1.6	3.2	3.9	4.7	5.8
25 - 19	1.0	1.6	3.1	3.8	4.6	5.7
25 - 20	1.0	1.5	3.1	3.8	4.6	5.6
25 - 21	1.0	1.5	3.0	3.7	4.5	5.6
25 - 22	1.0	1.5	3.0	3.7	4.4	5.5
25 - 23	1.0	1.5	3.0	3.7	4.5	5.5
26 - 00	1.0	1.5	3.0	3.7	4.4	5.5

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering							Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency							Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%	Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs	Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
26 - 01	0.3	0.5	0.9	1.2	1.4	1.8	26 - 01	0.9	1.5	3.0	3.6	4.4	5.4
26 - 02	0.3	0.5	0.9	1.2	1.4	1.7	26 - 02	0.9	1.5	2.9	3.6	4.3	5.4
26 - 03	0.3	0.5	0.9	1.1	1.4	1.7	26 - 03	0.9	1.4	2.9	3.5	4.3	5.3
26 - 04	0.3	0.5	0.9	1.1	1.4	1.7	26 - 04	0.9	1.4	2.9	3.5	4.2	5.2
26 - 05	0.3	0.5	0.9	1.1	1.4	1.7	26 - 05	0.9	1.4	2.8	3.4	4.2	5.2
26 - 06	0.3	0.5	0.9	1.1	1.3	1.7	26 - 06	0.9	1.4	2.8	3.4	4.1	5.1
26 - 07	0.3	0.4	0.9	1.1	1.3	1.6	26 - 07	0.9	1.4	2.8	3.4	4.1	5.0
26 - 08	0.3	0.4	0.9	1.1	1.3	1.6	26 - 08	0.9	1.4	2.7	3.3	4.0	5.0
26 - 09	0.3	0.4	0.9	1.1	1.3	1.6	26 - 09	0.9	1.3	2.7	3.3	4.0	4.9
26 - 10	0.3	0.4	0.8	1.0	1.3	1.6	26 - 10	0.8	1.3	2.7	3.2	3.9	4.9
26 - 11	0.3	0.4	0.8	1.0	1.3	1.6	26 - 11	0.8	1.3	2.6	3.2	3.9	4.8
26 - 12	0.3	0.4	0.8	1.0	1.3	1.5	26 - 12	0.8	1.3	2.6	3.2	3.8	4.7
26 - 13	0.3	0.4	0.8	1.0	1.2	1.5	26 - 13	0.8	1.3	2.6	3.1	3.8	4.7
26 - 14	0.3	0.4	0.8	1.0	1.2	1.5	26 - 14	0.8	1.3	2.5	3.1	3.7	4.6
26 - 15	0.3	0.4	0.8	1.0	1.2	1.5	26 - 15	0.8	1.3	2.5	3.1	3.7	4.6
26 - 16	0.3	0.4	0.8	1.0	1.2	1.5	26 - 16	0.8	1.2	2.5	3.0	3.7	4.5
26 - 17	0.3	0.4	0.8	1.0	1.2	1.4	26 - 17	0.8	1.2	2.4	3.0	3.6	4.5
26 - 18	0.3	0.4	0.8	1.0	1.2	1.4	26 - 18	0.8	1.2	2.4	2.9	3.6	4.4
26 - 19	0.3	0.4	0.8	0.9	1.2	1.4	26 - 19	0.8	1.2	2.4	2.9	3.5	4.4
26 - 20	0.3	0.4	0.8	0.9	1.1	1.4	26 - 20	0.7	1.2	2.4	2.9	3.5	4.3
26 - 21	0.2	0.4	0.7	0.9	1.1	1.4	26 - 21	0.7	1.2	2.3	2.8	3.4	4.3
26 - 22	0.2	0.4	0.7	0.9	1.1	1.4	26 - 22	0.7	1.2	2.3	2.8	3.4	4.2
26 - 23	0.2	0.4	0.7	0.9	1.1	1.3	26 - 23	0.7	1.1	2.3	2.8	3.4	4.2
27 - 00	0.2	0.4	0.7	0.9	1.1	1.3	27 - 00	0.7	1.1	2.2	2.7	3.3	4.1
27 - 01	0.2	0.4	0.7	0.9	1.1	1.3	27 - 01	0.7	1.1	2.2	2.7	3.3	4.1
27 - 02	0.2	0.4	0.7	0.9	1.1	1.3	27 - 02	0.7	1.1	2.2	2.7	3.2	4.0
27 - 03	0.2	0.4	0.7	0.9	1.0	1.3	27 - 03	0.7	1.1	2.2	2.6	3.2	4.0
27 - 04	0.2	0.3	0.7	0.8	1.0	1.3	27 - 04	0.7	1.1	2.1	2.6	3.2	3.9
27 - 05	0.2	0.3	0.7	0.8	1.0	1.3	27 - 05	0.7	1.1	2.1	2.6	3.1	3.9
27 - 06	0.2	0.3	0.7	0.8	1.0	1.2	27 - 06	0.7	1.0	2.1	2.6	3.1	3.8
27 - 07	0.2	0.3	0.7	0.8	1.0	1.2	27 - 07	0.7	1.0	2.1	2.5	3.0	3.8
27 - 08	0.2	0.3	0.7	0.8	1.0	1.2	27 - 08	0.6	1.0	2.0	2.5	3.0	3.7
27 - 09	0.2	0.3	0.6	0.8	1.0	1.2	27 - 09	0.6	1.0	2.0	2.5	3.0	3.7
27 - 10	0.2	0.3	0.6	0.8	1.0	1.2	27 - 10	0.6	1.0	2.0	2.4	2.9	3.6
27 - 11	0.2	0.3	0.6	0.8	1.0	1.2	27 - 11	0.6	1.0	2.0	2.4	2.9	3.6
27 - 12	0.2	0.3	0.6	0.8	0.9	1.2	27 - 12	0.6	1.0	1.9	2.4	2.9	3.6
27 - 13	0.2	0.3	0.6	0.8	0.9	1.1	27 - 13	0.6	1.0	1.9	2.3	2.8	3.5
27 - 14	0.2	0.3	0.6	0.7	0.9	1.1	27 - 14	0.6	1.0	1.9	2.3	2.8	3.5
27 - 15	0.2	0.3	0.6	0.7	0.9	1.1	27 - 15	0.6	0.9	1.9	2.3	2.8	3.4
27 - 16	0.2	0.3	0.6	0.7	0.9	1.1	27 - 16	0.6	0.9	1.9	2.3	2.7	3.4
27 - 17	0.2	0.3	0.6	0.7	0.9	1.1	27 - 17	0.6	0.9	1.8	2.2	2.7	3.4
27 - 18	0.2	0.3	0.6	0.7	0.9	1.1	27 - 18	0.6	0.9	1.8	2.2	2.7	3.3
27 - 19	0.2	0.3	0.6	0.7	0.9	1.1	27 - 19	0.6	0.9	1.8	2.2	2.6	3.3
27 - 20	0.2	0.3	0.6	0.7	0.9	1.0	27 - 20	0.6	0.9	1.8	2.2	2.6	3.2
27 - 21	0.2	0.3	0.6	0.7	0.8	1.0	27 - 21	0.6	0.9	1.7	2.1	2.6	3.2
27 - 22	0.2	0.3	0.6	0.7	0.8	1.0	27 - 22	0.5	0.9	1.7	2.1	2.5	3.2
27 - 23	0.2	0.3	0.5	0.7	0.8	1.0	27 - 23	0.1	0.2	0.5	0.6	0.7	0.8
28 - 00	0.0	0.0	0.0	0.0	0.8	0.0	28 - 00	0.5	0.8	1.5	1.8	2.2	2.7
28 - 01	0.1	0.1	0.2	0.2	0.0	0.3	28 - 01	0.7	1.1	2.2	2.6	3.2	3.9
28 - 02	0.2	0.2	0.5	0.6	0.2	0.9	28 - 02	0.7	1.1	2.3	2.8	3.4	4.2
28 - 03	0.2	0.3	0.7	0.8	0.7	1.2	28 - 03	0.7	1.1	2.2	2.7	3.3	4.1

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
28 - 04	0.2	0.4	0.7	0.9	1.0	1.3
28 - 05	0.2	0.4	0.7	0.9	1.1	1.3
28 - 06	0.2	0.3	0.7	0.8	1.0	1.2
28 - 07	0.2	0.3	0.6	0.8	1.0	1.2
28 - 08	0.2	0.3	0.6	0.7	0.9	1.1
28 - 09	0.2	0.3	0.6	0.7	0.9	1.0
28 - 10	0.2	0.3	0.5	0.7	0.8	1.0
28 - 11	0.2	0.3	0.5	0.6	0.8	0.9
28 - 12	0.2	0.2	0.5	0.6	0.8	0.9
28 - 13	0.2	0.2	0.5	0.6	0.7	0.9
28 - 14	0.1	0.2	0.4	0.6	0.7	0.8
28 - 15	0.1	0.2	0.4	0.5	0.7	0.8
28 - 16	0.1	0.2	0.4	0.5	0.6	0.8
28 - 17	0.1	0.2	0.4	0.5	0.6	0.7
28 - 18	0.1	0.2	0.4	0.5	0.6	0.7
28 - 19	0.1	0.2	0.4	0.5	0.6	0.7
28 - 20	0.1	0.2	0.4	0.5	0.6	0.7
28 - 21	0.1	0.2	0.4	0.4	0.6	0.7
28 - 22	0.1	0.2	0.4	0.4	0.5	0.6
28 - 23	0.1	0.2	0.3	0.4	0.5	0.6
29 - 00	0.1	0.2	0.3	0.4	0.5	0.6
29 - 01	0.1	0.2	0.3	0.4	0.5	0.6
29 - 02	0.1	0.2	0.3	0.4	0.5	0.6
29 - 03	0.1	0.2	0.3	0.4	0.5	0.6
29 - 04	0.1	0.2	0.3	0.4	0.5	0.6
29 - 05	0.1	0.2	0.3	0.4	0.5	0.6
29 - 06	0.1	0.1	0.3	0.4	0.4	0.5
29 - 07	0.1	0.1	0.3	0.4	0.4	0.5
29 - 08	0.1	0.1	0.3	0.3	0.4	0.5
29 - 09	0.1	0.1	0.3	0.3	0.4	0.5
29 - 10	0.1	0.1	0.3	0.3	0.4	0.5
29 - 11	0.1	0.1	0.3	0.3	0.4	0.5
29 - 12	0.1	0.1	0.3	0.3	0.4	0.5
29 - 13	0.1	0.1	0.3	0.3	0.4	0.5
29 - 14	0.1	0.1	0.3	0.3	0.4	0.5
29 - 15	0.1	0.1	0.2	0.3	0.4	0.5
29 - 16	0.1	0.1	0.2	0.3	0.4	0.5
29 - 17	0.1	0.1	0.2	0.3	0.4	0.4
29 - 18	0.1	0.1	0.2	0.3	0.4	0.4
29 - 19	0.1	0.1	0.2	0.3	0.4	0.4
29 - 20	0.1	0.1	0.2	0.3	0.3	0.4
29 - 21	0.1	0.1	0.2	0.3	0.3	0.4
29 - 22	0.1	0.1	0.2	0.3	0.3	0.4
29 - 23	0.1	0.1	0.2	0.3	0.3	0.4
30 - 00	0.1	0.1	0.2	0.3	0.3	0.4
30 - 01	0.1	0.1	0.2	0.3	0.3	0.4
30 - 02	0.1	0.1	0.2	0.3	0.3	0.4
30 - 03	0.1	0.1	0.2	0.3	0.3	0.4
30 - 04	0.1	0.1	0.2	0.3	0.3	0.4
30 - 05	0.1	0.1	0.2	0.2	0.3	0.4
30 - 06	0.1	0.1	0.2	0.2	0.3	0.4

Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
28 - 04	0.7	1.1	2.1	2.6	3.1	3.9
28 - 05	0.6	1.0	2.0	2.4	3.0	3.7
28 - 06	0.6	0.9	1.9	2.3	2.8	3.5
28 - 07	0.6	0.9	1.8	2.2	2.6	3.3
28 - 08	0.5	0.9	1.7	2.1	2.5	3.1
28 - 09	0.5	0.8	1.6	2.0	2.4	3.0
28 - 10	0.5	0.8	1.6	1.9	2.3	2.9
28 - 11	0.5	0.7	1.5	1.8	2.2	2.7
28 - 12	0.5	0.7	1.4	1.8	2.1	2.6
28 - 13	0.4	0.7	1.4	1.7	2.1	2.5
28 - 14	0.4	0.7	1.3	1.6	2.0	2.5
28 - 15	0.4	0.7	1.3	1.6	1.9	2.4
28 - 16	0.4	0.6	1.3	1.5	1.9	2.3
28 - 17	0.4	0.6	1.2	1.5	1.8	2.2
28 - 18	0.4	0.6	1.2	1.4	1.8	2.2
28 - 19	0.4	0.6	1.2	1.4	1.7	2.1
28 - 20	0.4	0.6	1.1	1.4	1.7	2.1
28 - 21	0.3	0.5	1.1	1.3	1.6	2.0
28 - 22	0.3	0.5	1.1	1.3	1.6	2.0
28 - 23	0.3	0.5	1.0	1.3	1.5	1.9
29 - 00	0.3	0.5	1.0	1.2	1.5	1.9
29 - 01	0.3	0.5	1.0	1.2	1.5	1.8
29 - 02	0.3	0.5	1.0	1.2	1.4	1.8
29 - 03	0.3	0.5	1.0	1.2	1.4	1.7
29 - 04	0.3	0.5	0.9	1.1	1.4	1.7
29 - 05	0.3	0.5	0.9	1.1	1.4	1.7
29 - 06	0.3	0.5	0.9	1.1	1.3	1.6
29 - 07	0.3	0.4	0.9	1.1	1.3	1.6
29 - 08	0.3	0.4	0.9	1.1	1.3	1.6
29 - 09	0.3	0.4	0.9	1.0	1.3	1.6
29 - 10	0.3	0.4	0.8	1.0	1.2	1.5
29 - 11	0.3	0.4	0.8	1.0	1.2	1.5
29 - 12	0.3	0.4	0.8	1.0	1.2	1.5
29 - 13	0.3	0.4	0.8	1.0	1.2	1.5
29 - 14	0.2	0.4	0.8	1.0	1.2	1.4
29 - 15	0.2	0.4	0.8	0.9	1.1	1.4
29 - 16	0.2	0.4	0.8	0.9	1.1	1.4
29 - 17	0.2	0.4	0.7	0.9	1.1	1.4
29 - 18	0.2	0.4	0.7	0.9	1.1	1.3
29 - 19	0.2	0.4	0.7	0.9	1.1	1.3
29 - 20	0.2	0.4	0.7	0.9	1.1	1.3
29 - 21	0.2	0.4	0.7	0.9	1.0	1.3
29 - 22	0.2	0.3	0.7	0.8	1.0	1.3
29 - 23	0.2	0.3	0.7	0.8	1.0	1.2
30 - 00	0.2	0.3	0.7	0.8	1.0	1.2
30 - 01	0.2	0.3	0.7	0.8	1.0	1.2
30 - 02	0.2	0.3	0.7	0.8	1.0	1.2
30 - 03	0.2	0.3	0.6	0.8	1.0	1.2
30 - 04	0.2	0.3	0.6	0.8	0.9	1.2
30 - 05	0.2	0.3	0.6	0.8	0.9	1.2
30 - 06	0.2	0.3	0.6	0.8	0.9	1.1

Table A5 Orestimba Creek Local Flow from Subarea 5, ORSUB5 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
30 - 07	0.1	0.1	0.2	0.2	0.3	0.4
30 - 08	0.1	0.1	0.2	0.2	0.3	0.4
30 - 09	0.1	0.1	0.2	0.2	0.3	0.4
30 - 10	0.1	0.1	0.2	0.2	0.3	0.4
30 - 11	0.1	0.1	0.2	0.2	0.3	0.3
30 - 12	0.1	0.1	0.2	0.2	0.3	0.3
30 - 13	0.1	0.1	0.2	0.2	0.3	0.3
30 - 14	0.1	0.1	0.2	0.2	0.3	0.3
30 - 15	0.1	0.1	0.2	0.2	0.3	0.3
30 - 16	0.1	0.1	0.2	0.2	0.3	0.3
30 - 17	0.1	0.1	0.2	0.2	0.3	0.3
30 - 18	0.1	0.1	0.2	0.2	0.3	0.3
30 - 19	0.1	0.1	0.2	0.2	0.3	0.3
30 - 20	0.1	0.1	0.2	0.2	0.3	0.3
30 - 21	0.1	0.1	0.2	0.2	0.3	0.3
30 - 22	0.1	0.1	0.2	0.2	0.2	0.3
30 - 23	0.1	0.1	0.2	0.2	0.2	0.3

Table A6 Orestimba Creek Local Flow from Subarea 6, ORSUB6 Concurrent Centering						
	Flood Frequency					
Period	20%	10%	2.0%	1.0%	0.05%	0.02%
Day-hr	cfs	cfs	cfs	cfs	cfs	cfs
30 - 07	0.2	0.3	0.6	0.8	0.9	1.1
30 - 08	0.2	0.3	0.6	0.7	0.9	1.1
30 - 09	0.2	0.3	0.6	0.7	0.9	1.1
30 - 10	0.2	0.3	0.6	0.7	0.9	1.1
30 - 11	0.2	0.3	0.6	0.7	0.9	1.1
30 - 12	0.2	0.3	0.6	0.7	0.9	1.1
30 - 13	0.2	0.3	0.6	0.7	0.8	1.0
30 - 14	0.2	0.3	0.6	0.7	0.8	1.0
30 - 15	0.2	0.3	0.6	0.7	0.8	1.0
30 - 16	0.2	0.3	0.6	0.7	0.8	1.0
30 - 17	0.2	0.3	0.5	0.7	0.8	1.0
30 - 18	0.2	0.3	0.5	0.7	0.8	1.0
30 - 19	0.2	0.3	0.5	0.7	0.8	1.0
30 - 20	0.2	0.3	0.5	0.6	0.8	1.0
30 - 21	0.2	0.3	0.5	0.6	0.8	1.0
30 - 22	0.2	0.3	0.5	0.6	0.8	1.0
30 - 23	0.2	0.3	0.5	0.6	0.8	0.9

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
There are no flows for the first six days.						
7 - 00	0.0	0.0	0.0	0.0	0.0	0.0
7 - 01	0.0	0.0	0.0	0.0	0.0	0.0
7 - 02	0.0	0.0	0.0	0.0	0.0	0.0
7 - 03	0.0	0.0	0.0	0.0	0.0	0.0
7 - 04	0.0	0.0	0.0	0.0	0.0	0.0
7 - 05	0.0	0.0	0.0	0.0	0.0	0.0
7 - 06	0.0	0.0	0.0	0.0	0.0	0.0
7 - 07	0.0	0.0	0.0	0.0	0.0	0.0
7 - 08	0.0	0.0	0.0	0.0	0.0	0.0
7 - 09	0.0	0.0	0.0	0.0	0.0	0.0
7 - 10	0.0	0.0	0.0	0.0	0.0	0.0
7 - 11	0.0	0.0	0.0	0.0	0.0	0.0
7 - 12	0.0	0.0	0.0	0.0	0.0	0.0
7 - 13	0.0	0.0	0.0	0.0	0.0	0.0
7 - 14	0.0	0.0	0.0	0.0	0.0	0.0
7 - 15	0.0	0.0	0.0	0.0	0.0	0.0
7 - 16	0.0	0.0	0.0	0.0	0.0	0.0
7 - 17	0.0	0.0	0.0	0.0	0.0	0.0
7 - 18	0.0	0.0	0.0	0.0	0.0	0.0
7 - 19	0.0	0.0	0.0	0.0	0.0	0.0
7 - 20	0.0	0.0	0.0	0.0	0.0	0.0
7 - 21	0.0	0.0	0.0	0.0	0.0	0.0
7 - 22	0.0	0.0	0.0	0.0	0.0	0.0
7 - 23	0.0	0.0	0.0	0.0	0.0	0.0
8 - 00	0.9	1.4	2.7	3.3	4.0	5.0
8 - 01	0.9	1.5	3.0	3.6	4.4	5.4
8 - 02	2.9	4.5	9.1	11.1	13.4	16.6
8 - 03	4.1	6.5	13.0	15.9	19.2	23.8
8 - 04	4.4	6.9	13.8	16.9	20.4	25.3
8 - 05	4.3	6.7	13.5	16.4	19.9	24.7
8 - 06	4.1	6.4	12.8	15.6	18.9	23.4
8 - 07	3.8	6.1	12.1	14.8	17.9	22.1
8 - 08	3.6	5.7	11.4	13.9	16.9	20.9
8 - 09	3.4	5.4	10.8	13.2	16.0	19.8
8 - 10	3.3	5.2	10.3	12.6	15.2	18.9
8 - 11	3.1	4.9	9.8	12.0	14.5	18.0
8 - 12	3.0	4.7	9.4	11.5	13.9	17.2
8 - 13	2.9	4.5	9.1	11.0	13.4	16.6
8 - 14	2.8	4.4	8.7	10.6	12.9	15.9
8 - 15	2.7	4.2	8.4	10.2	12.4	15.4
8 - 16	2.6	4.1	8.1	9.9	12.0	14.9
8 - 17	2.5	3.9	7.9	9.6	11.6	14.4
8 - 18	2.4	3.8	7.6	9.3	11.2	13.9
8 - 19	2.3	3.7	7.4	9.0	10.9	13.5
8 - 20	2.3	3.6	7.2	8.8	10.6	13.1
8 - 21	2.2	3.5	7.0	8.5	10.3	12.8
8 - 22	2.2	3.4	6.8	8.3	10.0	12.4
8 - 23	2.1	3.3	6.6	8.1	9.8	12.1

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
9 - 00	2.1	3.2	6.5	7.9	9.5	11.8
9 - 01	2.0	3.2	6.3	7.7	9.3	11.5
9 - 02	2.0	3.1	6.2	7.5	9.1	11.3
9 - 03	1.9	3.0	6.0	7.4	8.9	11.0
9 - 04	1.9	3.0	5.9	7.2	8.7	10.8
9 - 05	1.8	2.9	5.8	7.0	8.5	10.6
9 - 06	1.8	2.8	5.7	6.9	8.4	10.4
9 - 07	1.8	2.8	5.5	6.8	8.2	10.1
9 - 08	1.7	2.7	5.4	6.6	8.0	9.9
9 - 09	1.7	2.7	5.3	6.5	7.9	9.8
9 - 10	1.7	2.6	5.2	6.4	7.7	9.6
9 - 11	1.6	2.6	5.1	6.3	7.6	9.4
9 - 12	1.6	2.5	5.1	6.2	7.5	9.2
9 - 13	1.6	2.5	5.0	6.1	7.3	9.1
9 - 14	1.5	2.4	4.9	6.0	7.2	8.9
9 - 15	1.5	2.4	4.8	5.9	7.1	8.8
9 - 16	1.5	2.4	4.7	5.8	7.0	8.6
9 - 17	1.5	2.3	4.7	5.7	6.9	8.5
9 - 18	1.5	2.3	4.6	5.6	6.8	8.4
9 - 19	1.4	2.3	4.5	5.5	6.7	8.2
9 - 20	1.4	2.2	4.4	5.4	6.6	8.1
9 - 21	1.4	2.2	4.4	5.3	6.5	8.0
9 - 22	1.4	2.2	4.3	5.3	6.4	7.9
9 - 23	1.3	2.1	4.3	5.2	6.3	7.8
10 - 00	1.3	2.1	4.2	5.1	6.2	7.7
10 - 01	1.3	2.0	4.1	5.0	6.0	7.5
10 - 02	1.3	2.0	4.1	4.9	6.0	7.4
10 - 03	1.3	2.0	4.0	4.9	5.9	7.3
10 - 04	1.3	2.0	4.0	4.8	5.8	7.2
10 - 05	1.2	2.0	3.9	4.8	5.8	7.1
10 - 06	1.2	1.9	3.9	4.7	5.7	7.1
10 - 07	1.2	1.9	3.8	4.6	5.6	7.0
10 - 08	1.2	1.9	3.8	4.6	5.6	6.9
10 - 09	1.2	1.9	3.7	4.5	5.5	6.8
10 - 10	1.2	1.8	3.7	4.5	5.4	6.7
10 - 11	1.2	1.8	3.6	4.4	5.4	6.6
10 - 12	1.1	1.8	3.6	4.4	5.3	6.6
10 - 13	1.1	1.8	3.5	4.3	5.2	6.5
10 - 14	1.1	1.8	3.5	4.3	5.2	6.4
10 - 15	1.1	1.7	3.5	4.2	5.1	6.3
10 - 16	1.1	1.7	3.4	4.2	5.0	6.3
10 - 17	1.1	1.7	3.4	4.1	5.0	6.2
10 - 18	1.1	1.7	3.3	4.1	4.9	6.1
10 - 19	1.0	1.6	3.3	4.0	4.9	6.0
10 - 20	1.0	1.6	3.3	4.0	4.8	6.0
10 - 21	1.0	1.6	3.2	3.9	4.8	5.9
10 - 22	1.0	1.6	3.2	3.9	4.7	5.8
10 - 23	1.0	1.6	3.1	3.8	4.6	5.8
11 - 00	1.0	1.6	3.1	3.8	4.6	5.7
11 - 01	1.0	1.5	3.1	3.7	4.5	5.6
11 - 02	1.0	1.5	3.0	3.7	4.5	5.5

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
11 - 03	1.0	1.5	3.0	3.7	4.4	5.5
11 - 04	0.9	1.5	3.0	3.6	4.4	5.4
11 - 05	0.9	1.5	2.9	3.6	4.3	5.4
11 - 06	0.9	1.4	2.9	3.5	4.3	5.3
11 - 07	0.9	1.4	2.9	3.5	4.2	5.2
11 - 08	0.9	1.4	2.8	3.4	4.2	5.2
11 - 09	0.9	1.4	2.8	3.4	4.1	5.1
11 - 10	0.9	1.4	2.8	3.4	4.1	5.0
11 - 11	0.9	1.4	2.7	3.3	4.0	5.0
11 - 12	0.9	1.3	2.7	3.3	4.0	4.9
11 - 13	0.8	1.3	2.7	3.2	3.9	4.9
11 - 14	0.8	1.3	2.6	3.2	3.9	4.8
11 - 15	0.8	1.3	2.6	3.2	3.8	4.7
11 - 16	0.8	1.3	2.6	3.1	3.8	4.7
11 - 17	0.8	1.3	2.5	3.1	3.7	4.6
11 - 18	0.8	1.3	2.5	3.1	3.7	4.6
11 - 19	0.8	1.2	2.5	3.0	3.7	4.5
11 - 20	0.8	1.2	2.4	3.0	3.6	4.5
11 - 21	0.8	1.2	2.4	2.9	3.6	4.4
11 - 22	0.8	1.2	2.4	2.9	3.5	4.4
11 - 23	0.7	1.2	2.4	2.9	3.5	4.3
12 - 00	0.7	1.2	2.3	2.8	3.4	4.3
12 - 01	0.7	1.2	2.3	2.8	3.4	4.2
12 - 02	0.7	1.1	2.3	2.8	3.4	4.2
12 - 03	0.7	1.1	2.2	2.7	3.3	4.1
12 - 04	0.7	1.1	2.2	2.7	3.3	4.1
12 - 05	0.7	1.1	2.2	2.7	3.2	4.0
12 - 06	0.7	1.1	2.2	2.6	3.2	4.0
12 - 07	0.7	1.1	2.1	2.6	3.2	3.9
12 - 08	0.7	1.1	2.1	2.6	3.1	3.9
12 - 09	0.7	1.0	2.1	2.6	3.1	3.8
12 - 10	0.7	1.0	2.1	2.5	3.0	3.8
12 - 11	0.6	1.0	2.0	2.5	3.0	3.7
12 - 12	0.6	1.0	2.0	2.5	3.0	3.7
12 - 13	0.6	1.0	2.0	2.4	2.9	3.6
12 - 14	0.6	1.0	2.0	2.4	2.9	3.6
12 - 15	0.6	1.0	1.9	2.4	2.9	3.6
12 - 16	0.6	1.0	1.9	2.3	2.8	3.5
12 - 17	0.6	1.0	1.9	2.3	2.8	3.5
12 - 18	0.6	0.9	1.9	2.3	2.8	3.4
12 - 19	0.6	0.9	1.9	2.3	2.7	3.4
12 - 20	0.6	0.9	1.8	2.2	2.7	3.4
12 - 21	0.6	0.9	1.8	2.2	2.7	3.3
12 - 22	0.6	0.9	1.8	2.2	2.6	3.3
12 - 23	0.6	0.9	1.8	2.2	2.6	3.2
13 - 00	1.5	2.4	4.9	5.9	7.2	8.9
13 - 01	4.7	7.4	14.8	18.1	21.9	27.1
13 - 02	6.8	10.7	21.3	26.0	31.4	39.0
13 - 03	7.2	11.3	22.6	27.6	33.4	41.4
13 - 04	7.0	11.0	22.0	26.9	32.5	40.3
13 - 05	6.6	10.5	20.9	25.5	30.9	38.3

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
13 - 06	6.3	9.9	19.8	24.1	29.2	36.2
13 - 07	5.9	9.3	18.7	22.8	27.6	34.2
13 - 08	5.6	8.9	17.7	21.6	26.1	32.4
13 - 09	5.3	8.4	16.9	20.6	24.9	30.8
13 - 10	5.1	8.0	16.1	19.6	23.8	29.4
13 - 11	4.9	7.7	15.4	18.8	22.7	28.2
13 - 12	4.7	7.4	14.8	18.1	21.8	27.1
13 - 13	4.5	7.1	14.2	17.4	21.0	26.1
13 - 14	4.4	6.9	13.7	16.8	20.3	25.1
13 - 15	4.2	6.6	13.3	16.2	19.6	24.3
13 - 16	4.1	6.4	12.8	15.7	19.0	23.5
13 - 17	3.9	6.2	12.4	15.2	18.4	22.8
13 - 18	3.8	6.0	12.1	14.7	17.8	22.1
13 - 19	3.7	5.9	11.7	14.3	17.3	21.5
13 - 20	3.6	5.7	11.4	13.9	16.8	20.9
13 - 21	3.5	5.6	11.1	13.6	16.4	20.3
13 - 22	3.4	5.4	10.8	13.2	16.0	19.8
13 - 23	3.4	5.3	10.6	12.9	15.6	19.3
14 - 00	3.3	5.2	10.3	12.6	15.2	18.9
14 - 01	3.2	5.0	10.1	12.3	14.9	18.4
14 - 02	3.1	4.9	9.9	12.0	14.5	18.0
14 - 03	3.1	4.8	9.6	11.8	14.2	17.6
14 - 04	3.0	4.7	9.4	11.5	13.9	17.3
14 - 05	2.9	4.6	9.3	11.3	13.7	16.9
14 - 06	2.9	4.5	9.1	11.1	13.4	16.6
14 - 07	2.8	4.4	8.9	10.8	13.1	16.3
14 - 08	2.8	4.4	8.7	10.6	12.9	16.0
14 - 09	2.7	4.3	8.6	10.4	12.6	15.7
14 - 10	2.7	4.2	8.4	10.3	12.4	15.4
14 - 11	2.6	4.1	8.3	10.1	12.2	15.1
14 - 12	2.6	4.1	8.1	9.9	12.0	14.9
14 - 13	2.5	4.0	8.0	9.7	11.8	14.6
14 - 14	2.5	3.9	7.9	9.6	11.6	14.4
14 - 15	2.4	3.9	7.7	9.4	11.4	14.1
14 - 16	2.4	3.8	7.6	9.3	11.2	13.9
14 - 17	2.4	3.7	7.5	9.1	11.0	13.7
14 - 18	2.3	3.7	7.4	9.0	10.9	13.5
14 - 19	2.3	3.6	7.3	8.9	10.7	13.3
14 - 20	2.3	3.6	7.2	8.7	10.6	13.1
14 - 21	2.2	3.5	7.1	8.6	10.4	12.9
14 - 22	2.2	3.5	7.0	8.5	10.3	12.7
14 - 23	2.2	3.4	6.9	8.4	10.1	12.5
15 - 00	2.1	3.4	6.7	8.2	9.9	12.3
15 - 01	2.1	3.3	6.6	8.1	9.8	12.1
15 - 02	2.1	3.3	6.5	8.0	9.7	12.0
15 - 03	2.1	3.2	6.5	7.9	9.5	11.8
15 - 04	2.0	3.2	6.4	7.8	9.4	11.7
15 - 05	2.0	3.2	6.3	7.7	9.3	11.5
15 - 06	2.0	3.1	6.2	7.6	9.2	11.4
15 - 07	2.0	3.1	6.2	7.5	9.1	11.3
15 - 08	1.9	3.0	6.1	7.4	9.0	11.1

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
15 - 09	1.9	3.0	6.0	7.3	8.9	11.0
15 - 10	1.9	3.0	5.9	7.2	8.8	10.9
15 - 11	1.9	2.9	5.9	7.2	8.7	10.7
15 - 12	1.8	2.9	5.8	7.1	8.6	10.6
15 - 13	1.8	2.9	5.7	7.0	8.4	10.5
15 - 14	1.8	2.8	5.7	6.9	8.3	10.3
15 - 15	1.8	2.8	5.6	6.8	8.2	10.2
15 - 16	1.8	2.8	5.5	6.7	8.1	10.1
15 - 17	1.7	2.7	5.5	6.7	8.1	10.0
15 - 18	1.7	2.7	5.4	6.6	8.0	9.9
15 - 19	1.7	2.7	5.3	6.5	7.9	9.7
15 - 20	1.7	2.6	5.3	6.4	7.8	9.6
15 - 21	1.6	2.6	5.2	6.3	7.7	9.5
15 - 22	1.6	2.6	5.1	6.3	7.6	9.4
15 - 23	1.6	2.5	5.1	6.2	7.5	9.3
16 - 00	1.6	2.5	5.0	6.1	7.4	9.2
16 - 01	1.6	2.5	5.0	6.0	7.3	9.1
16 - 02	1.6	2.5	4.9	6.0	7.2	9.0
16 - 03	1.5	2.4	4.8	5.9	7.1	8.9
16 - 04	1.5	2.4	4.8	5.8	7.1	8.8
16 - 05	1.5	2.4	4.7	5.8	7.0	8.6
16 - 06	1.5	2.3	4.7	5.7	6.9	8.5
16 - 07	1.5	2.3	4.6	5.6	6.8	8.4
16 - 08	1.4	2.3	4.6	5.6	6.7	8.3
16 - 09	1.4	2.3	4.5	5.5	6.6	8.2
16 - 10	1.4	2.2	4.5	5.4	6.6	8.1
16 - 11	1.4	2.2	4.4	5.4	6.5	8.0
16 - 12	1.4	2.2	4.3	5.3	6.4	7.9
16 - 13	1.4	2.1	4.3	5.2	6.3	7.9
16 - 14	1.3	2.1	4.2	5.2	6.3	7.8
16 - 15	1.3	2.1	4.2	5.1	6.2	7.7
16 - 16	1.3	2.1	4.1	5.1	6.1	7.6
16 - 17	1.3	2.0	4.1	5.0	6.0	7.5
16 - 18	1.3	2.0	4.0	4.9	6.0	7.4
16 - 19	1.3	2.0	4.0	4.9	5.9	7.3
16 - 20	1.3	2.0	3.9	4.8	5.8	7.2
16 - 21	1.2	2.0	3.9	4.8	5.8	7.1
16 - 22	1.2	1.9	3.9	4.7	5.7	7.1
16 - 23	1.2	1.9	3.8	4.6	5.6	7.0
17 - 00	1.2	1.9	3.8	4.6	5.6	6.9
17 - 01	1.2	1.9	3.7	4.5	5.5	6.8
17 - 02	1.2	1.8	3.7	4.5	5.4	6.7
17 - 03	1.2	1.8	3.6	4.4	5.4	6.6
17 - 04	1.1	1.8	3.6	4.4	5.3	6.6
17 - 05	1.1	1.8	3.5	4.3	5.2	6.5
17 - 06	1.1	1.8	3.5	4.3	5.2	6.4
17 - 07	1.1	1.7	3.5	4.2	5.1	6.3
17 - 08	1.1	1.7	3.4	4.2	5.0	6.3
17 - 09	1.1	1.7	3.4	4.1	5.0	6.2
17 - 10	1.1	1.7	3.3	4.1	4.9	6.1
17 - 11	1.0	1.6	3.3	4.0	4.9	6.0

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
17 - 12	1.0	1.6	3.3	4.0	4.8	6.0
17 - 13	1.0	1.6	3.2	3.9	4.8	5.9
17 - 14	1.0	1.6	3.2	3.9	4.7	5.8
17 - 15	1.0	1.6	3.1	3.8	4.6	5.8
17 - 16	1.0	1.6	3.1	3.8	4.6	5.7
17 - 17	1.0	1.5	3.1	3.7	4.5	5.6
17 - 18	1.0	1.5	3.0	3.7	4.5	5.5
17 - 19	1.0	1.5	3.0	3.7	4.4	5.5
17 - 20	0.9	1.5	3.0	3.6	4.4	5.4
17 - 21	0.9	1.5	2.9	3.6	4.3	5.4
17 - 22	0.9	1.4	2.9	3.5	4.3	5.3
17 - 23	3.1	4.9	9.8	12.0	14.5	18.0
18 - 00	5.2	8.2	16.4	20.0	24.2	30.0
18 - 01	5.6	8.9	17.8	21.7	26.3	32.6
18 - 02	17.2	27.1	54.3	66.2	80.1	99.3
18 - 03	24.7	39.0	78.0	95.2	115.1	142.7
18 - 04	26.3	41.4	82.8	101.0	122.2	151.5
18 - 05	25.6	40.4	80.7	98.5	119.1	147.7
18 - 06	24.3	38.4	76.7	93.6	113.2	140.3
18 - 07	23.0	36.2	72.5	88.4	106.9	132.5
18 - 08	21.7	34.2	68.5	83.5	101.0	125.3
18 - 09	20.6	32.5	64.9	79.2	95.8	118.7
18 - 10	19.6	30.9	61.8	75.3	91.1	113.0
18 - 11	18.7	29.5	59.0	71.9	87.0	107.9
18 - 12	17.9	28.2	56.5	68.9	83.3	103.3
18 - 13	17.2	27.1	54.2	66.1	80.0	99.2
18 - 14	16.5	26.1	52.2	63.6	77.0	95.4
18 - 15	16.0	25.2	50.3	61.4	74.3	92.1
18 - 16	15.4	24.3	48.6	59.3	71.7	88.9
18 - 17	14.9	23.5	47.1	57.4	69.4	86.1
18 - 18	14.5	22.8	45.6	55.6	67.3	83.4
18 - 19	14.0	22.1	44.2	54.0	65.3	80.9
18 - 20	13.6	21.5	43.0	52.4	63.4	78.6
18 - 21	13.3	20.9	41.8	51.0	61.7	76.5
18 - 22	12.9	20.4	40.7	49.7	60.1	74.5
18 - 23	12.6	19.8	39.7	48.4	58.6	72.6
19 - 00	12.3	19.4	38.7	47.2	57.1	70.8
19 - 01	12.0	18.9	37.8	46.1	55.8	69.2
19 - 02	11.7	18.5	36.9	45.1	54.5	67.6
19 - 03	11.5	18.1	36.1	44.0	53.3	66.1
19 - 04	11.2	17.7	35.3	43.1	52.1	64.6
19 - 05	11.0	17.3	34.6	42.2	51.0	63.3
19 - 06	10.7	16.9	33.9	41.3	50.0	62.0
19 - 07	10.5	16.6	33.2	40.5	49.0	60.8
19 - 08	10.3	16.3	32.6	39.7	48.1	59.6
19 - 09	10.1	16.0	32.0	39.0	47.2	58.5
19 - 10	9.9	15.7	31.4	38.3	46.3	57.4
19 - 11	9.8	15.4	30.8	37.6	45.4	56.3
19 - 12	9.6	15.1	30.3	36.9	44.6	55.4
19 - 13	9.4	14.9	29.7	36.3	43.9	54.4
19 - 14	9.3	14.6	29.2	35.7	43.1	53.5

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
19 - 15	9.1	14.4	28.8	35.1	42.4	52.6
19 - 16	9.0	14.1	28.3	34.5	41.8	51.8
19 - 17	8.8	13.9	27.8	34.0	41.1	50.9
19 - 18	8.7	13.7	27.4	33.4	40.5	50.2
19 - 19	8.6	13.5	27.0	32.9	39.8	49.4
19 - 20	8.4	13.3	26.6	32.4	39.3	48.7
19 - 21	8.3	13.1	26.2	32.0	38.7	47.9
19 - 22	8.2	12.9	25.8	31.5	38.1	47.3
19 - 23	8.1	12.7	25.5	31.1	37.6	46.6
20 - 00	8.0	12.6	25.1	30.6	37.1	45.9
20 - 01	7.8	12.3	24.6	29.9	36.2	44.9
20 - 02	7.7	12.1	24.3	29.6	35.8	44.4
20 - 03	7.6	12.0	24.0	29.2	35.4	43.8
20 - 04	7.5	11.8	23.7	28.9	35.0	43.3
20 - 05	7.4	11.7	23.4	28.5	34.5	42.8
20 - 06	7.3	11.6	23.1	28.2	34.1	42.3
20 - 07	7.2	11.4	22.8	27.8	33.7	41.7
20 - 08	7.1	11.3	22.5	27.5	33.3	41.2
20 - 09	7.1	11.1	22.3	27.2	32.9	40.7
20 - 10	7.0	11.0	22.0	26.8	32.5	40.2
20 - 11	6.9	10.9	21.7	26.5	32.1	39.8
20 - 12	6.8	10.7	21.5	26.2	31.7	39.3
20 - 13	6.7	10.6	21.2	25.9	31.3	38.8
20 - 14	6.7	10.5	21.0	25.6	31.0	38.4
20 - 15	6.6	10.4	20.7	25.3	30.6	37.9
20 - 16	6.5	10.2	20.5	25.0	30.2	37.5
20 - 17	6.4	10.1	20.2	24.7	29.9	37.0
20 - 18	6.3	10.0	20.0	24.4	29.5	36.6
20 - 19	6.3	9.9	19.8	24.1	29.1	36.1
20 - 20	6.2	9.8	19.5	23.8	28.8	35.7
20 - 21	6.1	9.6	19.3	23.5	28.5	35.3
20 - 22	6.0	9.5	19.1	23.2	28.1	34.9
20 - 23	6.0	9.4	18.8	23.0	27.8	34.4
21 - 00	5.9	9.3	18.6	22.7	27.5	34.0
21 - 01	5.8	9.2	18.4	22.4	27.1	33.6
21 - 02	5.8	9.1	18.2	22.2	26.8	33.2
21 - 03	5.7	9.0	17.9	21.9	26.5	32.8
21 - 04	5.6	8.9	17.7	21.6	26.2	32.4
21 - 05	5.6	8.8	17.5	21.4	25.9	32.1
21 - 06	5.5	8.7	17.3	21.1	25.5	31.7
21 - 07	5.4	8.6	17.1	20.9	25.2	31.3
21 - 08	5.4	8.5	16.9	20.6	24.9	30.9
21 - 09	5.3	8.4	16.7	20.4	24.6	30.6
21 - 10	5.2	8.3	16.5	20.1	24.4	30.2
21 - 11	5.2	8.2	16.3	19.9	24.1	29.8
21 - 12	5.1	8.1	16.1	19.7	23.8	29.5
21 - 13	5.0	8.0	15.9	19.4	23.5	29.1
21 - 14	5.0	7.9	15.7	19.2	23.2	28.8
21 - 15	4.9	7.8	15.5	19.0	22.9	28.4
21 - 16	4.9	7.7	15.4	18.7	22.7	28.1
21 - 17	4.8	7.6	15.2	18.5	22.4	27.8

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
21 - 18	4.8	7.5	15.0	18.3	22.1	27.4
21 - 19	4.7	7.4	14.8	18.1	21.9	27.1
21 - 20	4.6	7.3	14.6	17.9	21.6	26.8
21 - 21	4.6	7.2	14.5	17.6	21.3	26.5
21 - 22	4.5	7.1	14.3	17.4	21.1	26.1
21 - 23	4.5	7.1	14.1	17.2	20.8	25.8
22 - 00	4.4	7.0	14.0	17.0	20.6	25.5
22 - 01	4.4	6.9	13.8	16.8	20.3	25.2
22 - 02	4.3	6.8	13.6	16.6	20.1	24.9
22 - 03	4.3	6.7	13.5	16.4	19.9	24.6
22 - 04	4.2	6.7	13.3	16.2	19.6	24.3
22 - 05	4.2	6.6	13.1	16.0	19.4	24.0
22 - 06	4.1	6.5	13.0	15.8	19.2	23.8
22 - 07	4.1	6.4	12.8	15.7	18.9	23.5
22 - 08	4.0	6.3	12.7	15.5	18.7	23.2
22 - 09	4.0	6.3	12.5	15.3	18.5	22.9
22 - 10	3.9	6.2	12.4	15.1	18.3	22.6
22 - 11	3.9	6.1	12.2	14.9	18.0	22.4
22 - 12	3.8	6.0	12.1	14.7	17.8	22.1
22 - 13	3.8	6.0	11.9	14.6	17.6	21.8
22 - 14	3.7	5.9	11.8	14.4	17.4	21.6
22 - 15	3.7	5.8	11.7	14.2	17.2	21.3
22 - 16	3.7	5.8	11.5	14.1	17.0	21.1
22 - 17	3.6	5.7	11.4	13.9	16.8	20.8
22 - 18	3.6	5.6	11.2	13.7	16.6	20.6
22 - 19	3.5	5.6	11.1	13.6	16.4	20.3
22 - 20	3.5	5.5	11.0	13.4	16.2	20.1
22 - 21	3.4	5.4	10.8	13.2	16.0	19.8
22 - 22	3.4	5.4	10.7	13.1	15.8	19.6
22 - 23	3.4	5.3	10.6	12.9	15.6	19.4
23 - 00	0.9	1.5	2.9	3.5	4.3	5.3
23 - 01	2.8	4.4	8.8	10.8	13.1	16.2
23 - 02	4.0	6.4	12.7	15.5	18.8	23.3
23 - 03	4.3	6.7	13.5	16.5	19.9	24.7
23 - 04	4.2	6.6	13.2	16.0	19.4	24.1
23 - 05	4.0	6.3	12.5	15.2	18.5	22.9
23 - 06	3.7	5.9	11.8	14.4	17.4	21.6
23 - 07	3.5	5.6	11.2	13.6	16.5	20.4
23 - 08	3.4	5.3	10.6	12.9	15.6	19.4
23 - 09	3.2	5.0	10.1	12.3	14.9	18.4
23 - 10	3.0	4.8	9.6	11.7	14.2	17.6
23 - 11	2.9	4.6	9.2	11.2	13.6	16.8
23 - 12	2.8	4.4	8.8	10.8	13.0	16.2
23 - 13	2.7	4.3	8.5	10.4	12.5	15.6
23 - 14	2.6	4.1	8.2	10.0	12.1	15.0
23 - 15	2.5	4.0	7.9	9.7	11.7	14.5
23 - 16	2.4	3.8	7.7	9.4	11.3	14.0
23 - 17	2.4	3.7	7.4	9.1	11.0	13.6
23 - 18	2.3	3.6	7.2	8.8	10.6	13.2
23 - 19	2.2	3.5	7.0	8.5	10.3	12.8
23 - 20	2.2	3.4	6.8	8.3	10.1	12.5

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
23 - 21	2.1	3.3	6.6	8.1	9.8	12.1
23 - 22	2.1	3.2	6.5	7.9	9.5	11.8
23 - 23	2.0	3.2	6.3	7.7	9.3	11.5
24 - 00	2.0	3.1	6.2	7.5	9.1	11.3
24 - 01	1.9	3.0	6.0	7.3	8.9	11.0
24 - 02	1.9	2.9	5.9	7.2	8.7	10.8
24 - 03	1.8	2.9	5.8	7.0	8.5	10.5
24 - 04	1.8	2.8	5.6	6.9	8.3	10.3
24 - 05	1.8	2.8	5.5	6.7	8.2	10.1
24 - 06	1.7	2.7	5.4	6.6	8.0	9.9
24 - 07	1.7	2.7	5.3	6.5	7.8	9.7
24 - 08	1.7	2.6	5.2	6.4	7.7	9.5
24 - 09	1.6	2.6	5.1	6.2	7.5	9.4
24 - 10	1.6	2.5	5.0	6.1	7.4	9.2
24 - 11	1.6	2.5	4.9	6.0	7.3	9.0
24 - 12	1.5	2.4	4.8	5.9	7.2	8.9
24 - 13	1.5	2.4	4.8	5.8	7.0	8.7
24 - 14	1.5	2.3	4.7	5.7	6.9	8.6
24 - 15	1.5	2.3	4.6	5.6	6.8	8.4
24 - 16	1.4	2.3	4.5	5.5	6.7	8.3
24 - 17	1.4	2.2	4.5	5.5	6.6	8.2
24 - 18	1.4	2.2	4.4	5.4	6.5	8.1
24 - 19	1.4	2.2	4.3	5.3	6.4	7.9
24 - 20	1.4	2.1	4.3	5.2	6.3	7.8
24 - 21	1.3	2.1	4.2	5.1	6.2	7.7
24 - 22	1.3	2.1	4.2	5.1	6.1	7.6
24 - 23	1.3	2.0	4.1	5.0	6.0	7.5
25 - 00	1.3	2.0	4.0	4.9	5.9	7.3
25 - 01	1.3	2.0	4.0	4.8	5.8	7.2
25 - 02	1.2	2.0	3.9	4.8	5.8	7.1
25 - 03	1.2	1.9	3.9	4.7	5.7	7.1
25 - 04	1.2	1.9	3.8	4.7	5.6	7.0
25 - 05	1.2	1.9	3.8	4.6	5.6	6.9
25 - 06	1.2	1.9	3.7	4.5	5.5	6.8
25 - 07	1.2	1.8	3.7	4.5	5.4	6.7
25 - 08	1.2	1.8	3.6	4.4	5.4	6.6
25 - 09	1.1	1.8	3.6	4.4	5.3	6.6
25 - 10	1.1	1.8	3.5	4.3	5.2	6.5
25 - 11	1.1	1.8	3.5	4.3	5.2	6.4
25 - 12	1.1	1.7	3.5	4.2	5.1	6.3
25 - 13	1.1	1.7	3.4	4.2	5.0	6.3
25 - 14	1.1	1.7	3.4	4.1	5.0	6.2
25 - 15	1.1	1.7	3.3	4.1	4.9	6.1
25 - 16	1.0	1.6	3.3	4.0	4.9	6.0
25 - 17	1.0	1.6	3.3	4.0	4.8	6.0
25 - 18	1.0	1.6	3.2	3.9	4.8	5.9
25 - 19	1.0	1.6	3.2	3.9	4.7	5.8
25 - 20	1.0	1.6	3.1	3.8	4.6	5.8
25 - 21	1.0	1.6	3.1	3.8	4.6	5.7
25 - 22	1.0	1.5	3.1	3.7	4.5	5.6
25 - 23	1.0	1.5	3.0	3.7	4.5	5.5

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
26 - 00	1.0	1.5	3.0	3.7	4.4	5.5
26 - 01	0.9	1.5	3.0	3.6	4.4	5.4
26 - 02	0.9	1.5	2.9	3.6	4.3	5.4
26 - 03	0.9	1.4	2.9	3.5	4.3	5.3
26 - 04	0.9	1.4	2.9	3.5	4.2	5.2
26 - 05	0.9	1.4	2.8	3.4	4.2	5.2
26 - 06	0.9	1.4	2.8	3.4	4.1	5.1
26 - 07	0.9	1.4	2.8	3.4	4.1	5.0
26 - 08	0.9	1.4	2.7	3.3	4.0	5.0
26 - 09	0.9	1.3	2.7	3.3	4.0	4.9
26 - 10	0.8	1.3	2.7	3.2	3.9	4.9
26 - 11	0.8	1.3	2.6	3.2	3.9	4.8
26 - 12	0.8	1.3	2.6	3.2	3.8	4.7
26 - 13	0.8	1.3	2.6	3.1	3.8	4.7
26 - 14	0.8	1.3	2.5	3.1	3.7	4.6
26 - 15	0.8	1.3	2.5	3.1	3.7	4.6
26 - 16	0.8	1.2	2.5	3.0	3.7	4.5
26 - 17	0.8	1.2	2.4	3.0	3.6	4.5
26 - 18	0.8	1.2	2.4	2.9	3.6	4.4
26 - 19	0.8	1.2	2.4	2.9	3.5	4.4
26 - 20	0.7	1.2	2.4	2.9	3.5	4.3
26 - 21	0.7	1.2	2.3	2.8	3.4	4.3
26 - 22	0.7	1.2	2.3	2.8	3.4	4.2
26 - 23	0.7	1.1	2.3	2.8	3.4	4.2
27 - 00	0.7	1.1	2.2	2.7	3.3	4.1
27 - 01	0.7	1.1	2.2	2.7	3.3	4.1
27 - 02	0.7	1.1	2.2	2.7	3.2	4.0
27 - 03	0.7	1.1	2.2	2.6	3.2	4.0
27 - 04	0.7	1.1	2.1	2.6	3.2	3.9
27 - 05	0.7	1.1	2.1	2.6	3.1	3.9
27 - 06	0.7	1.0	2.1	2.6	3.1	3.8
27 - 07	0.7	1.0	2.1	2.5	3.0	3.8
27 - 08	0.6	1.0	2.0	2.5	3.0	3.7
27 - 09	0.6	1.0	2.0	2.5	3.0	3.7
27 - 10	0.6	1.0	2.0	2.4	2.9	3.6
27 - 11	0.6	1.0	2.0	2.4	2.9	3.6
27 - 12	0.6	1.0	1.9	2.4	2.9	3.6
27 - 13	0.6	1.0	1.9	2.3	2.8	3.5
27 - 14	0.6	1.0	1.9	2.3	2.8	3.5
27 - 15	0.6	0.9	1.9	2.3	2.8	3.4
27 - 16	0.6	0.9	1.9	2.3	2.7	3.4
27 - 17	0.6	0.9	1.8	2.2	2.7	3.4
27 - 18	0.6	0.9	1.8	2.2	2.7	3.3
27 - 19	0.6	0.9	1.8	2.2	2.6	3.3
27 - 20	0.6	0.9	1.8	2.2	2.6	3.2
27 - 21	0.6	0.9	1.7	2.1	2.6	3.2
27 - 22	0.5	0.9	1.7	2.1	2.5	3.2
27 - 23	0.2	0.2	0.5	0.6	0.7	0.9
28 - 00	0.5	0.8	1.5	1.9	2.3	2.8
28 - 01	0.7	1.1	2.2	2.7	3.2	4.0
28 - 02	0.7	1.2	2.3	2.8	3.4	4.3

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
28 - 03	0.7	1.1	2.3	2.8	3.4	4.2
28 - 04	0.7	1.1	2.2	2.6	3.2	4.0
28 - 05	0.6	1.0	2.0	2.5	3.0	3.7
28 - 06	0.6	1.0	1.9	2.4	2.8	3.5
28 - 07	0.6	0.9	1.8	2.2	2.7	3.3
28 - 08	0.6	0.9	1.7	2.1	2.6	3.2
28 - 09	0.5	0.8	1.7	2.0	2.5	3.0
28 - 10	0.5	0.8	1.6	1.9	2.3	2.9
28 - 11	0.5	0.8	1.5	1.9	2.3	2.8
28 - 12	0.5	0.7	1.5	1.8	2.2	2.7
28 - 13	0.4	0.7	1.4	1.7	2.1	2.6
28 - 14	0.4	0.7	1.4	1.7	2.0	2.5
28 - 15	0.4	0.7	1.3	1.6	2.0	2.4
28 - 16	0.4	0.6	1.3	1.6	1.9	2.4
28 - 17	0.4	0.6	1.2	1.5	1.8	2.3
28 - 18	0.4	0.6	1.2	1.5	1.8	2.2
28 - 19	0.4	0.6	1.2	1.4	1.7	2.2
28 - 20	0.4	0.6	1.1	1.4	1.7	2.1
28 - 21	0.4	0.6	1.1	1.4	1.7	2.0
28 - 22	0.3	0.5	1.1	1.3	1.6	2.0
28 - 23	0.3	0.5	1.1	1.3	1.6	1.9
29 - 00	0.3	0.5	1.0	1.3	1.5	1.9
29 - 01	0.3	0.5	1.0	1.2	1.5	1.9
29 - 02	0.3	0.5	1.0	1.2	1.5	1.8
29 - 03	0.3	0.5	1.0	1.2	1.4	1.8
29 - 04	0.3	0.5	1.0	1.2	1.4	1.7
29 - 05	0.3	0.5	0.9	1.1	1.4	1.7
29 - 06	0.3	0.5	0.9	1.1	1.4	1.7
29 - 07	0.3	0.5	0.9	1.1	1.3	1.6
29 - 08	0.3	0.4	0.9	1.1	1.3	1.6
29 - 09	0.3	0.4	0.9	1.1	1.3	1.6
29 - 10	0.3	0.4	0.9	1.0	1.3	1.6
29 - 11	0.3	0.4	0.8	1.0	1.2	1.5
29 - 12	0.3	0.4	0.8	1.0	1.2	1.5
29 - 13	0.3	0.4	0.8	1.0	1.2	1.5
29 - 14	0.3	0.4	0.8	1.0	1.2	1.5
29 - 15	0.2	0.4	0.8	1.0	1.2	1.4
29 - 16	0.2	0.4	0.8	0.9	1.1	1.4
29 - 17	0.2	0.4	0.8	0.9	1.1	1.4
29 - 18	0.2	0.4	0.8	0.9	1.1	1.4
29 - 19	0.2	0.4	0.7	0.9	1.1	1.4
29 - 20	0.2	0.4	0.7	0.9	1.1	1.3
29 - 21	0.2	0.4	0.7	0.9	1.1	1.3
29 - 22	0.2	0.4	0.7	0.9	1.0	1.3
29 - 23	0.2	0.3	0.7	0.8	1.0	1.3
30 - 00	0.2	0.3	0.7	0.8	1.0	1.3
30 - 01	0.2	0.3	0.7	0.8	1.0	1.2
30 - 02	0.2	0.3	0.7	0.8	1.0	1.2
30 - 03	0.2	0.3	0.7	0.8	1.0	1.2
30 - 04	0.2	0.3	0.7	0.8	1.0	1.2
30 - 05	0.2	0.3	0.6	0.8	0.9	1.2

Table A7
Orestimba Creek Local Flow
from Subarea 7, ORSUB7
Concurrent Centering

Period Day-hr	Flood Frequency					
	20%	10%	2.0%	1.0%	0.05%	0.02%
	cfs	cfs	cfs	cfs	cfs	cfs
30 - 06	0.2	0.3	0.6	0.8	0.9	1.2
30 - 07	0.2	0.3	0.6	0.8	0.9	1.1
30 - 08	0.2	0.3	0.6	0.8	0.9	1.1
30 - 09	0.2	0.3	0.6	0.7	0.9	1.1
30 - 10	0.2	0.3	0.6	0.7	0.9	1.1
30 - 11	0.2	0.3	0.6	0.7	0.9	1.1
30 - 12	0.2	0.3	0.6	0.7	0.9	1.1
30 - 13	0.2	0.3	0.6	0.7	0.9	1.1
30 - 14	0.2	0.3	0.6	0.7	0.9	1.1
30 - 15	0.2	0.3	0.6	0.7	0.8	1.0
30 - 16	0.2	0.3	0.6	0.7	0.8	1.0
30 - 17	0.2	0.3	0.6	0.7	0.8	1.0
30 - 18	0.2	0.3	0.6	0.7	0.8	1.0
30 - 19	0.2	0.3	0.5	0.7	0.8	1.0
30 - 20	0.2	0.3	0.5	0.7	0.8	1.0
30 - 21	0.2	0.3	0.5	0.6	0.8	1.0
30 - 22	0.2	0.3	0.5	0.6	0.8	1.0
30 - 23	0.2	0.3	0.5	0.6	0.8	0.9

REAL ESTATE PLAN
For informational purposes only

Orestimba Creek Flood Risk Management
Interim Feasibility Study

PREPARED FOR THE
SOUTH PACIFIC DIVISION

7/25/2012

PREPARED
BY THE
SACRAMENTO DISTRICT
REAL ESTATE DIVISION
SOUTH PACIFIC DIVISION

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Real Estate Plan

Orestimba Flood Control Project
Interim Feasibility Report

7/25/2012

1. INTRODUCTION

This report presents the Real Estate requirements for the West Stanislaus Orestimba Creek Feasibility Study located in Stanislaus County, California.

The Corps of Engineers (Corps) initiated the Feasibility Study at the request of Stanislaus County, the non-Federal sponsor for the study. The Corps and Stanislaus County are the lead agencies in the Feasibility Study; at the request of the county, The State of California will be the Non Federal sponsor and will share the cost of the study going forward into PED and construction.

Throughout the Feasibility Study, the Corps has coordinated closely with the City of Newman and the Orestimba Creek Flood Control District. Numerous other agencies, organizations, and individuals participated in the study including local landowners and residents, the California Department of Water Resources (DWR), the California Department of Fish and Game (CDFG), the U.S. Fish and Wildlife Service (USFWS), and The Nature Conservancy (TNC). Congressman Dennis Cardoza and his staff members have been actively involved with the study.

As a result of flooding along Orestimba Creek in February 1980, the Reclamation Board of the State of California requested the Corps investigate potential solutions to the flooding problems. A reconnaissance investigation by the Corps was completed in July 1980 which resulted in a finding that a viable solution may exist to the flooding along Orestimba Creek. This study was not pursued due to lack of landowner support for the project. An earlier Corps of Engineers effort in January 1964 was cited in this Reconnaissance Report but a report was not produced. In March, 1995, Orestimba Creek experienced the largest storm in over 70 years of record. 12,000 cfs was recorded at the USGS gage on Orestimba Creek near the California Aqueduct. The floodwater overwhelmed the channel and flowed overland across agricultural fields, backing up against a railroad embankment and inundating the City of Newman. Stanislaus County subsequently prepared a Hazard Mitigation Grant Application dated January 1996. At the request of Stanislaus County, the Corps of Engineers initiated a Section 905(b) Analysis in April 1997 which determined a likely Federal interest in flood damage reduction for Orestimba Creek. The Feasibility Phase was initiated in September 1998. Over the next ten years the project was slowed by limited study funds and the lack of other resources, contracting out the report, and the focus of the non-Federal sponsor on a Dry Dam west of Newman.

2. PROJECT AUTHORITY

This investigation is being conducted under the authority of a House Resolution adopted May 8, 1964 which states: "Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report on Sacramento-San Joaquin Basin Streams, California,

published as House Document No. 367, 81st Congress, 1st Session, and other reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time, with particular reference to further coordinated development of the water resources in the San Joaquin River Basin, California."

This study will only partially address the San Joaquin River Basin Authority. Therefore, the Orestimba Creek Feasibility Study will be called an “Interim Feasibility Report” which indicates that the study is addressing the water resource issues of a specific area within the authority, rather than the entire area authorized for study.

Funds to initiate the study were provided in the Energy and Water Development Appropriations Bill, (HR 104-679) 1997, for the San Joaquin River Basin, West Stanislaus County, California.

3. PROJECT DESCRIPTION

The study area is located on the west side of the San Joaquin River in Stanislaus County, California. It encompasses approximately 186 square miles of rangeland and very productive irrigated cropland. The largest community in the study area is the city of Newman, which is located along State Highway 33. Modesto, the county seat is located 20 miles from the city of Newman. Orestimba Creek is a "west side tributary" to the San Joaquin River, and originates from the eastern slopes of the Diablo Range, a section of the larger Coast Range of California. Orestimba Creek is traversed by U.S. Interstate Highway 5, the California Aqueduct, the Delta-Mendota Canal, State Highway 33, the Northern California Railroad (NCRR), and the Central California Irrigation District (CCID) Main Canal. Elevations vary from 180 feet above sea level at the Delta-Mendota Canal to about 3,600 feet at the headwaters of Orestimba Creek. The creek is ephemeral, with high flows normally occurring in late winter, and irrigation drainage accounting for low flows during the summer months. The creek flows in a northeasterly direction through steep mountain canyons until it emerges at the edge of the foothills. Here, on the gently sloping valley floor, the decreased slope and size of the streambed reduces the creek’s channel capacity. Flood flows spread over a wide undefined alluvial fan. Most west side tributary streambeds disappear in the area, join other creeks, or are confined to manmade structures due to farming. Orestimba Creek is one of the few tributaries to maintain a definite open channel from the Coast Range to the San Joaquin River. The tentatively recommended plan is the Locally Preferred Plan (LPP). This plan is justified by the positive Benefit-to-Cost (BC) ratio. This plan allows the local community to meet both FEMA certification requirements and the State of California’s criteria for funding of flood management projects. The chevron levee would be constructed and parallel the east bank of the Central California Irrigation District (CCID) Main Canal about 4.0 miles from the Newman Wasteway. The levee alignment would continue diagonally at about a 45’ angle northeast constructing another 0.7 miles and tying into the railroad embankment near an existing culvert to reduce the frequency and duration of floodwater ponding on the north side of the levee. The levee would also extend an additional 35 feet east of the California Northern Railroad (CNRR) embankment to insure that floodwaters do not flank the proposed levee. The Corps is in communication with the CNRR. The levee would be about 4.7 miles.

- **Chevron Levee along CCID Canal - Tentative National Economic Development Plan (NED)**

The NED plan consists of the construction of a chevron levee along the city of Newman's northwestern perimeter. The chevron levee maximizes benefits to the urban area by reducing flood damages associated with Orestimba Creek overflows. The north side of the chevron levee would be constructed along 1 mile of an unnamed farm road about 1 mile north of town. The western segment would be constructed along the eastern bank of the CCID Main Canal from the farm road south to the Newman Wasteway, a distance of about 4 miles. The chevron levee height would equate to about elevation 112.75 feet which means the levee will be about four to five feet high, depending on the ground elevation changes along the levee alignment. This levee elevation captured the most benefits for the least amount of costs and was therefore identified as the elevation that would be included in the NED plan.

Various chevron levee alignments and heights were analyzed in the process of identifying the NED plan. Alignments in which the Chevron Levee construction continued further to the north were also considered but were dropped because of the deeper floodplains which resulted. This northern alignment also directed flood flows to the opposite side of the creek, causing significant induced flooding. A levee alignment along Stuhr Road was also evaluated. The benefit of locating the levee at the farm road location rather than the Stuhr Road location is the reduction in overall cost that would come from less material being required, fewer utilities to contend with, and no traffic to re-route during construction. Less fill material would be required to construct the levee because the top width of this levee only needs to be 16' wide whereas the Stuhr Road levee would need to be 35' wide to replace the existing width of the County road.

Construction of the Chevron Levee would alter the nature of the existing floodplain by increasing the depth of flooding to the north of the proposed levee. Flood flows will pond in this area as the flows are metered through culverts under Highway 33 and the railroad berm. Any future improvements by local interests to increase the channel capacity in the creek would reduce the occurrence of this increased depth of flooding. Ponding of floodwaters already occurs in the without project condition along the CCID Main canal berm. For the very large events, the ponded areas will be greater due to the increased height of the levee which will prohibit overtopping as would happen in the without project condition.

The farm road segment of the levee was refined to a diagonal alignment in order to tie in to the Railroad embankment near an existing culvert to reduce the frequency and duration of floodwater ponding on the north side of the levee. During small flood events and localized rainfall events, Orestimba creek floodwater or local runoff would be conveyed to the east side of the railroad embankment through existing drainage culverts. However, the railroad would be overtopped during a big flood event. To mitigate for this condition, the east side of the railroad embankment will need sand filter and be lined with rock revetment to prevent erosion. Approximately 10 culverts under the CNRR embankment will be extended to accommodate the seepage embankment and erosion protection. New upstream and downstream headwalls will be constructed at each culvert. The railroad embankment protection plan begins where the proposed levee crosses the railroad and ends where the railroad crosses Orestimba Creek. This distance is approximately 2 miles.

- **Chevron Levee along CCID Canal - Locally Preferred Plan**

The Locally Preferred Plan (LPP) includes the same elements as the NED plan but raises the height of the chevron levee to include three feet of freeboard above the mean 0.5% water surface elevation (1/200 AEP). This freeboard was requested by the local sponsor in order to meet FEMA certification requirements as well as more stringent State of California requirements for urban areas. The LPP levee will be six to seven feet tall or about 2 feet taller than the NED levee.

FEMA requires 3' of freeboard on top of the 1% mean water surface elevation for certification purposes. The State of California requires urban and urbanizing areas (with a population of 10,000 or greater) to achieve 200 year level of protection in order to qualify for State funding of flood management projects. The State's interim levee design guidelines require 3' feet of freeboard above the median 1/200 Annual Exceedence Probability (AEP) water surface elevation or higher if required for wind setup and wave run up. It was determined that additional freeboard to account for wind waves would not be required. The proposed Chevron Levee alignment would be sheltered from wind waves by the existing CCID berm. Analysis of the Lundy road segment indicated the wave height plus setup would be less than 3 feet at the 1/200 AEP median water surface elevation.

The State criteria also specifies that civil engineers would be allowed and encouraged to adjust the Design Water Surface Elevation (DWSE) upward to account for climate change. Additional freeboard was not specified for climate change in the LPP. The 200-year median water surface profile was found to be relatively insensitive to increased flood discharge.

The difference between the 1% and the .5% (the 100 year and 200 year) water surface elevation is only several inches due to the nature of alluvial fan flooding which is broad and shallow and highly subject to changes in topography which could alter the flow path in many different directions.

Construction of the Chevron Levee would alter the nature of the existing floodplain by increasing the depth of flooding to the north of the proposed levee. Flood flows will pond in this area as the flows are metered through culverts under Highway 33 and the railroad berm. Any future improvements by local interests to increase the channel capacity in the creek would reduce the occurrence of this increased depth of flooding. Ponding of floodwaters already occurs in the without project condition along the CCID Main canal berm. For the very large events, the ponded areas will be greater in the LPP than the without project condition due to the increased height of the levee which will prohibit overtopping as would happen in the without project condition.

Once the plan is selected and the specific information is known, the following chart will be completed. During the feasibility study the objective was to base the real estate costs on the largest footprint of the levee and base the cost on the highest estate value. Once the designs have reached 90% and it has been determined what estate is needed. The acreage may be split between Flood Protection Levee Easement and Flowage Easement.

- **Orestimba Creek Channel Modification**

SCREENED OUT DURING PLAN FORMULATION

Construction of a chevron levee reduces damages in the City of Newman, but does not reduce agricultural damages in the remainder of the study area. In order to increase the level of protection to the agricultural area, modifications to enlarge the Orestimba Creek channel were examined.

The channel modifications would enlarge the channel flow cross-section for additional capacity. The existing channel would be widened at several specific sites where the channel capacity is most constricted. The goal of this alternative would be to accommodate flows up to 3,500 cfs within the Orestimba Creek channel; flows higher than this design level would overtop the creek channel and flow overland. The chevron levee would provide the City of Newman with additional flood protection from these overland flows. The approximate reach of the channel modifications is between Eastin Road and one mile downstream of the Highway 33 Bridge, a distance of about 5 miles.

The channel modifications target the middle reach of the creek in which the capacity is most constricted. Both upstream and downstream the natural channel has the capacity to accommodate larger flows. In order to ensure that the channel modifications do not increase the flood potential for properties along the creek downstream of the channel work, this measure would also include the removal of non-native invasive plant species such as Arundo donax which can impede the flow in the creek and cause the water surface elevation to rise.

- **The Tentatively Recommended Plan**

The tentatively recommended plan is the LPP. This plan is justified. This plan allows the local community to meet both FEMA certification requirements and the State of California's criteria for funding of flood management projects. The LPP Plan is supported by the non-Federal sponsor and the State of California because it allows the City of Newman to meet the requirements of Senate Bill (SB) 5 which stipulates that urban and urbanizing areas of 10,000 or greater must achieve 1/200 ACE level of flood risk management in order to qualify for State funding of flood management projects. The LPP plan also allows residents of the City of Newman to substantially lower the flood insurance rate through the NFIP program.

Estate	**Orestimba Flood Control Project Requirements**
Flood Protection Levee Easement	88.65
Temporary Work Area Easement	90.58
Flowage Easement	Will be determined once designs are at 90%
Total Ownerships	23
Number of Private Owners	18

Number of Public Lands	5
Number of PL 91-646 Relocations * Included in Private Ownerships	1

Once the designs have been completed to 90%, some of Flood Protection Levee Easement may change to Flowage Easement. At that time the easement examples, shown above will be completed with tract numbers.

4. DESCRIPTION OF LERRD'S

ORESTIMBA CREEK FLOOD CONTROL PROJECT; Locally Preferred Plan (LPP)								
APN	GIS MAP	PARCEL AREA	P.R.E.	T.W.A.E.			F.P.L.E.	SUM APN
	SHEET #	ACRES		Staging	Constr	Haul		
ORESTIMBA CREEK_LPP			ACRES	ACRES	ACRES	ACRES	ACRES	ACRES
026-014-021		233.62			3.069		3.658	6.727
026-014-026		15.00			0.497			0.497
026-020-012		88.49			2.184		8.681	10.864
026-025-006		19.50			0.347		0.465	0.812
026-025-034		42.24			1.374		4.100	5.474
026-029-005		65.25			1.795		3.456	5.251
026-029-006		75.79			0.290		0.632	0.922
026-031-007		47.33			10.715		4.309	15.024
026-031-008		102.18			0.430		2.641	3.071
026-031-012		17.65			0.551		2.935	3.486
026-034-002		100.13			22.536		5.757	28.293
027-018-023		115.25					6.599	6.599
027-018-029		5.31					1.056	1.056
049-014-005		150.25					0.045	0.045
049-020-005		99.78					0.270	0.270
049-021-003		147.09			25.874		5.946	31.820
049-022-001		183.72					0.036	0.036
CCID _Canal					20.472		19.298	39.771
Draper rd					0.044		0.171	0.215
Orestimba Rd.					0.350		0.148	0.498
Shiells Rd					0.024		0.116	0.141
St. Hwy 33							18.246	18.246
W. Stuhr rd					0.026		0.088	0.114
TOTAL IN ACRES =		0.00	0.00	0.00	90.58	0.00	88.65	179.23

T.W.A.E. = TEMPORARY WORK AREA EASEMENT
F.P.L.E = FLOOD PROTECTION LEVEE EASEMENT

- Ownerships and Acreages shown in above table, values shown in cost estimate in section 12

5. LERRD'S OWNED BY THE NFS AND CREDITING

Stanislaus County is the Non-Federal Sponsor during feasibility and plan formulation, State of California will be taking over the funding for design and construction. There are no LERRD'S owned by the NFS.

6. STANDARD FEDERAL ESTATES AND NON-STANDARD ESTATES

The non-Federal Sponsor will acquire the minimum interests in real estate to support the construction and subsequent operation and maintenance of the project. The specific areas that will be required to be acquired and the estates necessary will be determined when the final design is selected.

The following standard estates will be used for the project:

- **Flood Protection Levee Easement**
  A perpetual and assignable right and easement in (the land described in Schedule A) (Tracts Nos. __, __ and __) to construct, maintain, repair, operate, patrol and replace a flood protection levee, including all appurtenances thereto; reserving, however, to the owners, their heirs and assigns, all such rights and privileges in the land as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

- **Flowage Easement (Occasional Flooding)**
  The perpetual right, power, privilege and easement occasionally to overflow, flood and submerge (the land described in Schedule A) (Tracts Nos. , , and) and to maintain mosquito control in connection with the operation and maintenance of the( )project as authorized by the Act of Congress approved( ), together with all right, title and interest in and to the structures and improvements now situate on the land, except fencing and also excepting here identify those structures not designed for human habitation which the District Engineer determines may remain on the land provided that no structures for human habitation shall be constructed or maintained on the land, that no other structures shall be constructed or maintained on the land except as may be approved in writing by the representative of the United States in charge of the project, and that no excavation shall be conducted and no landfill placed on the land without such approval as to the location and method of excavation and/or placement of landfill; the above estate is taken subject to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress or abridging the rights and easement hereby acquired; provided further that any use of the land shall be subject to Federal and State laws with respect to pollution.

- **Temporary Work Area Easements (TWAE)**
  A temporary easement and right-of-way in, on, over and across the land , for a period not to exceed three (3) years, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a work area, including the right to borrow and/or deposit fill, spoil and waste material thereon,

move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Orestimba Flood Control Project , together with the right to trim, cut, fell and remove there from all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines. The contractor's staging areas would be located along the CCID canal within the TWAE. The staging areas will have temporary fencing placed around the perimeter and around vegetation within its confines. Borrow material will come from County of Newman owned landfill. Disposal of surface debris, non-reusable materials, and trash are planned to return to County f Newman owned landfill areas.

- Once the Alternative Formulation Briefing (AFB) has been completed and the tentative plan has been identified and selected, the Real Estate Plan (REP) will be revised as required by real estate regulations.

- **BORROW \ DISPOSAL AREAS**
  The borrow site is anticipated to be the Fink Road Landfill. Local sponsors have indicated at PDT meetings that there will be no 'royalties' required for the borrow material. Disposal of debris is considered normal and anticipated to be at the landfill as well. Materials generated from stripping farmland/orchards are anticipated to be spread in the 'ditch' created between the new levee and the CCID canal levee. The total distance to the construction site from Fink Land fill is about 12 miles.

7. DESCRIPTION OF ANY FEDERAL PROJECT IN OR PARTIALLY IN THE PROPOSED PROJECT

See 1.6 in Chapter 1 of the Orestimba Creek Flood Risk Management *Draft Feasibility Report/EA/IS*

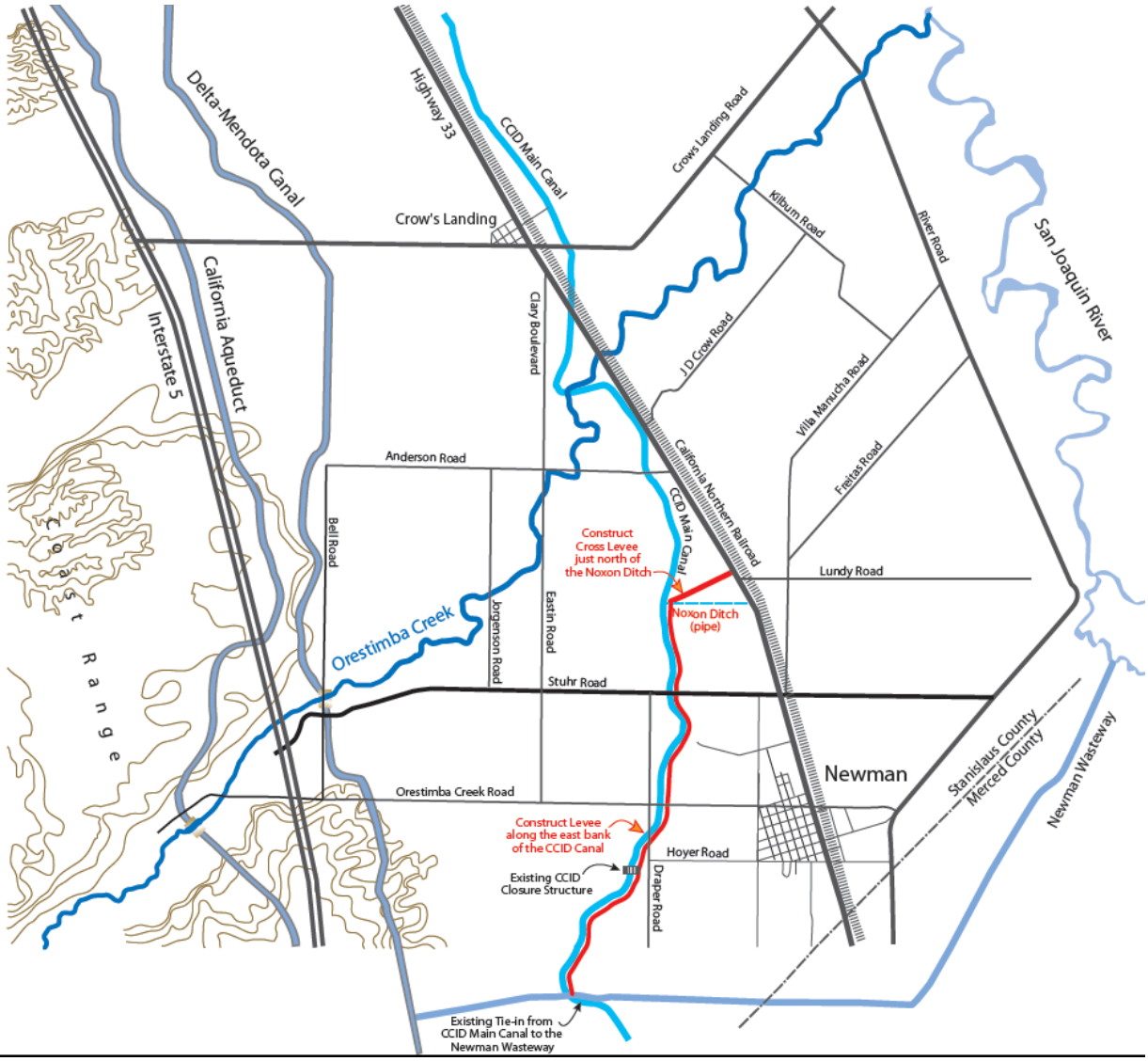
8. DESCRIPTION OF ANY FEDERALLY OWNED LAND NEEDED FOR THE PROJECT

N/A

9. APPLICATION OF NAVIGATIONAL SERVITUDE TO THE LERRD'S REQUIREMENT

No lands to be acquired are within the navigational servitude

10. PROJECT MAP



11. ANTICIPATED INCREASED FLOODING AND IMPACTS

Based on the results of hydraulic modeling, the area indicated on Figure 1 might experience potential increased depths in some locations. With the potential depths being less than .5 ft, and are projected to recede in less than 24 hours indicates there would be No Significant Induced Flooding and therefore it has been determined by Office of Counsel that a Physical Takings Analysis is not required. See Chapters 3 and 9 in the Draft Feasibility Report.

Table 2: Change in depth at residential properties during 1/10 AEP Flood Event

Condition	Residential Properties			
	049-022-007	049-022-009	049-027-004	049-034-005
Existing	0.47	0.1	0.2	0
w/Project	0.85	0.26	0.69	0.22
Depth increase	0.38	0.16	0.49	0.22

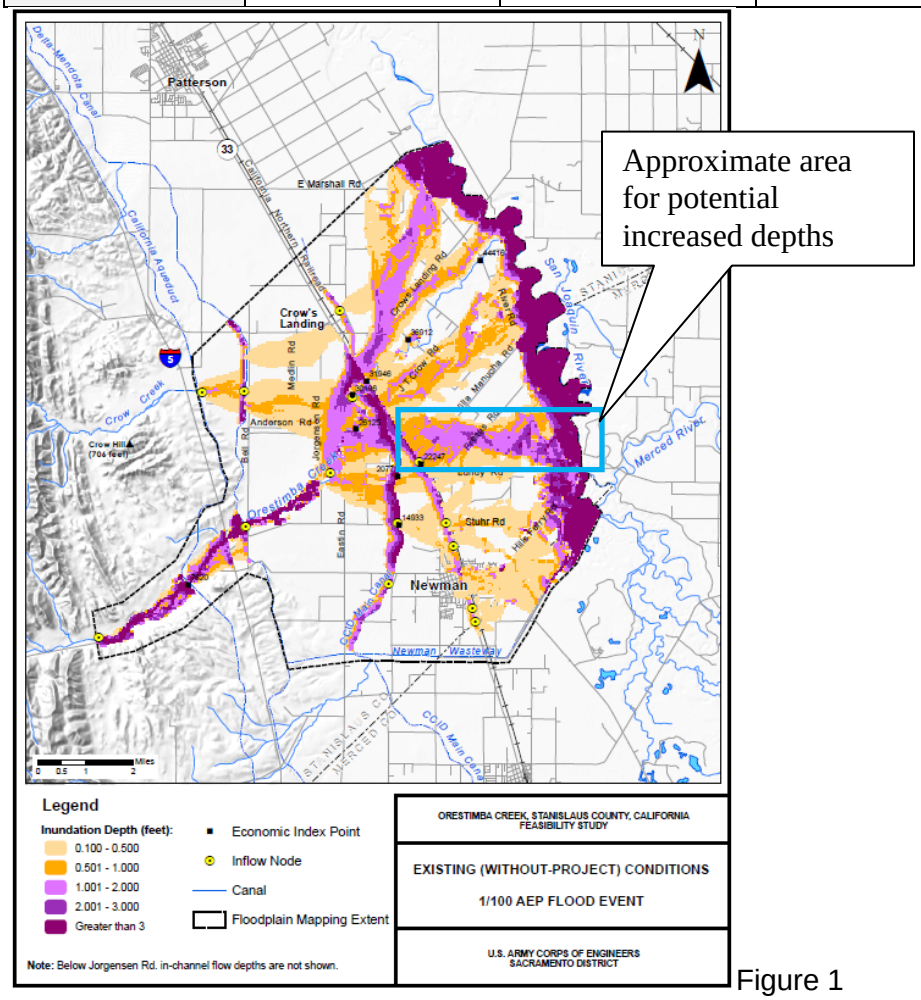


Figure 1

12. COST ESTIMATE

The baseline cost for the chevron levee along the CCID Canal was established by an estimate prepared by the Sacramento District Appraisal Branch, Real Estate Division with a date value of December 7, 2011. The approximate costs by alternative are as follows:

- **Chevron Levee along CCID Canal - Locally Preferred Plan**

Land	Acres	Cost
Lands and Easements	179.23	$864,253
Incremental RE Costs (25% contingency)		$385,000
Improvements to be Acquired (7 Buildings)		$384,417
Facility/Utility Relocations Costs		$5,977,417
Subtotal LERRDs		**$7,611,087**
*Non Federal Administrative Costs		$492,000
Total LERRDs including Administrative Costs		***$8,103,087***
**Federal Administrative Costs (including crediting)		$68,000

***Provided by Sponsor**
****Provided by Sacramento District**

- **Orestimba Creek Channel Modification -** ***No Real Estate Evaluation***

  Although the channel modification appeared to be incrementally justified during the preliminary screening of alternatives, more detailed cost estimates showed the increment to be significantly more costly. Because the channel modifications are a second increment to the project after the chevron levee, the benefits for this increment come from the Rural area and the ability of the modified creek to better contain some of the more frequent event flows which cause more significant flooding under existing conditions. See the Hydraulics Appendix for floodplains and more detailed information about this residual flooding.

  Updated floodplains and economics showed the incremental annual benefits for the channel modifications to be around $700 thousand. Updated (but not completed) costs for the channel modifications were estimated to be around $1.3 million in annual costs ($28 million first costs) on the lower end. These costs are on the low end because they did not yet include environmental mitigation, OMRR&R or real estate costs, which could add another $1 million in annual costs to the increment. Before these additional costs are added to the channel modifications, it has an incremental benefit-to-cost ratio of 0.54 to 1, and thus was dropped from the federal interest as being economically infeasible. Development of more detailed MCACES level costs for this increment was forgone.

13. RELOCATION ASSISTANCE BENEFITS

All real estate acquisition must be performed in accordance with The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended. Building structures are located inside the proposed levee footprint. There would be seven (7) buildings or structures that would be bought out and demolished. Out of the seven (7), there will be one (1) is an owner occupied residence and would qualify for Relocation Assistance. The others are either used for equipment or are houses provided for staff housing. A cost for the buildings was provided in the appraisal and an estimate for the relocation was added into the cost. A relocation report will be produced when the final plan has been selected and the designs have reached 90% completion

14. MINERAL / TIMBER ACTIVITY

There are no identified mineral or timber activities in the project area

15. NON-FEDERAL SPONSOR'S ABILITY TO ACQUIRE

Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **YES**

b. Does the sponsor have the power of eminent domain for this project? **YES**

c. Does the sponsor have "quick-take" authority for this project? **NO**

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? **YES**

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **UNKNOWN, PROJECT INFORMATION AND DETAILS HAVE NOT BEEN RECEIVED, AND THE OWNERSHIP INFORMATION HAS NOT BEEN RESEARCHED.**

16. ZONING ANTICIPATED IN LIEU OF ACQUISITION

N/A

17. ACQUISITION SCHEDULE

The schedule below will be completed once the designs have reached a 90% completion.

REAL ESTATE ACQUISITION SCHEDULE				
Project Name: Orestimba Creek	**COE Start**	**COE Finish**	**NFS Start**	**NFS Finish**
Receipt of preliminary drawings from Engineering/PM	10/17/2011	10/17/2011		
Receipt of final drawings from Engineering/PM				
Execution of PPA				
Formal transmittal of final drawings & instruction to acquire LERRDS				
Conduct landowner meetings				
Prepare/review mapping & legal descriptions				
Obtain/review title evidence				
Obtain/review tract appraisals				
Conduct negotiations				
Perform closing				
Prepare/review condemnations				
Perform condemnations				
Obtain Fee Simple Title				
Complete/review PL 91-646 benefit assistance				
Conduct/review facility and utility relocations.				
Certify all necessary LERRDS are available for construction				
Prepare and submit credit requests (3 months)				
Review/approve or deny credit requests (2 months)				
Establish value for creditable LERRDS in F&A cost accounting system				

18. DESCRIPTION OF FACILITY AND UTILITY RELOCATIONS

For cost-shared projects, the non-federal sponsor has the responsibility to perform or assure the performance of relocations. The term "relocation" generally means providing a functionally equivalent facility to the owner of an existing utility, cemetery, highway, or other eligible public facility, and railroad (excluding existing railroad bridges and approaches thereto) when such action is authorized in accordance with applicable legal principles of just compensation. Providing a functionally equivalent facility may take the form of alteration, lowering, raising, or replacement (and attendant removal) of the affected facility or part thereof.

Utility/Facility Features	Quantities on LPP Plan	Cost on LPP Plan ($)	Cost on NED Plan ($)
MOB/DEMOB & SWPP	1	$204,517	$216,205
Wells/Pumps	10	$557,672	$578,367
Pipes	24	$1,619,728	$1,590,099
Power Poles	55	$1,192,682	$1,231,155
Ditch Along CCID Canal	1	$7,779	$8,068
Culverts for Irrigation Ditches	2	$634,469	$209,812
Culverts along UPP Railroad	10	$201,816	$209,306
HW 33	Elevate 1-2 Feet		$716,554
HW 33	Elevate 4 Feet	$1,250,807	
RR Removal and Replacement	1	$70,443	$73,057
Irrigation Standpipes	6	$94,003	$97,492
Drip Irrigation Sand Filters	2	$143,501	$148,826
Total Costs		**$5,977,417**	**$5,078,941**

- An **Opinion of Compensability** will be completed during the PED phase of the project.

  ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THIS REPORT THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PERFORMED BY THE NON-FEDERAL SPONSOR AS PART OF ITS LERRD RESPONSIBILITIES IS PRELIMINARY ONLY. THE GOVERNMENT WILL MAKE A FINAL DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, OR MAINTENANCE OF THE PROJECT AFTER FURTHER ANALYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILITY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES.

19. HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE IMPACTS / CULTURAL RESOURCES

During the progress of the work no hazardous or toxic materials have been identified at this point in the study, per the requirements of the NEPA document and reported in the Integrated Feasibility & EA/IS document. A complete accounting and description will be accomplished once a final plan has been selected. No significant impacts

Per section 106 of the National Historic Preservation Act (NHPA) (16 U.S.C. § 470 et seq., 36 CFR 800.3) requires a Federal agency to consider the effects of Federal undertakings on historical and archeological resources. A records search was conducted at Central California Information Center (CCIC) at California State University, Stanislaus in Turlock on August 15, 2008 to determine whether additional cultural resource investigations have occurred within the study area since the Corps' initial records search in 2001. It was determined that no additional archaeological investigations have been conducted within the study area since the 2001 Corps' records search. There are no significant impacts to the surrounding farm lands and therefore no mitigation is required for this project, per the Draft Fish and Wildlife Coordination Act Report Orestimba Creek Feasibility Study.

20. ATTITUDE OF LANDOWNERS

During previous public meetings, landowners were supportive of the project. There has been some concern of the additional need for real estate, due to the levee being offset from the canal. Additional concerns are the operations and maintenance procedures of the land between the levee and the canal berm. Meetings have been well attended.

EXHIBIT A – PROJECT MAPS

EXHIBIT B – ASSESSMENT OF NON-FEDERAL PARTNERS REAL ESTATE ACQUISITION CAPABILITY

ORESTIMBA FLOOD CONTROL PROJECT
SPONSOR: State of California
(*Sponsor's answers to Assessment indicated below in BOLD)*

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **Yes**
b. Does the sponsor have the power of eminent domain for this project? **Yes**
c. Does the sponsor have "quick-take" authority for this project? **No**
d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? **Yes**
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **Unknown, project information and details have not been received, and the ownership information has not been researched.**

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? **No**
b. If the answer to II.a. is "yes," has a reasonable plan been developed to provide such training? **N/A**
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **Yes**
d. Is the sponsor's project in-house staffing level sufficient considering its other workload, if any, and the project schedule? **Dependent upon the workload and the resources available at the time this project requests work to be performed.**
e. Can the sponsor obtain contractor support, if required, in a timely fashion? **N/A**
f. Will the sponsor likely request USACE assistance in acquiring real estate? **No**

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? **Yes**
b. Has the sponsor approved the project real estate schedule/milestones? **No, there has been NO information provided on the project, the schedule, etc.**

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? **Unknown**

V. Coordination:

a. Has this assessment been coordinated with the sponsor? **Unknown, DOE-REB has NOT met with the sponsor of this project.**
b. Does the sponsor concur with this assessment? **Unknown, DOE-REB has NOT met with the sponsor of this project.**

NOTE:
The answers are being provided as a courtesy to the Division of Flood Management; however, any and all answers are subject to change due to the fact that the questions were answered with many factors unknown to the Division of Engineering, Real Estate Branch (REB).

The unknown variables, include, but are not limited to, the Project itself (this is the first time REB has heard of this project) , the real property interest requirements necessary for the project, what are the project details, what type of project is this, what type of repair(s) is being proposed, the schedule of the project, is the project area ready for construction, i.e. are there any relocations that have to occur prior to construction commencing, are all of the required environmental documents and consultations complete, and is the area free and clear to commence with the construction.

EXHIBIT C – DRAFT GRANT OF TRAIL EASEMENT

N/A

Prepared by:

_____
Todd Wixom
Realty Specialist

Date _____

Approved by:

_____
Sharon Caine
Division Chief, Real Estate Division, SPK

Date _____

Orestimba Creek Feasibility Study
DRAFT Report

Stanislaus County, California

FLOOD RISK MANAGEMENT PROJECT

APPENDIX E
ECONOMICS

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Economics
Planning Division
Sacramento District

September 2012

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Executive Summary – Economics – Orestimba Creek Feasibility Study

ES.1 Overview

The study area is located in the southwestern portion of Stanislaus County, in what is referred to as the Newman Division by the U.S. Census Bureau (see Figure 1). Orestimba Creek stretches approximately 7.5 within the study after having left the foothills of the Diablo Mountain Range. It is estimated that in the 500-year flood event the floodplain would encompass approximately 20,000 acres, including the City of Newman (see **Error! Reference source not found.**). The City of Newman is the home of approximately 12,321 residents (2010 Census data). The study area is home to some of California's most efficient and important agricultural industries. Tomato and vegetable processing, cheese manufacturing, and turkey hatching are examples of some of the agricultural industries located in the area. The area is acknowledged for crop diversity and productivity, which can be accredited to a combination of exceptional factors such as, soil quality, air quality, climate, and water supply.

The city of Newman has experienced 14 floods in the past 58 years (1954, 1955, 1957-1959, 1963, 1968, 1969, 1978, 1980, 1983, 1986, 1995 and 1998). The major floods occurred in 6 out of the last 14 flooding events (1955, 1958, 1963, 1980, 1983, 1995 and 1998), with 1995 being the flood of record. These floods occurred along Orestimba Creek and affected both rural and urban land uses. The frequency of flooding in and around Newman is similar that which occurs on an average cycle of between 4 to 5 years. These flooding events have affected the same general areas each time except when there was a levee failure or similar occurrence that changed the location of flooding and the type of land uses that were adversely affected.

ES.2 Purpose and Scope of Economic Analysis

The purpose of this report is to present the results of the economic analysis performed for the Feasibility Study of the Orestimba Creek Project. The report documents the existing condition within the study area and proposed alternative plans to improve flood risk management, and designate the National Economic Development (NED) Plan for purposes of estimating federal interest for Orestimba Creek. The report presents findings related to flood risk, potential flood damages and potential flood damage reduction benefits.

This Economic Appendix is intended to:

- Document the current hydrologic data used in the economic analysis for the Orestimba study area under both the without-project and with-project conditions
- Document the current hydraulic floodplains and HEC-FDA hydraulic input data used in the economic analysis for the Orestimba under both the without-project and with-project conditions

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- Document the economic methodologies, major assumptions, models, and data used in the economic analysis for Orestimba under both the without-project and with-project conditions
- Document the economic damage/benefit categories considered in the economic analysis for Orestimba under both the without-project and with-project conditions
- Document the results (detailed HEC-FDA output files and EAD/AEP results) of the HEC-FDA model runs for Orestimba under both the without-project and with-project conditions
- Document the cost estimates used to perform the net benefit and benefit-to-cost analyses
- Describe the approach used to perform the with-project benefits analysis and document the results of the net benefit and benefit-to-cost analyses used to determine plan optimization and feasibility

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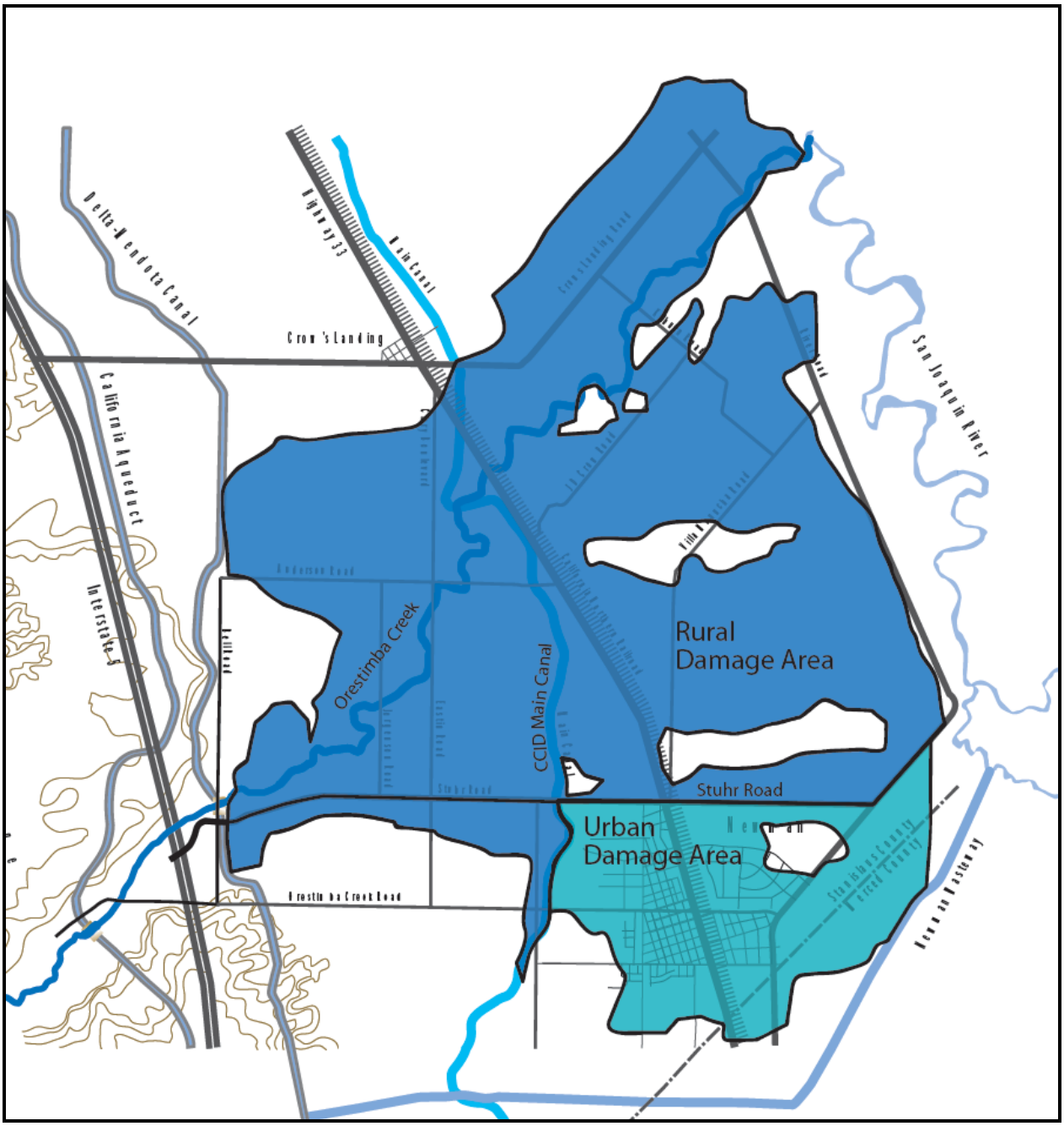
Figure E- 1: Orestimba Study Area and Economic Impact Areas



ES.3 Structural Inventory

The without-project damages and with-project benefits were based on potential damages to residential structures and contents, non-residential (commercial, industrial and public) structures and contents, automobiles, agriculture, cleanup costs and emergency. The study area was

divided into two Economic Impact Areas for purposes of this analysis; Urban and Rural. The delineation of these impact areas can be found in **Error! Reference source not found.**.

There are approximately 1365 structures in the Orestimba study area within the 0.2% (1/500) Annual Chance Exceedance (ACE) floodplain boundary. The 0.2% annual chance floodplain is shown in Figure E- 2. Structure counts are presented in Table E- 1. Total value of damageable property (structures and contents) is displayed in Table E- 2 and is approximately $300 million.

Table E- 1: Structural Inventory
Number of Units within the 0.2% (1/500) Annual Chance Floodplain by Land Use

Economic Impact Area	Residential	Commercial	Industrial	Public	Total
Rural	158	0	0	0	**158**
Urban	1122	62	16	7	**1207**
TOTAL	**1,280**	**62**	**16**	**7**	**1365**

Table E- 2: Value of Damageable Property
Within the 0.2% (1/500) Annual Chance Floodplain
October 2011 Prices ($1,000's)

Land Use	Structural Value		Content Value		TOTAL
	Rural	Urban	Rural	Urban	
Residential	17,706	123,204	8,853	61,602	**$211,365**
Commercial	0	23,732	0	25,030	**$48,763**
Industrial	0	13,593	0	20,014	**$33,607**
Public	0	4,541	0	2,123	**$6,664**
TOTAL	**$17,706**	**$165,070**	**$8,853**	**$108,769**	**$300,398**

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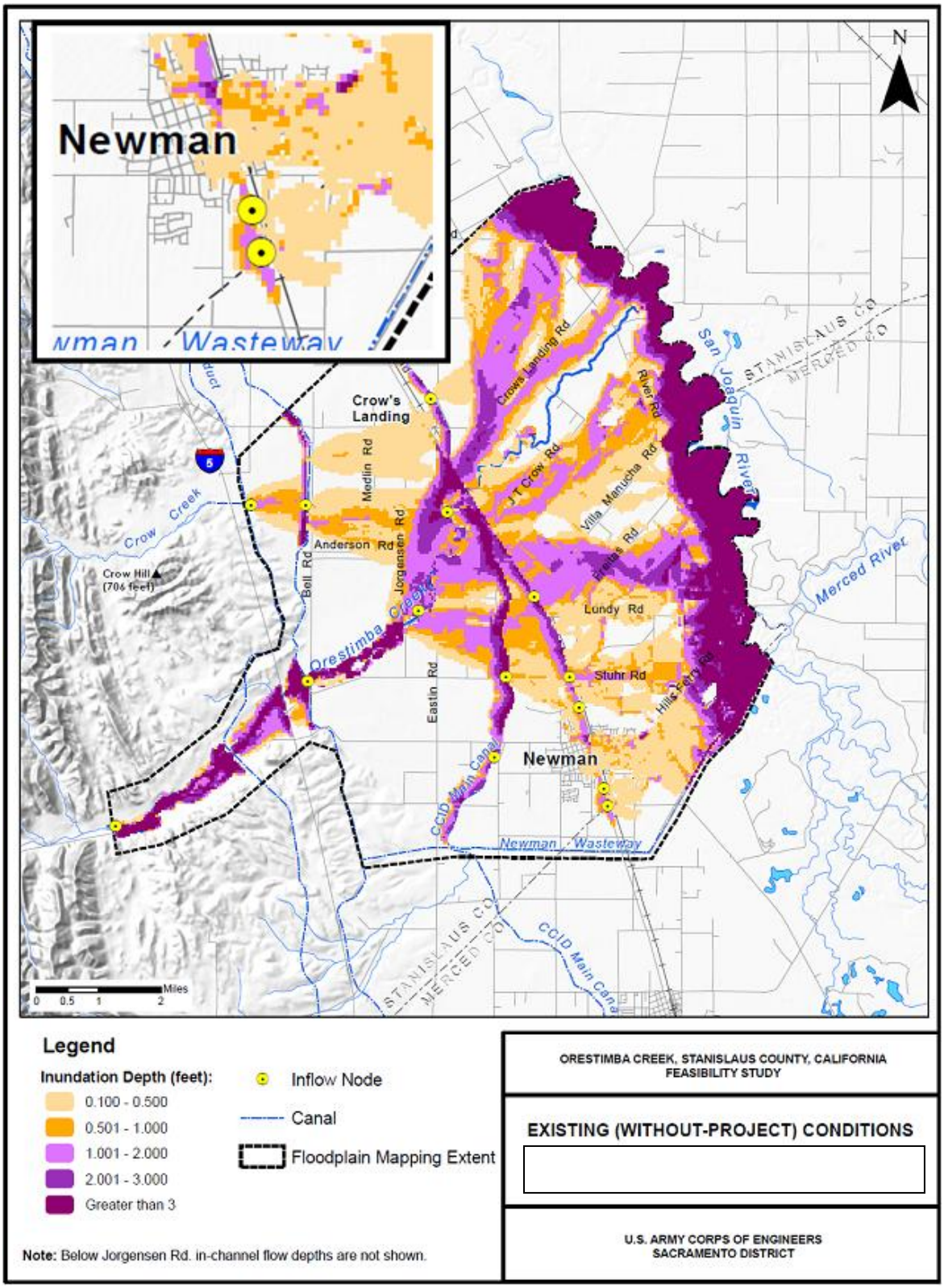
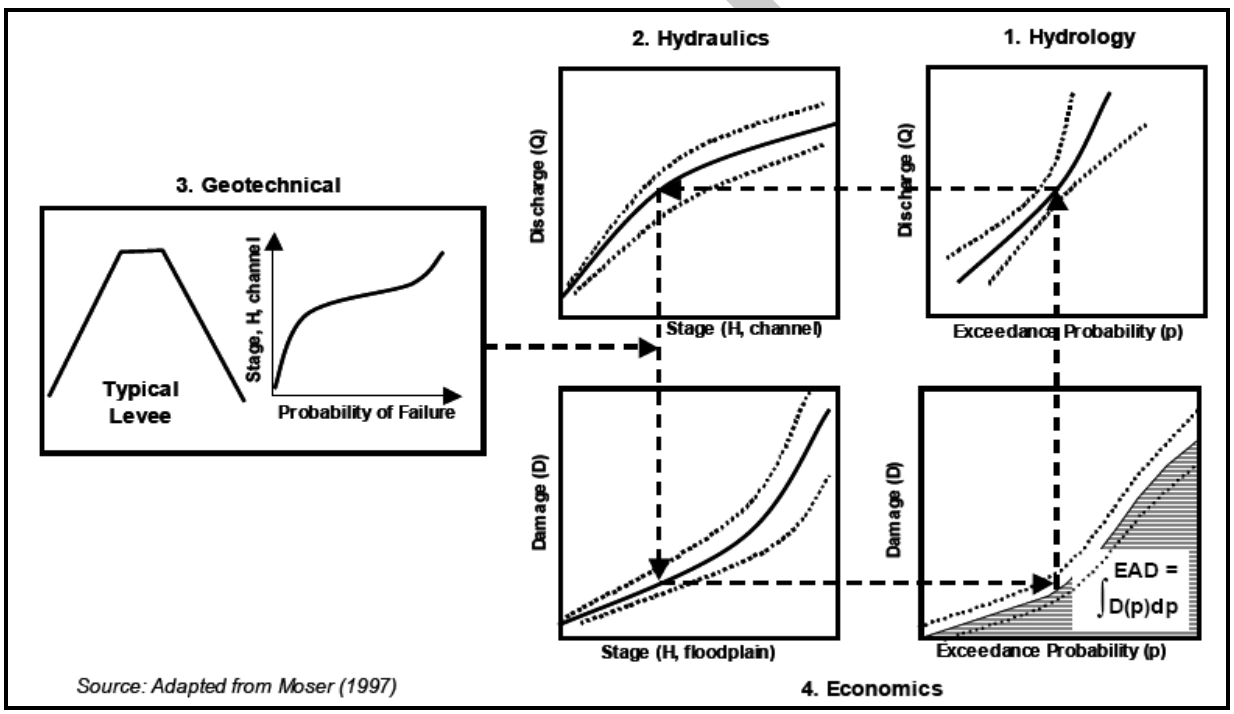
Figure E- 2: Existing Condition 0.2% (1/500) Annual Chance Floodplain



ES.4 Without Project Damages

To find the damage for any given flood frequency, the discharge for that frequency is first located in the discharge-frequency graph (graph #1), then the river channel stage associated with that discharge value is determined in the stage-discharge graph (graph #2). Once the levees fail and water enters the floodplain, the stages (water depths) in the floodplain inundate structures and cause damage (graph #4, left side). By plotting this damage and repeating for process many times, the damage-frequency curve is determined (graph #4, right side). EAD is then computed by finding the area under the flood damage-frequency curve by integration for the without, interim, and with project conditions. Reductions in EAD attributable to projects are flood reduction benefits. Uncertainties are present for each of the functions discussed above and these are carried forth from one graph to the next, ultimately accumulating in the EAD. These uncertainties are shown in Figure E- 3 as "error bands" located above and below the hydrologic, hydraulic and economics curves.

Figure E- 3: Uncertainty in Discharge, Stage and Damage in Determination of Expected Annual Damages



Single-event damages for the 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% ACE event flood events were computed in the economic model (HEC-FDA v1.2.5a) and are presented in Table E- 3. These results represent probability damages prior to the application of economic uncertainty parameters.

Table E- 3: Without Project Probability-Stage-Damage Functions – by Economic Impact Area (EIA)
October 2011 Prices ($1,000's)

Damage Category	Annual Chance Exceedance Probability of Event and Damages															
	99% (1/1)		20% (1/5)		10% (1/10)		5% (1/20)		2% (1/50)		1% (1/100)		0.5% (1/200)		0.2% (1/500)	
EIA	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
AUTO	$0	$0	$0	$101	$71	$170	$100	$210	$114	$266	$150	$301	$169	$339	$189	$392
Clean	$0	$0	$0	$66	$1,134	$132	$1,752	$167	$1,914	$200	$2,065	$229	$2,115	$251	$2,180	$281
Emergency	$0	$0	$0	$386	$364	$531	$930	$602	$1,101	$687	$1,416	$765	$1,521	$847	$1,627	$927
Commercial	$0	$0	$39	$0	$2,266	$0	$3,210	$0	$3,386	$0	$3,699	$0	$3,798	$0	$3,919	$0
Industrial	$0	$0	$0	$0	$2,232	$0	$2,414	$0	$2,476	$0	$2,547	$0	$2,586	$0	$2,685	$0
Public	$0	$0	$0	$0	$78	$0	$142	$0	$151	$0	$177	$0	$182	$0	$189	$0
Residential	$0	$0	$43	$782	$5,115	$1,798	$12,001	$2,381	$13,818	$3,001	$15,952	$3,511	$16,589	$3,967	$17,334	$4,583
Agricultural	$0	$0	$0	$3,190	$0	$5,877	$0	$7,377	$0	$8,698	$0	$9,539	$0	$10,267	$0	$11,025
Subtotals	***$0***	***$0***	***$82***	***$4,525***	***$11,260***	***$8,508***	***$20,549***	***$10,737***	***$22,960***	***$12,853***	***$26,005***	***$14,346***	***$26,959***	***$15,670***	***$28,124***	***$17,207***
TOTAL	**$0**		**$4,607**		**$19,767**		**$31,286**		**$35,813**		**$40,351**		**$42,630**		**$45,332**	

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The HEC-FDA model results (Expected Annual Damages) for contents, structures, automobiles, cleanup costs and emergency costs for each economic impact area (EIA) under the without project condition from are found in Table E- 4. Total study area without project expected annual damages are equal to approximately $5.4 million.

Table E- 4: Expected Annual Damages - Without Project Conditions October 2011 Prices ($1,000's)

Damage Category	EAD by Impact Area		TOTAL
	Rural	Urban	
Agriculture	$1,381	$0	**$1,381**
Auto	$61	$50	**$111**
Cleanup	$37	$183	**$220**
Emergency	$148	$194	**$341**
Commercial	$0	$520	**$520**
Industrial	$0	$417	**$417**
Public	$0	$33	**$33**
Residential	$657	$1,733	**$2,389**
TOTAL	**$2,284**	**$3,130**	**$5,413**

ES.5 With-Project Damages and Benefits

This section will describe how benefits of flood damage reduction of the final array of alternatives were estimated. Non-monetary outputs such as environmental measures, which may vary for the final array of alternatives, are not included but may factor in the plan formulation decision process.

Benefits were determined by incorporating residual with-project floodplains and rating curves into the FDA model that represent various with project improvements. Flood risk management benefits equal the difference between the without project damage conditions and the with-project residual damages.

The reduction in project flood plains in both extent and depth from the larger without project flood plains accounts for the decrease in damages of the given alternative.

<u>Optimization of Chevron Levee Height</u>

The chevron levee height was optimized by inserting incrementally higher levees into HEC-FDA and comparing the increased benefits to the estimated incremental costs. Costs were estimated by Cost Engineering for a levee equal to the mean 2% (1/50) WSEL and the mean 0.5% (1/200) WSEL + 3ft. These two values were then used to create a linear interpolation between the two points in order to estimate the cost of incrementally higher levees. These costs include only

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those costs that are variable depending on the height of the levee (mostly fill material). The index point used for this height optimization was at the Stuhr Rd. and CCID canal intersection, so the benefits here appear higher than those reported in the without project chapter of this report. The optimization of the levee height must use an index point at a location where the levee would be located to come up with a proper levee elevation. The particular index point location for the optimization was chosen because it was the first point that flooding overtopped the existing CCID canal (near Stuhr Rd), which is adjacent to the chevron levee's location. This was the original location for the economic evaluation as well, but the index was changed later based on rating curve sensitivity for high probability events (see section 5.5 of the main Economic Appendix) and likely overestimation of EAD. Because the CCID Canal location and the eventual urban economic analysis index location (intersection of Lundy Rd. and the Railroad) have rating curves with nearly identical slopes for lower probability events (2% (1/50) annual chance event and above), the difference in an optimization height was assumed negligible. To confirm this assumption, a sensitivity analysis was performed using the Lundy Rd. index location and the optimal heights were found to be within 0.2 ft of each other and well within error bands in stage/ground elevations. The final benefits used for economic justification will be based on the without project conditions as summarized in Table E- 6. In addition, costs reported here do not reflect Total Project First Costs; instead these costs represent only those variable costs in relation to levee height. Total Project First Costs can be found in Table E- 10. This analysis is solely used for optimization of the levee height in order for costs and residual benefits to be determined in more detail on only one plan. As shown in Table E- 5 below, the optimal elevation for the top of levee at this index point is determined to be around 112.75 feet, which equates to a levee 5.5 to 8 feet tall depending on the ground elevation changes along the levee alignment. It is noted here that this height is higher than the mean 0.2% (1/500) WSEL, but because of the alluvial fan type of flooding, the mean 0.2% (1/500) WSEL is only 9 inches higher than the mean 2% (1/50) mean WSEL.

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Table E- 5: Optimization of the Chevron Levee Height at Stuhr Rd and CCID Canal Crossing

Return Period	Levee Elevation (ft.)	*Annual Benefits ($1,000's)	*Annual Costs ($1,000's)	*Net Benefits ($1,000's)
1/50	111.21	6,079	749	5,330
	111.25	6,188	753	5,435
	111.5	6,412	777	5,636
	111.75	6,612	800	5,812
1/500	112	6,785	823	5,962
	112.25	6,910	847	6,063
	112.5	6,990	870	6,120
	112.75	**7,035**	**893**	**6,142**
	113	7,056	917	6,139
	113.25	7,064	940	6,124
	113.5	7,066	964	6,103
	113.75	7,067	987	6,080
	114	7,067	1,010	6,057
	114.25	7,067	1,034	6,034
1/200+3ft	114.8	7,067	1,085	5,982

** The Benefits and Costs shown here are different than those presented in Chapter 3 of the main report, because these show the actual values used for the sensitivity, while the main report has adjusted those values to reflect total project benefits and costs. Annual Benefits, Annual Costs and Net Benefits shown here do not reflect actual benefits and total costs used for final net benefit and BCR calculations. The index point used for this height optimization exercise is different from the one used for economic justification. Benefits and costs used for economic justification can be found in Table E- 10. More information about different index points and the effect on damages in this study area is available upon request.*

Sensitivity analysis was performed on other index locations along the levee alignment and the results were within 0.2ft, which is well within the error bands of the ground elevations. The optimized height is approximately 1.5ft above the existing 2% (1/50) WSEL, which is reasonable for an alluvial fan floodplain given uncertainty in ground elevations and stages.

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The Final Array of Alternatives

The final array of alternatives is listed below. See the main report for a detailed description of all other alternatives that were evaluated and screened out during the plan formulation process.

1. No Action Plan
2. Chevron Levee: Chevron levee at optimized height. (TOL elevation of 112.75 feet)
3. Local Plan: Chevron Levee set at a height equal to the mean 0.5% (1/200) WSEL + 3 Feet. (TOL elevation of 114.8 feet)[1].

A map showing the locations for the chevron levee is shown in Figure E- 4 below. For a more detailed description of these alternatives, please see the main report.

Annual Benefits

The mean annual benefits for the final 3 alternatives can be found in Table E- 6 below. Note that there is no incremental benefit for the Local Plan because the incrementally higher levee height does not provide an additional measurable benefit to the city of Newman and is mainly just to comply with State of California requirements.

Residual Damage in the Urban EIA with the Chevron Levee in place consist of existing storm drainage damages caused by rain events above a 10% annual chance frequency.

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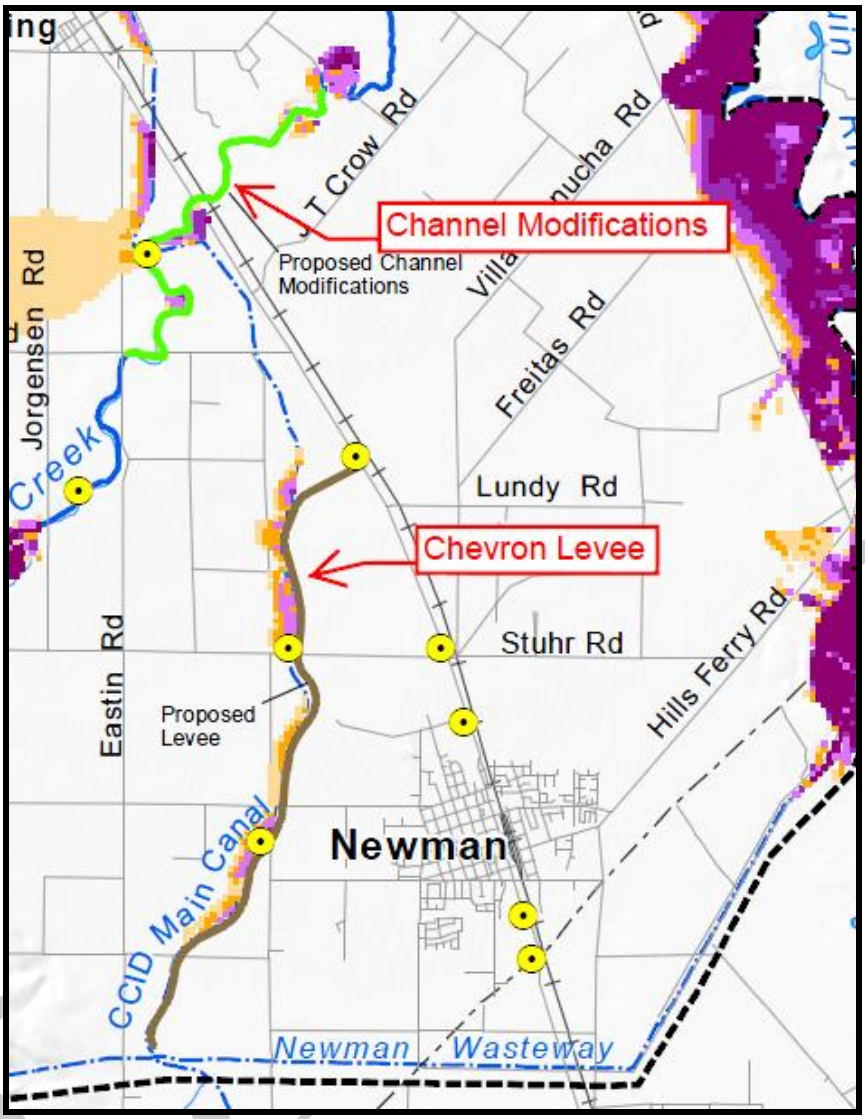
[1] Senate Bill 5 (SB-5) in the State of California requires that levee's be built to the mean 0.5% (1/200) annual chance exceedance event WSEL in order to qualify for state participation.

Figure E- 4: Location of the Chevron Levee



**Note: The Channel Modifications increment was screened out prior to the final array of alternatives. See the main report for more detail.*

Table E- 6: Annual Benefits – The Final Array – TOTAL Study Area
October 2011 Prices ($1,000's), 4% Interest Rate

Alternative	Annual Damages	Annual Benefits	Incremental Benefits
1. No Action	5,413	0	0
2. Chevron Levee at 112.75ft	2,285	3,128	3,128
3. Chevron Levee at 114.8ft	2,285	3,128	0

Probability Distribution of Damages Reduced

In accordance with ER 1105-2-101, flood damages reduced were determined as mean values and by probability exceeded. The tables below show the benefits for each alternative for the 75%, 50% and 25% probability that benefit exceeds indicated value. The damage reduced column represents the mean benefits for each increment and the 75%, 50% and 25% represent the probability that the flood damage reduction benefits exceed the number in that column for that increment. For example, Alternative 2, the Chevron Levee, has an average (mean) benefit of $3.1 million, but a 50% chance that benefits will be greater than $$2.7 million, 75% confidence that benefits will be equal or greater than $1.3 million and 25% confidence that benefits will exceed $4.4 million. This range is the probability distribution of damages reduced and represents the uncertainty in the benefit estimates and incorporates all the uncertainties in hydrology, hydraulics, and economics in the HEC-FDA model. The uncertainty in damages reduced should be considered when selecting an optimal plan during the plan formulation process. Judgment should be used to determine if an alternative meets a reasonable level of confidence regarding positive net benefits and identifying if changes in net benefits from alternative to alternative are significant.

Table E- 7: Probability Distribution of Damages Reduced – TOTAL Study Area October 2011 Prices ($1,000's), 4% Interest Rate

Alternative	Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
	Without Project	With Project	Damage Reduced	75%	50%	25%
1. No Action	5,413	5,413	0	0	0	0
2. Chevron Levee at 112.75ft	5,413	2,285	3,128	1,282	2,679	4,363
3. Chevron Levee at 114.8ft	5,413	2,285	3,128	1,282	2,679	4,363

ES.6 Project Performance

In addition to damages estimates, HEC-FDA reports flood risk in terms of project performance. Three statistical measures are provided, in accordance with ER 1105-2-101, to describe performance risk in probabilistic terms. These include annual exceedance probability, long-term risk, and assurance by event.

- Annual exceedance probability measures the chance of having a damaging flood in any given year.

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- Long-term risk provides the probability of having one or more damaging floods over a period of time.
- Assurance is the probability that a target stage will not be exceeded during the occurrence of a specified flood.

Project performance statistics for each impact area is displayed by impact area for both without and with project conditions in the tables below.

Table E- 8: Project Performance – With Project Conditions – Rural EIA

Alternative	Annual Exceedance Probability		Long-Term Risk			Assurance by Events			
	Median	Expected	10 Year Period	30 Year Period	50 Year Period	10%	2%	1%	0.20%
1. No Action	24.31%	24.22%	94%	99%	99%	6%	2%	1%	1%
2. Chevron Levee at 112.75ft	24.31%	24.22%	94%	99%	99%	6%	2%	1%	1%
3. Chevron Levee at 114.8ft	24.31%	24.22%	94%	99%	99%	6%	2%	1%	1%

Table E- 9: Project Performance – With Project Conditions – Urban EIA

Alternative	Annual Exceedance Probability		Long-Term Risk			Assurance by Events			
	Median	Expected	10 Year Period	30 Year Period	50 Year Period	10%	2%	1%	0.20%
1. No Action	14.43%	15.13%	81%	98%	99%	13%	0%	0%	0%
2. Chevron Levee at 112.75ft	0.01%	0.04%	0%	1%	2%	99%	99%	99%	98%
3. Chevron Levee at 114.8ft	0.00%	0.00%	0%	0%	0%	99%	99%	99%	99%

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ES.7 Net Benefit Analysis

With benefits calculations complete, annual costs need to be derived to complete the benefit cost analysis. Economic feasibility and project efficiency are determined through benefit cost analysis. For a project or increment to be feasible, benefits must exceed costs and the most efficient alternative is the one that maximizes net benefits (annual benefits minus annual costs).

The NED Plan

With the Channel Modifications increment dropping from the Federal Interest, the optimized Chevron Levee becomes the NED Plan.

The Tentatively Recommended Plan

The only difference between the Tentatively Recommended Plan and the NED Plan is the height of the chevron levee. The height of the chevron levee for the local plan must meet State of California requirements of being at least 3 feet above the with-project 200 year mean WSEL. This means a levee that is about 7.5 to 10 feet tall or approximately 2 feet taller than the federal interest levee.

Benefits and Costs

A more rigorous and detailed MCACES cost estimate was performed for the NED Chevron Levee and the LPP (Alternatives 2 and 3 respectively). Benefits and costs for these alternatives are provided in Table E- 10 below.

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Table E- 10: Total Annual Benefits and Costs by Alternative
October 2011 Prices ($1,000's), 4% Interest Rate
Based on a 50-year Period of Analysis

ITEM	FRM Costs/Benefits	
	Tentative NED Plan (Alt 2)	Tentatively Recommended Plan (Alt 3)
Investment Costs:		
First Costs	35,219	44,056
Less Cult Res	(281)	(353)
Less Sunk PED costs	0	0
Interest During Construction	2,141	2,679
Total	***37,079***	***46,382***
Annual Cost:		
Interest and Amortization	1,726	2,159
OMRR&R	164	180
Subtotal	***1,890***	***2,339***
Annual Benefits:	***3,128***	***3,128***
Net Annual FRM Benefits	***1,238***	***789***
FRM Benefit-Cost Ratio	***1.66***	***1.34***

ES.8 Conclusions

The NED Plan is Alternative 2, the stand-alone Chevron Levee at the optimized elevation of 112.75 feet. The NED and it has an annual net benefit of $1.2 million and a BCR of 1.6. The Tentatively Recommended Plan is Alternative 3, the stand-alone Chevron Levee at an elevation of 114.8ft. The Recommended Plan has net annual benefits of $0.8 million and a BCR of 1.3.

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ORESTIMBA CREEK PROJECT, CALIFORNIA
FEASIBILITY STUDY AND REPORT
ECONOMICS APPENDIX
APPENDIX E
Draft Report
August 2012

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1.0 Introduction

1.1 Purpose and Scope

The purpose of this report is to present the results of the economic analysis performed for the Feasibility Study of the Orestimba Creek Project. The report documents the existing condition within the study area and proposed alternative plans to improve flood risk management, and designate the National Economic Development (NED) Plan for purposes of estimating federal interest for Orestimba Creek. The report presents findings related to flood risk, potential flood damages and potential flood damage reduction benefits.

1.2 Study Area

The study area is located in the southwestern portion of Stanislaus County, in what is referred to as the Newman Division by the U.S. Census Bureau (see, Figure 1). Orestimba Creek stretches approximately 7.5 within the study after having left the foothills of the Diablo Mountain Range. It is estimated that in the 500-year flood event the floodplain would encompass approximately 20,000 acres, including the City of Newman (see Figure 2-1). The City of Newman is the home of approximately 12,321 residents (2010 Census data). Newman is home to the world's first school bus company and along with the surrounding area, it is home to some of California's most efficient and important agricultural industries. Tomato and vegetable processing, cheese manufacturing, and turkey hatching are examples of some of the agricultural industries located in the area. The area is acknowledged for crop diversity and productivity, which can be accredited to a combination of exceptional factors such as, soil quality, air quality, climate, and water supply.

1.3 History of Flooding

The city of Newman has experienced 14 floods in the past 58 years (1954, 1955, 1957-1959, 1963, 1968, 1969, 1978, 1980, 1983, 1986, 1995 and 1998). The major floods occurred in 6 out of the last 14 flooding events (1955, 1958, 1963, 1980, 1983, 1995 and 1998). These floods occurred along Orestimba Creek and affected both rural and urban land uses. The frequency of flooding in and around Newman is similar that which occurs on an average cycle of between 4 to 5 years. These flooding events have affected the same general areas each time except when there was a levee failure or similar occurrence that changed the location of flooding and the type of land uses that were adversely affected. The following flooding summary descriptions focus on the seven largest major flooding events.

In 1955, floodwaters inundated agricultural, residential, and commercial properties; caused breaks in the DMC; washed out public streets and culverts; inundated and closed public streets in many areas; and washed out the Southern Pacific Railroad ballast and ties.

The April 1958 flood damaged agricultural lands and public facilities in the Orestimba Creek basin. Some residents were forced to evacuate their homes. Subsequently, in the 1959 flood,

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Orestimba Creek floodwaters eroded the west embankment of the Anderson Road bridge causing it to drop 2 feet in elevation and create several cracks in the bridge.

In early February 1963, about 6 inches of rainfall over the Orestimba Creek basin caused both flooding and one of the largest peak flows of record. About 2,000 acres located 4 to 5 miles north of Newman were inundated by shallow floodwaters. Agricultural lands experienced soil erosion and silt deposition. The DMC siphon and access ramps to both road and railroad bridges were eroded to an extent that required repair. These floodwaters left debris that had to be removed.

Extensive rainfall in January 1969 caused the flooding of nearly 2,000 acres. Flood damages occurred primarily on agricultural lands and consisted of erosion of agricultural soils, deposition of sediment, and prolonged field inundation which adversely affected area walnut orchards.

In March 1995, Newman experienced the worst flood in the city's 107 year history. During the storm, the valley floor received between 2.5 and 4.0 inches of rain within 24-hours and more intense rainfall in the foothills. On March 10, 1995, the USGS gauging station located upstream from the California Aqueduct siphon registered a peak flow of 12,000 cfs. A convalescent hospital located on the north side of the city was entirely inundated by 2 feet of water in the building and 4 feet of water in the parking lot. Sixty-five residents were evacuated by a Medi-Flight helicopter after a failed attempt to use two ambulances and a school bus. Expansive areas of agricultural cropland were inundated by floodwaters. Additionally, a bean crop storage facility located just north of the city experienced extensive flooding affecting land and property forced the business into bankruptcy shortly after the flood. A neighboring agricultural packing facility also experienced flooding.

During the 1995 flood event, many public streets and highways, including State Highway 33, were closed. These road closures limited or, in some cases, prevented access for emergency vehicles which resulted in diminished local and regional emergency response capabilities. Similar public health risks caused by area flooding included floodwater affected domestic water wells and individual septic systems, many of which were rendered unusable.

In 1995, the city of Newman incurred *reported* flood damages of $7.8 million dollars (2011 prices). Additionally, a bean crop storage facility located just north of the city experienced extensive flooding affecting land and property that loss of $465,000 dollars and was forced the business into bankruptcy shortly after the flood. This facility closure resulted in lost wages and income for 14 employees and 20 to 25 local growers. Another agricultural packing facility experienced $400,000 dollars in losses. Many public streets and highways including State Highway 33 were closed that limited or prevented access for emergency vehicles resulting in diminished emergency response capabilities. Flooding that affected domestic water wells and septic systems rendering many unusable also increased public health risks.

Actual damages incurred from the 1998 flood are not known.

The actual monetary cost of flood damages incurred by private property owners in West Stanislaus County during the most recent floods of record are difficult to fully assess. There are

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few written records on historical floods in the cities of Patterson and Newman and in the predominantly agricultural lands of Stanislaus County. Property owners have taken care of their own flood damages without assistance from the Federal Emergency Management Agency. Therefore, the historical record is not a good reference point for baseline economic damages. Due to the relatively shallow depths of flooding, sandbagging and other flood-fighting methods have also helped to truncate damages incurred.

1.4 Methodology (References and Methods Cited)

This economic analysis is in accordance with standards, procedures, and guidance of the U.S. Army Corps of Engineers. The Planning Guidance Notebook (ER 1105-2-100, April 2000) serves as the primary source for evaluation methods of flood risk management studies and was used as reference for this analysis. Additional guidance for risk-based analysis was obtained from EM 1110-2-1619, *Engineering and Design – Risk-Based Analysis for Flood Damage Reduction Studies (August 1996)* and ER 1105-2-101, *Planning Risk-Based Analysis of Hydrology/Hydraulics, Geotechnical Stability, and Economics in Flood Damage Reduction Studies (March 1996)*. Economic evaluation was performed over a 50-year period of analysis. All values are presented in October 2011 price levels, and amortization calculations are based on the Fiscal Year 2012 federal discount rate of 4.0 percent as published in Corps of Engineers Economic Guidance Memorandum (EGM).

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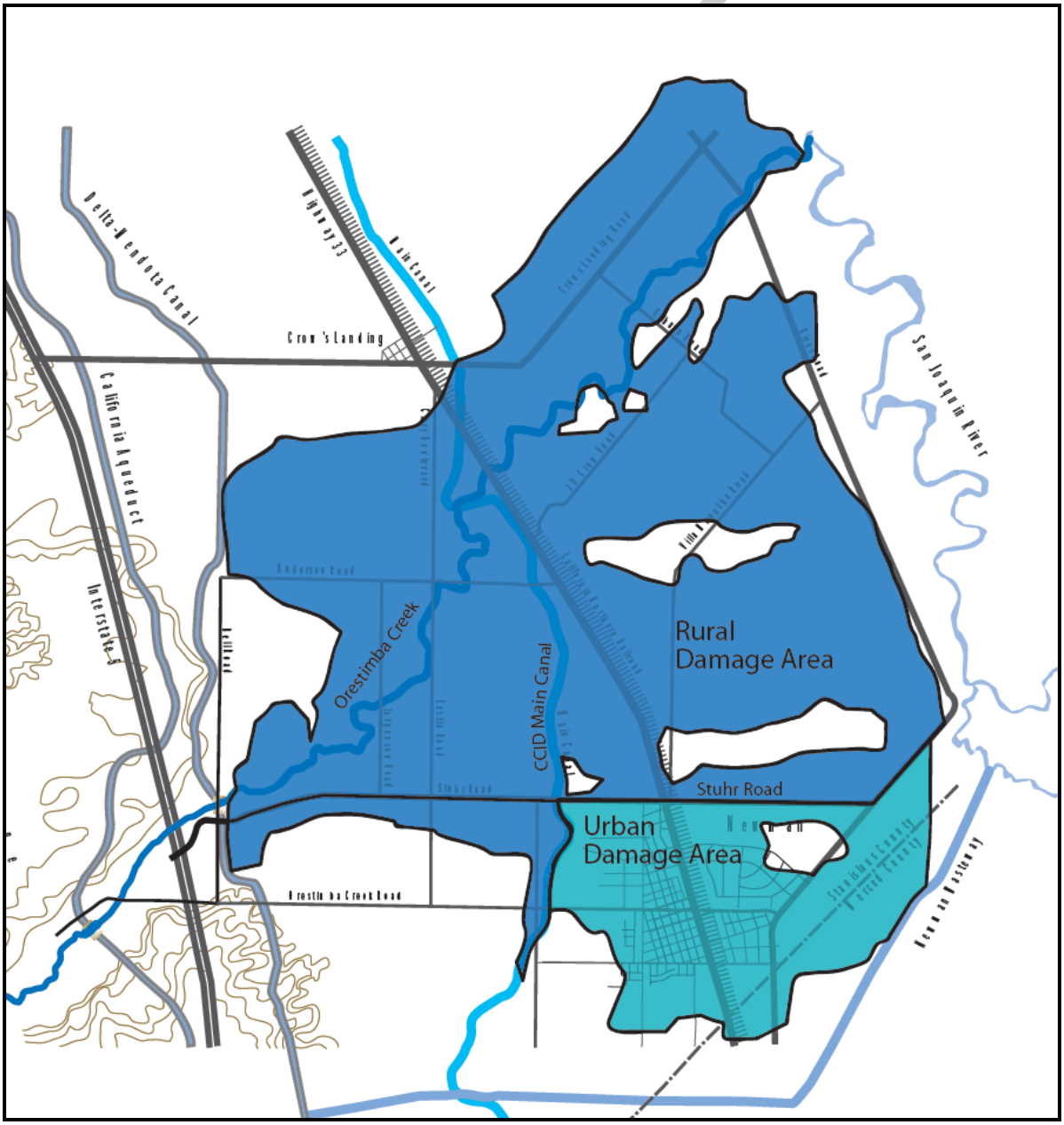
2.0 Flood Plain Area and Inventory

2.1 Economic Impact Areas

For economic evaluation and project performance purposes, the study area was divided into two economic impact areas. Delineation was made to address differences in economic conditions and inventory type within the floodplain. A map showing the two impact areas (Rural and Urban) is shown in Figure 2-1.

Figure 2-1: Orestimba Creek Economic Impact Areas



2.2 Inventory of Structures and Property in Study Area

A structural inventory was completed based on data gathered from assessor's parcel data and on-site inspection of structures within the flood plain. Structures were determined to be within the economic study area by using Geographical Information Systems (GIS) to compare the 0.2% (1/500) ACE flood plain boundary (plus a buffer) with the spatially referenced assessor parcel numbers (APN). Information from the assessor's parcel database (such as land use, building square footage, address) was supplemented during field visitation for each parcel within the flood plain by adding fields for foundation height, specific business activity (non-residential), building condition, type of construction, and number of units for example. Windshield survey field observation conducted on 100% of non-residential structures within 0.2% (1/500) ACE floodplain. Residential structures were sampled and grouped geographically by areas of homogeneous characteristics. Where square footage data was not available, the Google Earth measuring tool was used to estimate square footage. Parcels with structures, were categorized by land use and grouped into the following structural damage categories:

1) **Single Family Residential** – includes all parcels represented by a single unit such as detached single family homes, individually owned condominiums and townhouses.
2) **Multiple Family Residential** – includes residential parcels with more than one unit such as apartment complexes, duplexes and quadplex units. Each parcel may have multiple structures.
3) **Commercial** – includes retail, office buildings, restaurants
4) **Industrial** – includes warehouses, light and heavy manufacturing facilities.
5) **Public** – includes both public and semi-public uses such as post office, fire dept, government buildings, schools and churches.
6) **Agriculture** – Agricultural inventory was developed in a separate analysis. Please see Attachment B for a detailed writeup of this analysis.

All parcels with structures were assigned to one of the listed categories. Some parcels have more than one physical structure and some structures, such as condominiums, are represented by multiple parcels. Table 2-1 displays the total number of structures within the 0.2% (1/500) ACE floodplain by category. Single family and Multi-family have been grouped together as "Residential" for presentation purposes.

Table 2-1: Structural Inventory
Number of Units within the 0.2% (1/500) Annual Chance Floodplain by Land Use

Economic Impact Area	Residential	Commercial	Industrial	Public	Total
Rural	158	0	0	0	**158**
Urban	1122	62	16	7	**1207**
TOTAL	**1,280**	**62**	**16**	**7**	**1365**

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At the time of this writing, much of the planned development in Newman has stopped due to the economic downturn. It is not known at this time when/if this development may pick up again. Most development is taking place on the southwest and northeast side of Newman and would not fall within the current 0.2% (1/500) ACE floodplain. If any inventory were to be developed within existing floodplains in the future, only damages relating to events less frequent than the 1% (1/100) annual chance event would be counted, as it would be assumed that the structures were built with foundation heights above the water surface elevation for the 1% annual chance event. Any resulting damages would likely have minimal impact on the overall project damages. Therefore, the future condition is assumed to be the same as existing condition for purposes of this analysis.

Floodplain maps showing the existing condition 10% annual chance and 0.2% annual chance events are show in the figures below.

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Figure 2-2: Orestimba Creek Existing Condition Floodplain - 10% (1/10) Annual Chance Event

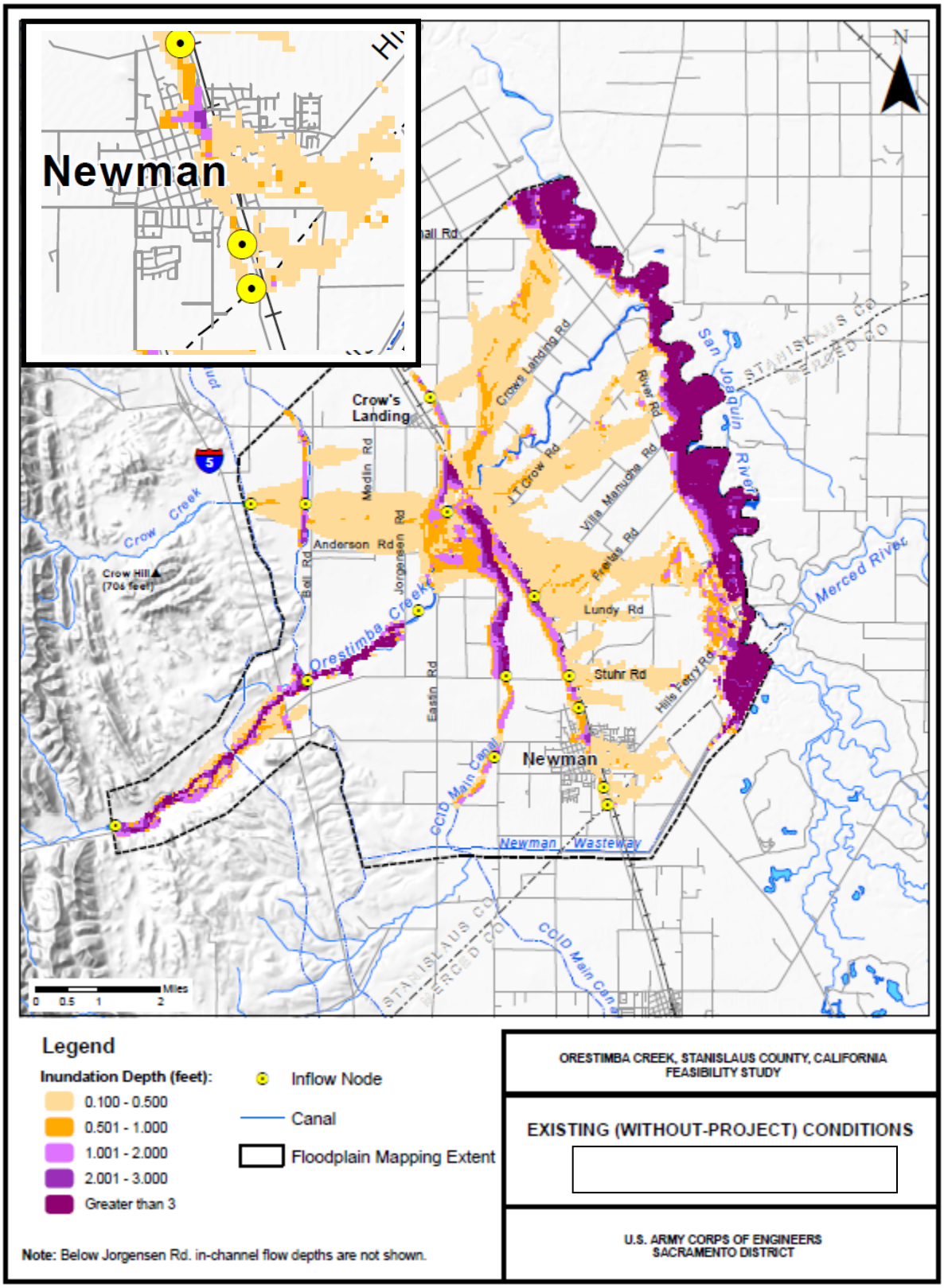
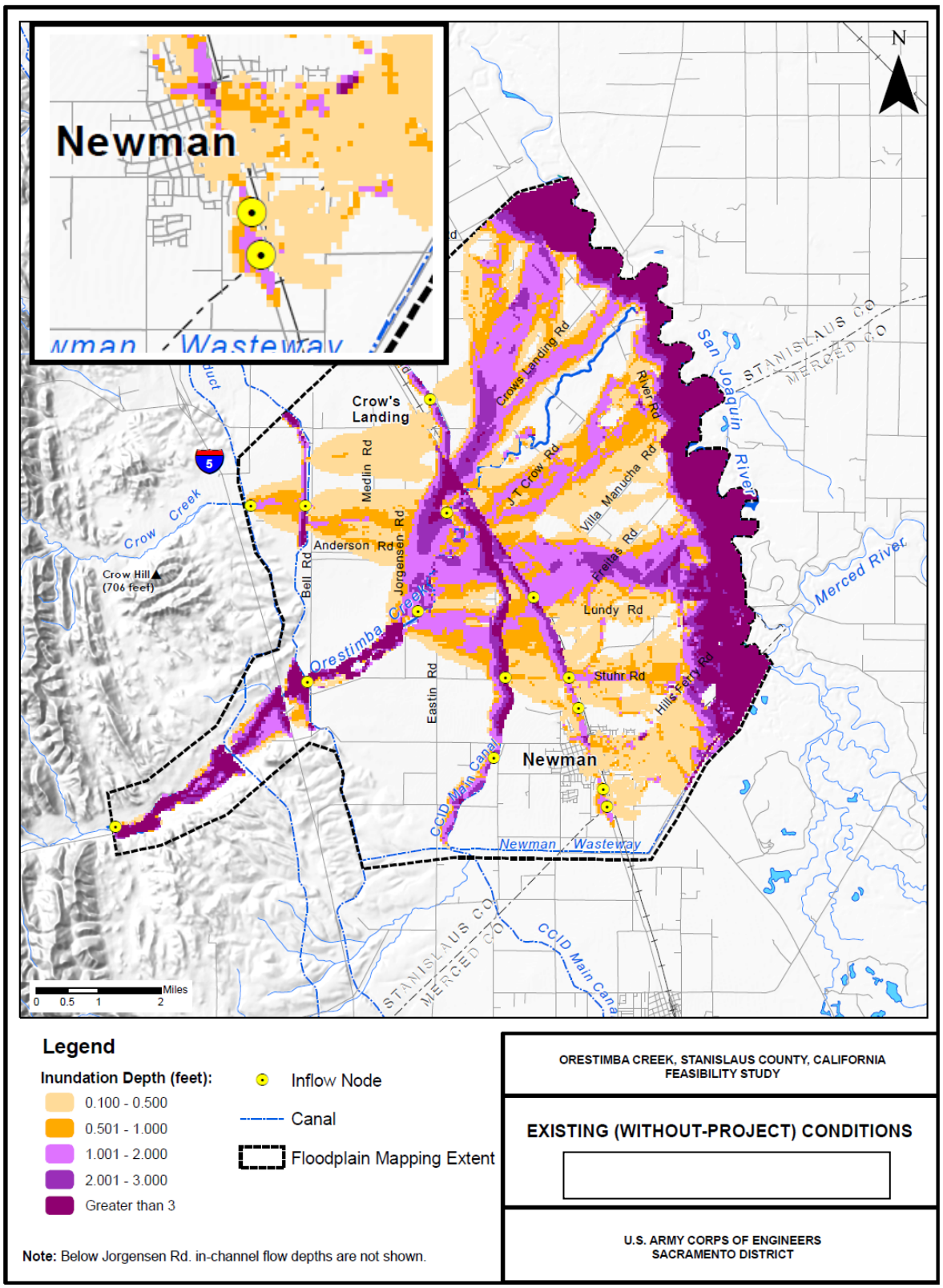


Figure 2-3: Orestimba Creek Existing Condition Floodplain – 0.2% (1/500) Annual Chance Event



2.3 Value of Damageable Property- Structure Value

For the structural inventory, the value of property at risk was estimated based on depreciated replacement values. Value of structure was determined based on the following function:

Depreciated Replacement Value =
(1) Square Footage of Structure X (2) Cost per Square Foot X
(3) Remaining Value (100% minus estimated depreciation percentage)

Note that this value accounts for the depreciated replacement cost of the structure. Evaluation of Corps flood damage reduction projects, require that structures be valued using replacement costs minus depreciation. These values may differ from assessed values, sales or market values, reproduction costs or values determined by income capitalization. Depreciated replacement cost does not include land values and market prices (which include land value) or sale price for homes and commercial property would be higher than the value of the depreciated structure alone.

Structures were valued using Marshall and Swift construction factors ($/sq ft). Each structure was categorized by specific value type (i.e. Dentist Office, Church, Elementary School, SFR, etc.) and then assigned a corresponding $/sq ft for that type of structure. This value was then updated to October 2011 price level using a current cost multiplier (CCM) for the general region (i.e. Western US) and then by local multiplier (LM) to adjust for more specific costs in the local area (in this case Modesto was used). @Risk software was then used to address the uncertainty in the construction quality using triangular distributions (fair, avg, good, etc.). An "expected value" was then placed on each structure based on this triangular distribution. This value per square foot was then multiplied by the actual square footage of the structure as listed in the County Assessor records to obtain a non-depreciated structure value.

Finally, depreciation was applied using guidance from IWR 95-R-9. Non-Residential structures were 100% surveyed during fieldwork and residential structures were grouped geographically by areas of homogeneous characteristics.

2.4 Value of Damageable Property- Content Value

In addition to structures, building contents can also be at risk of flood damages. For this study, non-residential content values were derived from the results of the Sacramento District SPK Expert Elicitation Panel of 2007. The value used is based on the "expected value" of a triangular distribution of the various land-use categories. Both depreciated and non-depreciated content are accounted for. These values have been indexed to 2011 prices using CPI data and a summary is listed below in Table 2-2. For residential structures, the content value is estimated at 50% of the depreciated structure value, similar to what's been used in most other Corps Feasibility Studies[2].

[2] In accordance with IWR depth damage functions, content damages for residential structures are based upon a percentage of structure value, and therefore a 100% content to structure ratio is applied within FDA to assure that content depth damage percentages are applied to the structure value rather than the content value.

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50% represents a rough estimate of actual content valuation for presentation purposes. For calculation of damages, 100% was used per EGM 04-01. EGM 04-01 also states that "the 'Error Associated with Content/Structure Value' on the 'Study Structure Occupancy Type' (within HEC-FDA) screen should be left blank." This was not done for Orestimba, but a sensitivity analysis showed only a 0.7% difference in the results had it been left blank.

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Table 2-2: Content Values (Non-residential)
October 2011 Prices

Use Category	Total Content Value per Square Foot		
	Mean	Std. Dev.	SD/Mean
C-OFF1	$36.90	$5.96	16%
C-OFF2	$36.47	$5.27	14%
C-RET1	$34.53	$6.16	18%
C-RET2	$34.53	$6.16	18%
C-FURN1	$39.14	$7.81	20%
C-FURN2	$39.14	$7.81	20%
C-DEAL1	$51.13	$6.17	12%
C-DEAL2	$51.13	$6.17	12%
C-HOT1	$130.06	$4.02	3%
C-HOT2	$130.06	$4.02	3%
C-MOT1	$130.06	$4.02	3%
C-MOT2	$130.06	$4.02	3%
C-FOOD1	$29.44	$8.01	27%
C-FOOD2	$29.44	$8.01	27%
C-REST1	$130.06	$4.02	3%
C-REST2	$130.06	$4.02	3%
C-RESTFF1	$48.08	$6.23	13%
C-RESTFF2	$48.08	$6.23	13%
C-MED1	$182.64	$84.17	46%
C-MED2	$182.64	$84.17	46%
C-HOS1	$254.10	$116.89	46%
C-HOS2	$254.10	$116.89	46%
C-SHOP1	$58.64	$13.23	23%
C-SHOP2	$89.44	$13.23	15%
C-GROC1	$89.44	$3.36	4%
C-GROC2	$89.44	$3.36	4%
C-SERV1	$78.18	$2.94	4%
C-SERV2	$78.18	$2.94	4%
C-BANK1	$36.90	$5.96	16%
C-BANK2	$36.47	$5.27	14%
I-WH1	$32.98	$10.28	31%
I-WH2	$32.98	$10.28	31%
I-LT1	$69.01	$13.06	19%
I-LT2	$69.01	$13.06	19%
I-HV1	$28.34	$8.80	31%
I-HV2	$28.34	$8.80	31%
P-GOV1	$49.36	$4.13	8%
P-GOV2	$49.36	$4.13	8%
P-SCH1	$44.83	$14.72	33%
P-SCH2	$44.83	$14.72	33%
P-CH1	$23.33	$9.41	40%
P-CH2	$23.33	$9.41	40%
P-REC1	$66.89	$8.66	13%
P-REC2	$66.89	$8.66	13%
FARM1	$29.51	$4.27	14%
FARM2	$29.51	$4.27	14%

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Total value of damageable property is comprised of the structural and content values described for the parcels within the 0.2% annual chance floodplain. Table 2-3 shows the total structure and content values by category and economic impact area. In total, the study area has just over $300 million in estimated damageable property.

Table 2-3: Value of Damageable Property Within the 0.2% (1/500) Annual Chance Floodplain October 2011 Prices ($1,000's)

Land Use	Structural Value		Content Value		TOTAL
	Rural	Urban	Rural	Urban	
Residential	17,706	123,204	8,853	61,602	**$211,365**
Commercial	0	23,732	0	25,030	**$48,763**
Industrial	0	13,593	0	20,014	**$33,607**
Public	0	4,541	0	2,123	**$6,664**
TOTAL	**$17,706**	**$165,070**	**$8,853**	**$108,769**	**$300,398**

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3.0 Depth-Damage Relationships and Flooding Characteristics

3.1 Determining Flood Depths

For structure and content damages, depth of flooding relative to the structure's first floor is the primary factor in determining the magnitude of damage. The GIS database, provided by Stanislaus County contained spatially referenced polygons for each parcel in the study area. In this study, ground elevation was assigned to the centroid of each parcel using GIS. Foundation heights, which were determined via survey data from a previous Orestimba study, were verified by a new survey sample in 2007, where surveyors used the bottom of the wainscot of the residence. The results were very similar to heights estimated visually during field visitation and ranges from past Corps studies (1-1.5ft). These heights were then added to the assigned ground elevation to establish first floor elevations. Water surface elevations (WSEL) from the Flo2D model were provided in the form of shapefiles for the 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% ACE probability events. Details of hydraulic data and the Flo2D model can be found in the Hydraulics Appendix. The WSEL were referenced to the Flo-2D grid cells containing parcel centroids and by subtracting first floor elevations, depths were determined for each structure within the flood plain. Flooding depths in general were rather shallow with very few structures facing depths greater than 2 feet. Individual depths were assigned for each and every structure in the study area for the 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% ACE probability events and these water surface profiles were then imported into the FDA models. This data was used for establishing expected damages for each event.

3.2 Depth-Damage Relationships

Damages to structures and contents were determined based on depth of flooding relative to the structure's first floor elevation. To compute these damages, depth-damage (DD) curves were used. These curves assign loss as a percentage of value for each parcel. The deeper the relative depth, the greater the percentage of value damaged. The sources of the relationships were different depending on land use. For residential structures, the IWR DD curves were used in accordance with EGM-04-01. The non-residential structure DD curves used for this study are the standard 1998 FEMA Federal Insurance Administration non-residential curves based on insurance claims and empirical damages nationwide. These curves represent average Non-residential structures throughout the nation and are appropriate for the structures within the Orestimba Study area. DD curves for non-residential contents were taken from the American River Watershed Economic Re-evaluation Report (ERR) expert elicitation for short duration flooding. Depth Damage relationships are shown in the tables below.

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Table 3-1: Depth Damage Curves for Residential (Structure and Content)

CATEGORY		DEPTH OF FLOODING ABOVE THE FIRST FLOOR IN FEET							
		-4.0	-1.0	0.0	1	3	5	10	15
1 Story	Structure	0%	3%	13%	23%	40%	53%	73%	80%
	Content	0%	2%	8%	13%	22%	29%	38%	40%
2 Story	Structure	0%	3%	9%	15%	26%	36%	56%	68%
	Content	0%	1%	5%	9%	16%	21%	32%	37%
Split	Structure	0%	6%	7%	9%	17%	29%	63%	84%
	Content	0%	2%	3%	5%	11%	20%	46%	61%
1 Story w/base	Structure	5%	19%	26%	32%	46%	59%	80%	81%
	Content	6%	13%	16%	19%	25%	30%	39%	39%
2 Story w/base	Structure	5%	14%	18%	22%	32%	42%	65%	76%
	Content	5%	10%	12%	14%	18%	22%	34%	49%
Split w/base	Structure	5%	14%	19%	23%	33%	44%	65%	69%
	Content	4%	9%	12%	14%	18%	22%	26%	26%
Mobile Home-Short Duration	Structure	0%	6%	10%	45%	46%	66%	66%	66%
	Content	0%	0%	0%	38%	69%	90%	90%	90%

Table 3-2: Depth Damage Curves for Non-Residential Structures

Category	Depth of Flooding above the first floor in feet						
	-1.0	0	1	3	5	10	15
1 story Short Duration	0	7	16	28	31	46	50
2 story Short Duration	0	5	10	18	22	38	38

Table 3-3: Depth Damage Curves for Non-Residential Content 1-story

CATEGORY	DEPTH OF FLOODING ABOVE THE FIRST FLOOR IN FEET						
	-1.0	0	1	3	5	10	15
Food Stores	0	0	29	96	100	100	100
Furniture-Retail	0	0	80	96	100	100	100
Grocery Store	0	0	32	89	100	100	100
Hotel-Full Service	0	0	23	90	100	100	100
Medical	0	0	33	89	100	100	100
Office	0	0	35	90	100	100	100
Restaurant	0	0	30	96	100	100	100
Rest-Fast Food	0	0	23	90	100	100	100
Retail	0	0	80	96	100	100	100
Service-Auto	9	10	23	67	100	100	100
Shopping Centers	0	0	33	72	100	100	100
Heavy	0	0	16	56	92	100	100
Light	0	0	35	75	96	100	100
Warehouse	0	0	23	69	96	100	100
Churches	0	0	33	85	99	99	100
Government	0	0	35	90	100	100	100
Recreation	0	0	38	95	100	100	100
Schools	0	0	22	67	88	100	100
Farms	0	0	30	76	100	100	100

Table 3-4: Depth Damage Curves for Non-Residential Content 2-story

CATEGORY	DEPTH OF FLOODING ABOVE THE FIRST FLOOR IN FEET						
	-1.0	0	1	3	5	10	15
Food Stores	0	0	25	50	50	50	100
Furniture-Retail	0	0	42	50	50	50	100
Grocery Store	0	0	27	49	50	50	100
Hotel-Full Service	0	0	20	50	50	50	100
Medical	0	0	28	49	50	50	100
Office	0	0	29	50	50	50	100
Restaurant	0	0	25	50	50	50	100
Rest-Fast Food	0	0	20	50	50	50	100
Retail	0	0	19	36	50	50	100
Service-Auto	8	8	19	37	50	50	100
Shopping Centers	0	0	28	40	50	50	100
Heavy	0	0	14	31	46	50	100
Light	0	0	30	41	48	50	100
Warehouse	0	0	20	38	48	50	100
Churches	0	0	28	47	49	50	100
Government	0	0	30	50	50	50	100
Recreation	0	0	32	49	50	50	100
Schools	0	0	18	37	44	50	100

4.0 Uncertainty and Other Categories

4.1 FLO-2D Grid Cells and Parcel Assignments using GIS

GIS was used to assign centroids to each parcel within the study area and these "points" were then overlaid onto the grid-cells of the FLO-2D model, resulting in the assignment of each parcel to a specific grid-cell within the hydraulic model. Due to the random nature of parcel spacing compared to the structured nature of the FLO-2D grid-cells, some grid-cells contain zero parcels and other grid-cells have multiple parcels assigned to them. The water surface elevation of the grid-cell now becomes the water surface elevation for all parcels contained therein. Using the grid-cell assignments along with the depths of flooding for the 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% ACE probability events, water surface profiles were developed and imported into FDA.

4.2 Economic Uncertainty Parameters

Many of the factors that determine flood damages can be represented by a range of values instead of a single number. Errors in measurement, variation in classification and judgment can lead to differences in values. For this study, in accordance with EM 1110-2-1619, uncertainties in the following parameters were considered in the damage estimation:

- Structure Value
- Content Ratio
- First Floor Elevation (Foundation Height)
- Depth-Damage Percentage

Structure values were determined as a function of Marshall& Swift values per square foot, square footage and estimated depreciation. To estimate the mean value of structures, a triangular distribution for each of these parameters were set in the model as discussed in detail in section 2.3.

In addition, standard deviations for all 4 variables were used for all land use/structure types within the FDA model and applied during FDA's Monte Carlo simulation of the Expected Annual Damages. These coefficients of variation were based upon @Risk Monte Carlo simulations for representative structures for each category as listed in Table 4-1.

Risk and uncertainty was also included in the Depth Damage Percentages for residential structures and contents that were imported into FDA and applied during the Monte Carlo simulations. A summary of the standard deviations used for residential is also shown in Table 4-1. Uncertainty in non-residential content depth damages were also applied in the form of triangular distributions and the most common categories are summarized in Table 4-3.

Standard Deviation for foundation heights was set equal to 0.5 feet.

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Table 4-1: Standard Deviations for Risk and Uncertainty in Structure & Content Value

USE CATEGORY	UNCERTAINTY IN VALUE (INPUT TO HEC-FDA)	
	Structure- Coefficient of Variation (%)	Content- Coefficient of Variation (%)
Residential (SFR & MFR)	12	12
Mobile Homes	14	14
Office 2-Story	13	14
Office 1-Story	13	16
Retail	12	14
Retail-Furniture	12	20
Auto Dealerships	12	12
Hotel	12	3
Food Stores	11	27
Restaurants	12	3
Restaurants-Fast Food	12	13
Medical	11	46
Shopping Centers	11	23
Large Grocery Stores	12	4
Service (Auto)	12	4
Warehouse	14	31
Light Ind.	12	19
Heavy Ind.	12	31
Government	12	16
Schools	14	33
Religious	13	40
Recreation	12	13
Automobiles	15	N/A

Table 4-2: Standard Deviations for Depth-Damage Percentages - Residential

Damage Category	Structural (S) / Content (C)	Depth in Feet											
		-1	0	1	2	3	4	5	6	7	8	9	10
		% Damage to Structure/Content											
SFR1	S	3	13	23	32	40	47	53	59	63	67	71	73
	Std. Dev.	3	2	2	2	2	2	2	2	2	2	2	3
	C	2	8	13	18	22	26	29	32	34	36	37	38
	Std. Dev.	2	2	1	1	1	2	2	2	2	2	2	2
SFR2	S	3	9	15	21	26	31	36	41	45	49	52	56
	Std. Dev.	4	3	3	3	3	3	3	4	4	4	4	4
	C	1	5	9	12	16	19	21	24	26	28	30	32
	Std. Dev.	4	3	3	3	3	3	3	3	3	3	4	4
MFR1	S	3	13	23	32	40	47	53	59	63	67	71	73
	Std. Dev.	3	2	2	2	2	2	2	2	2	2	2	3
	C	2	8	13	18	22	26	29	32	34	36	37	38
	Std. Dev.	2	2	1	1	1	2	2	2	2	2	2	2
MFR2	S	3	9	15	21	26	31	36	41	45	49	52	56
	Std. Dev.	4	3	3	3	3	3	3	4	4	4	4	4
	C	1	5	9	12	16	19	21	24	26	28	30	32
	Std. Dev.	4	3	3	3	3	3	3	3	3	3	4	4

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Table 4-3: Non-Residential Content Depth-Damage Uncertainty

Damage Category Content Type	Triangular Distribution	Depth in Feet							
		-1	0	1	2	3	5	7	10
		% Damage to Contents							
C-RET1	Low	0	0	16	35	56	84	100	100
	Most Likely	0	0	23	50	65	100	100	100
	High	0	1	31	58	82	100	100	100
C-HOS1	Low	0	0	25	53	66	94	100	100
	Most Likely	0	0	33	73	89	100	100	100
	High	0	1	45	86	100	100	100	100
C-AUTO1	Low	0	0	24	55	77	100	100	100
	Most Likely	0	0	35	78	90	100	100	100
	High	0	0	44	87	100	100	100	100
C-HOTEL1	Low	0	0	15	49	60	100	100	100
	Most Likely	0	0	23	59	90	100	100	100
	High	0	2	46	100	100	100	100	100
C-RESTFF1	Low	0	0	15	49	60	100	100	100
	Most Likely	0	0	23	59	90	100	100	100
	High	0	2	46	100	100	100	100	100
C-GROC1	Low	0	0	20	45	57	77	100	100
	Most Likely	0	0	32	70	89	100	100	100
	High	0	2	50	90	100	100	100	100
C-OFF1	Low	0	0	24	55	77	100	100	100
	Most Likely	0	0	35	78	90	100	100	100
	High	0	0	44	87	100	100	100	100
C-REST1	Low	0	0	16	45	78	98	100	100
	Most Likely	0	0	30	77	96	100	100	100
	High	0	2	50	100	100	100	100	100
I-LT1	Low	0	0	25	51	65	89	100	100
	Most Likely	0	0	35	64	75	96	100	100
	High	0	0	44	75	100	100	100	100
I-HV1	Low	0	0	14	39	54	92	98	100
	Most Likely	0	0	16	41	56	92	98	100
	High	0	0	24	47	64	96	100	100
I-WH1	Low	0	0	18	46	55	83	100	100
	Most Likely	0	0	23	55	69	96	100	100
	High	0	1	31	60	79	100	100	100
P-CH1	Low	0	0	29	49	57	97	97	97
	Most Likely	0	0	33	75	86	99	99	99
	High	0	0	45	84	95	99	99	99
P-GOV1	Low	0	0	24	55	77	100	100	100
	Most Likely	0	0	35	78	90	100	100	100
	High	0	0	44	87	100	100	100	100
P-SCH1	Low	0	0	3	17	31	54	83	100
	Most Likely	0	0	22	47	67	88	100	100
	High	0	1	47	71	100	100	100	100

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4.3 Other Damage Categories

In addition to damages directly related to structures and their contents, losses were estimated for other categories such as damages to automobiles, emergency costs, and cleanup costs. While economic uncertainties for these damage categories are not specifically identified or required in EM 1110-2-1619, uncertainty parameters for these categories were included in this study.

Automobiles

Losses to automobiles were determined as a function of the number of vehicles per residence, average value per automobile, estimated percentage of autos removed from area prior to inundation, and depth of flooding above the ground elevation. Depth-damage relationships for autos were taken from EGM 09-04 and modified based on weighted average of distributions of car types (SUV, truck, sedan, sports car, etc) in California. Damages for autos begin once flood depth has reached 0.5 feet, and this damage curve can be seen in Table 4-4. Vehicle counts were estimated using an assumption of 2 vehicles per residential structure. Evacuation (autos moved out of the flooded area) was assumed to be 50%, as used on American River and other Corps studies. Depreciated replacement value of autos was based on a price adjusted Bureau of Labor Statistics average used car value of $8,865[3]. Uncertainty was incorporated using a normal distribution and a standard deviation at 15%.

Table 4-4: Automobile Depth Damage Function

Damage Category	Depth in Feet													
	-1	0	0.5	1	1.5	2	3	4	5	6	7	8	9	10
	% Damage to Structure/Content													
Automobiles	0	0	3	24	34	43	60	75	86	94	97	99	100	100
Std. Dev	0	0	10	8	7	6	5	3	4	7	7	7	8	8

Emergency Costs

Emergency costs were estimated for the relocation and emergency services provided for those displaced both during the peak flood event and during post-flood structural renovations. A methodology relating emergency costs to the percent damage to the structure, days displaced and relocation costs was used to calculate maximum cost of displacement and the percent damage curves. This methodology was also used on the Yuba General Re-Evaluation Report. The resulting depth-damage functions that were imported into FDA and used in the modeling are listed in Table 4-5. The depth-damage percentages are related to a maximum cost/value of $19,178 which was determined and used as the total value when values were imported into HEC-FDA (this represents the total cost if displaced for 1 year including rent, moving expenses,

[3] $8,865 was derived from taking a value of $7,988 from the approved 2010 Natomas PAC and adjusting for price level using CPI for used cars and trucks.

furniture rentals, etc). Due to the relatively shallow alluvial fan type flooding seen from the Orestimba Creek, annual damages for emergency costs were very minimal.

Table 4-5: Emergency Costs Depth-Damage Curves

Damage Category	Depth in Feet													
	-1	0	0.5	1	1.5	2	3	4	5	6	7	8	9	10
	% Damage to Structure/Content													
SFR1	0	17	28	38	49	57	74	89	100	100	100	100	100	100
SFR2	0	0	15	21	28	34	45	55	66	77	85	94	100	100
MFR1	0	17	28	38	49	57	74	89	100	100	100	100	100	100
MFR2	0	0	15	21	28	34	45	55	66	77	85	94	100	100
Mobile Home	0	0	81	85	85	87	100	100	100	100	100	100	100	100

Cleanup Costs

Cleanup Costs mainly include costs associated with cleanup of debris resulting from flooding. Cleanup costs were derived using structure values and a depth damage curve used in other Corps studies, such as the Yuba General Re-evaluation Report, (normal distribution and 8% standard deviation). The cleanup costs depth damage curve is shown below in Table 4-6. Similar to emergency costs, because of the shallow flooding that we see with the Orestimba Creek, cleanup costs turn out to be minimal.

Table 4-6: Cleanup Cost Depth-Damage Curve

Damage Category	Depth in Feet													
	-1	0	0.5	1	1.5	2	3	4	5	6	7	8	9	10
	% Damage for Cleanup													
Cleanup	1.00	1.50	1.75	2.00	2.25	2.50	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

For all three of these categories, elevation uncertainty was the same 0.5 feet as used in structure analysis.

Agricultural Damages

Agricultural Damages were estimated by event in a model outside of HEC-FDA. These event damages were then input into HEC-FDA in order to estimate EAD. For a more detailed writeup of this analysis and the assumptions used, please refer to Attachment B of this appendix.

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5.0 Expected Annual Damages –Without Project Conditions

5.1 HEC-FDA Model

For the Orestimba Creek Feasibility Study, expected annual damages were estimated using the US Army Corps of Engineers, FRM-PCX certified risk-based Monte Carlo simulation program HEC-FDA v. 1.2.5a. Risk is a function of both probability and consequence, and the fact that risk inherently involves chance leads directly to a need to describe and plan for uncertainty. Corps policy has long been to acknowledge risk and uncertainty in anticipating floods and their impacts and to plan accordingly[4]. Historically, that planning relied on analysis of the expected long-term performance of flood-damage reduction measures, application of safety factors and freeboard, designing for worse case scenarios, and other indirect solutions (such as engineering judgment) to compensate for uncertainty. These indirect approaches were necessary because of the lack of technical knowledge of the complex interaction of uncertainties in estimating hydrologic, hydraulic, geotechnical, and economic factors due to the complexities of the mathematics required for doing otherwise. However, with advances in statistical hydrology and the availability of computerized analysis tools (such as HEC-FDA described below), it is now possible to improve the evaluation of uncertainties in the hydrologic, hydraulic, geotechnical, and economic functions. Through this risk analysis, and with careful communication of the results, the public can be better informed about what to expect from flood-damage reduction projects and thus can make more informed decisions. The determination of EAD for a flood reduction study must take into account complex and uncertain hydrologic, hydraulic, geotechnical, and economic information:

- **Hydrologic -** The discharge-frequency function describes the probability of floods equal to or greater than some discharge Q,
- **Hydraulics -** The stage-discharge function describes how high (stage) the flow of water in a river channel might be for a given volume of flow discharge,
- **Geotechnical -** The geotechnical levee failure function describes the levee failure probabilities vs. stages in channel with resultant stages in the floodplain, and
- **Economics -** The stage-damage function describes the amount of damage that might occur given certain floodplain stages.

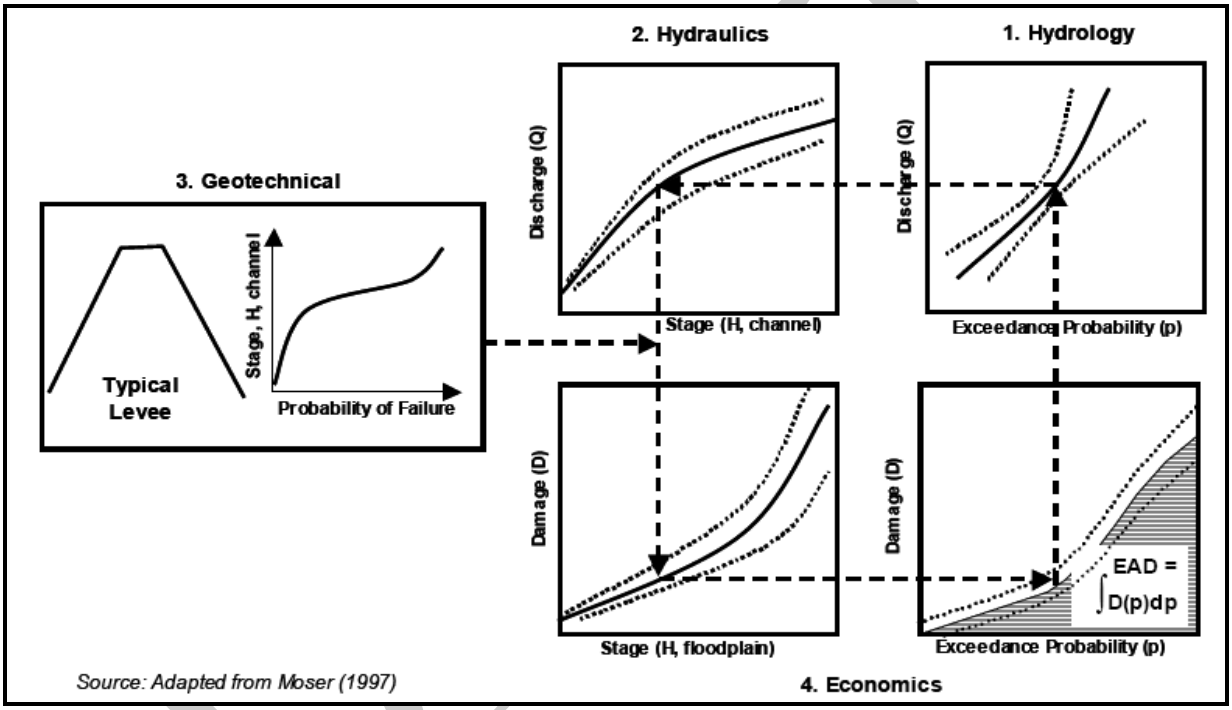
5.2 Estimation of Expected Annual Damages

Figure 5-1 illustrates the conceptual risk approach for Corps' flood damage analyses. To find the damage for any given flood frequency, the discharge for that frequency is first located in the discharge-frequency panel (panel #1), then the river channel stage associated with that discharge value is determined in the stage-discharge panel (panel #2). For the Orestimba Creek study it

[4] In a flood risk management study, risk is defined is the probability of failure during a flood event. Uncertainty is the measure of the imprecision of knowledge of variables in a project plan.

was assumed that levees would only overtop and would not fail, so only non-damage levee heights were put into the FDA model and the resulting residual floodplains were analyzed. Once the banks are overtopped and water enters the floodplain, the stages (water depths) in the floodplain inundate structures and crops and cause damage (panel #4, left side).[5] By plotting this damage and repeating for process many times, the damage-frequency curve is determined (panel #4, right side).[6] EAD is then computed by finding the area under the flood damage-frequency curve by integration for both without and with project conditions. Reductions in EAD attributable to projects are flood reduction benefits.

Figure 5-1: Uncertainty in Discharge, Stage and Damage in Determination of Expected Annual Damages



Source: San Joaquin and Sacramento River Basins Comprehensive Study (2002)

Uncertainties are present for each of the functions discussed above and these are carried forth from one panel to the next, ultimately accumulating in the EAD. These uncertainties are shown in Figure 5-1 as "error bands" located above and below the hydrologic, hydraulic and economics curves.[7]

Some of the important uncertainties specific to the Orestimba Creek Study include:

[5] For reaches with no levees, the stage in the channel and overbank areas is used to determine damage.
[6] The HEC-FDA model uses Monte Carlo analysis to repeat this "sampling" process thousands of times. Mathematically, HEC-FDA computes EAD in a different manner than illustrated by this figure.
[7] Uncertainty in the geotechnical levee probability of failure curves are multitude in character and the resultant curve used in the analysis reflects how well that levee can be expected to perform during random periods of high flows for a particular reach length. Typically, the greater the length of the levee reach, the less reliable that reach will perform during a flood event.

- **Hydrologic -** Uncertainty factors include hydrologic data record lengths that are often short or do not exist, precipitation-runoff computational methods that are not precisely known, and imprecise knowledge of the effectiveness of flow regulation.[8]
- **Hydraulics -** Uncertainty arising from the use of simplified models to describe complex hydraulic phenomena, including the lack of detailed geometric data, misalignments of hydraulic structures, debris load, infiltration rates, embankment failures, material variability, and from errors in estimating slope and roughness factors. For the Urban EIA as standard deviation in stage of 0.6 feet was used, while 1.5 feet was used for the Rural EIA (EM-1110-2-1619 guidance for minimum uncertainty standards alluvial fan vs. channel stage).
- **Geotechnical –** Under without project conditions, we have assumed the CCID canal fails when overtopped for hydraulic modeling purposes. This is based on input from the SPK geotechnical section and historical performance.
- **Economics -** Uncertainty concerning land uses, depth/damage relationships, structure/content values, structure locations, first floor elevations, the amount of debris and mud, flood duration, and warning time and response of floodplain inhabitants (flood fighting).

5.3 Probability-Stage-Damage Functions

Damages were estimated by each category, by impact area and by event based on varying depths within the flood plain relative to individual structures. These damages were then linked to a stage within the channel (or the floodplain) at a common index point for each impact area by exceedance probability. For the Urban EIA, an index point in the floodplain was used at the first point flooding within the area at the Railroad and Lundy Rd intersection. Index locations used for can be found in Figure 5-2. These stage-damage functions were calculated within HEC-FDA and they represent the economic relationships between the hydrology and hydraulics. These functions can be found by event, damage category and impact area in the tables below. These damage values differ from the calculated damages by event shown in the HEC-FDA calculated stage-damage curves due to uncertainties in each relationship. Damages within FDA are aggregated back to the chosen index location.

It is noted that there is a difference between the event damages calculated within HEC-FDA in the tables below and the actual damages *reported* from past flood events (Section 1.3), but this is to be expected. Historical record is not believed to be a good reference for actual damages in the area. A 2002 national study[9] of local flood damage estimates showed that "individual damage estimates for small floods or for local jurisdictions within a larger flood area tend to be extremely inaccurate. It is rare to have actual cost data to compare with damage estimates. The […] analysis of one large flood disaster indicates that, in cases where actual costs are less than $30

[8] The hydrologic data record lengths (period of record) are the number of years of a systematic record of peak discharges at a stream gage. This parameter directly influences the uncertainty associated with the frequency-discharge function shown in Figure 5-1 and consequently the project performance statistics. In general, a longer period of record implies less uncertainty associated with this function. The period of record for Orestimba Creek Hydrology is 45 years.

[9] Pielke, Jr., R.A., M.W. Downton, and J.Z. Barnard Miller, 2002: Flood Damage in the United States, 1926-2000: A Reanalysis of National Weather Service Estimates. Boulder, CO: UCAR.

million, a large proportion of estimates are off by at least a factor of two and sometimes much more."

For the most part, property owners in the study area have taken care of their own flood damages without assistance from the Federal Emergency Management Agency, resulting in many damages likely not being reported. Flood fighting has also likely truncated many potential damages as flood depths are relatively shallow. Alluvial fan flooding is highly uncertain by nature. The same flow from the 1995 event could occur, break out of the creek at a different location and result in very different floodplains and damages.

Table 5-1: Without Project Probability-Stage-Damage Functions - Rural Impact Area October 2011 Prices ($1,000's)

Damage Category	Annual Chance Exceedance of Event Followed By Corresponding Stage							
	99%	20%	10%	5%	2%	1%	0.50%	0.20%
	107.7	119.7	120.4	120.8	121	121.1	121.2	121.3
AUTO	$0	$101	$170	$210	$266	$301	$339	$392
Clean	$0	$66	$132	$167	$200	$229	$251	$281
Emergency	$0	$386	$531	$602	$687	$765	$847	$927
Commercial	$0	$0	$0	$0	$0	$0	$0	$0
Industrial	$0	$0	$0	$0	$0	$0	$0	$0
Public	$0	$0	$0	$0	$0	$0	$0	$0
Residential	$0	$782	$1,798	$2,381	$3,001	$3,511	$3,967	$4,583
Agricultural	$0	$3,173	$5,751	$7,211	$8,474	$9,283	$9,978	$10,696
TOTAL	**$0**	**$4,508**	**$8,382**	**$10,571**	**$12,629**	**$14,090**	**$15,381**	**$16,878**

Table 5-2: Without Project Probability-Stage-Damage Functions - Urban Impact Area October 2011 Prices ($1,000's)

Damage Category	Annual Chance Exceedance of Event Followed By Corresponding Stage							
	99%	20%	10%	5%	2%	1%	0.50%	0.20%
	96.12	96.13	99.39	99.48	99.5	99.6	99.7	99.79
AUTO	$0	$0	$71	$100	$114	$150	$169	$189
Clean	$0	$0	$1,134	$1,752	$1,914	$2,065	$2,115	$2,180
Emergency	$0	$0	$364	$930	$1,101	$1,416	$1,521	$1,627
Commercial	$0	$39	$2,266	$3,210	$3,386	$3,699	$3,798	$3,919
Industrial	$0	$0	$2,232	$2,414	$2,476	$2,547	$2,586	$2,685
Public	$0	$0	$78	$142	$151	$177	$182	$189
Residential	$0	$43	$5,115	$12,001	$13,818	$15,952	$16,589	$17,334
TOTAL	**$0**	**$82**	**$11,260**	**$20,549**	**$22,960**	**$26,005**	**$26,959**	**$28,124**

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Table 5-3: Without Project Probability-Stage-Damage Functions – TOTAL STUDY AREA

October 2011 Prices ($1,000's)

Damage Category	Annual Chance Exceedance of Event							
	99%	20%	10%	5%	2%	1%	0.50%	0.20%
AUTO	$0	$101	$241	$311	$380	$451	$508	$581
Clean	$0	$66	$1,266	$1,920	$2,115	$2,295	$2,365	$2,461
Emergency	$0	$386	$895	$1,532	$1,788	$2,181	$2,367	$2,554
Commercial	$0	$39	$2,266	$3,210	$3,386	$3,699	$3,798	$3,919
Industrial	$0	$0	$2,232	$2,414	$2,476	$2,547	$2,586	$2,685
Public	$0	$0	$78	$142	$151	$177	$182	$189
Residential	$0	$824	$6,912	$14,381	$16,819	$19,463	$20,555	$21,917
Agricultural	$0	$3,173	$5,751	$7,211	$8,474	$9,283	$9,978	$10,696
TOTAL	**$0**	**$4,590**	**$19,641**	**$31,120**	**$35,589**	**$40,095**	**$42,341**	**$45,003**

5.3.1 Stage-damage curves and alluvial fan (FLO-2D) floodplain modeling

Table 5-2 above shows a significant increase (83%) in urban damages between the 10% (1/10) annual chance event and the 5% (1/20) annual chance event, while only showing a 0.1 foot increase in WSEL at the index location. While this large increase in damages given a small increase in WSEL may not make intuitive sense for traditional "storage area" HEC-RAS floodplain modeling, it does make sense when looking at alluvial fan floodplain spreading FLO-2D modeling. The increase in damages vs. stage can be summarized for the Orestimba Study area by the following two points:

1. A very small change in stage causes a large increase in flooding extent as the water spreads over the alluvial fan. The number of structures within the floodplain increases by 58% between the 10% (1/10) and 5% (1/20) annual chance events (see Table 5-4). In addition to these newly flooded structures, those that were already flooded are now slightly deeper causing additional damages.

2. HEC-FDA uses stage-aggregated damages, meaning that all damages within an Economic Impact Area must be aggregated back to the stage a single representative index location. While the stage at this chosen index location may be generally representative of the area, it does not mean that the WSEL over the entire area only increases by 0.1 feet when modeled in FLO-2D. There are many homes and smaller pockets that see a more significant 0.5 -1 foot increase in flooding between these particular events.

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Table 5-4: Number of structures flooded by event – Urban EIA only

Damage Category	Annual Chance Exceedance Flood Event					
	10% (1/10)	*5% (1/20)*	*2% (1/50)*	*1% (1/100)*	*0.5% (1/200)*	*0.2% (1/500)*
Commercial	51	60	61	62	62	62
Industrial	15	15	16	16	16	16
Public	5	7	7	7	7	7
Residential	409	675	748	828	860	885
Total	480	757	832	913	945	970
%increase	0%	58%	10%	10%	4%	3%

5.4 Existing Condition Expected Annual Damages

Expected Annual Damages, under existing without project conditions, were estimated for each damage category for both impact areas. Results are summarized in Table 5-5 below.

Table 5-5: Expected Annual Damages - Without Project Conditions October 2011 Prices ($1,000's)

Damage Category	EAD by Impact Area		TOTAL
	Rural	Urban	
Agriculture	$1,381	$0	**$1,381**
Auto	$61	$50	**$111**
Cleanup	$37	$183	**$220**
Emergency	$148	$194	**$341**
Commercial	$0	$520	**$520**
Industrial	$0	$417	**$417**
Public	$0	$33	**$33**
Residential	$657	$1,733	**$2,389**
TOTAL	**$2,284**	**$3,130**	**$5,413**

5.5 Effect of Risk and Uncertainty on Existing Condition Urban Expected Annual Damages in HEC-FDA

Due to the alluvial fan nature of the Orestimba floodplains, the actual location of flooding and extent of flooding is inherently uncertain. Small changes to topography could impact spreading of the water significantly. Because the rating curves (flow vs. stage) are relatively flat for the Urban EIA area, uncertainty in the stage (0.6ft standard deviation) can have a large (increasing) effect on EAD when applied during Monte Carlo simulations. HEC-FDA is generally very sensitive to flat H&H curves. The index point (IP) used for reporting purposes in this document

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is located at the intersection near the Lundy Road and the Railroad, which is where initial floodwater enters the Urban impact area. An index location directly next to the channel was not deemed to be to be a good representation of the nature of flooding (stage increase) in Newman due to the spreading of the water that occurs when it leaves the channel.

Because EAD results are sensitive to rating curve changes, other index locations were tested in HEC-FDA to test the impact on the EAD results in Newman. Sensitivity IP 1 is located on the CCID Canal at the point of initial overtopping into Newman. Sensitivity IP 2 is located in the center of Newman in an area that is representative of stage increases in the city itself. Sensitivity IP 3 was the location used for the rural area, at the creeks initial point of overtopping. The index locations of the sensitivity runs are shown along with the documentation location in Figure 5-2 below.

The sensitivity runs show that the flatter the rating curve on the more frequent end, the more sensitive the results are to this stage uncertainty and the higher the EAD. These results can be found in Table 5-6 below. The index point used for this document appears to show a conservative EAD estimate compared to Sensitivity IP's 1and 2, but is one that is more in line with historical flooding in the area. One last sensitivity run was done "without R&U" to see how much the overall results were being impacted in general and the result was an EAD of $2.8 million, which is about 20% less than the "with R&U" result. This 20% seems to be in line with a modest increase in EAD usually seen when R&U is used.

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Figure 5-2: Index Locations (For Reporting and Sensitivity Runs)

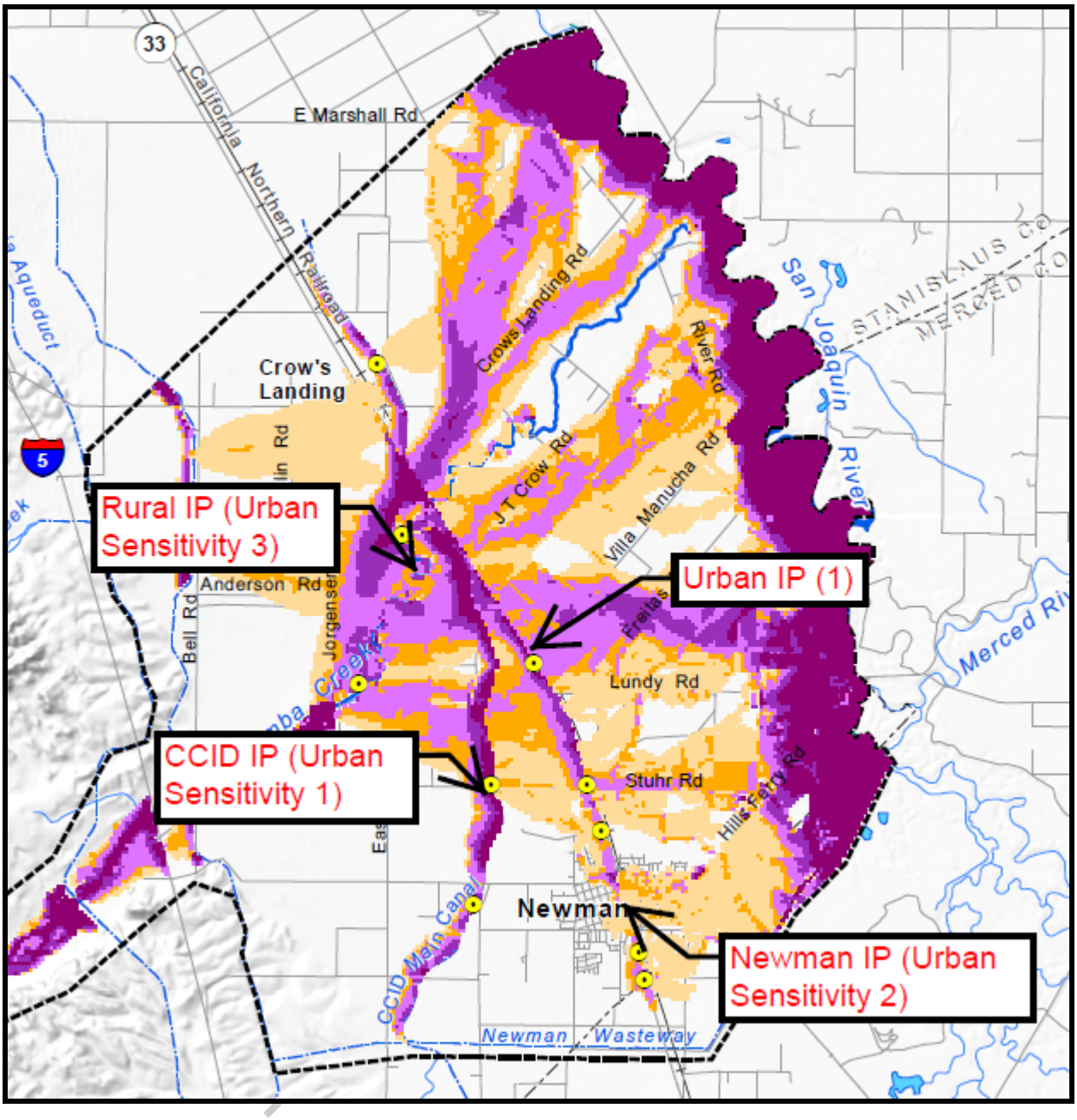

Table 5-6: Index Point Sensitivity Runs

Event	Flow (cfs)	Stage				Std. Dev. (ft.)
		Urban IP (un-modified)	CCID IP (Sensitivity 1)	Newman IP (Sensitivity 2)	Rural IP (Sensitivity 3)	
99.9%	0	96.12	108.61	90.13	107.72	0.6
20.0%	3,634	96.12	108.61	90.13	119.74	0.6
10.0%	5,679	99.39	109.01	90.53	120.44	0.6
5.0%	7,946	99.48	110.54	90.7	120.75	0.6
2.0%	11,208	99.5	111.12	90.74	120.98	0.6
1.0%	13,831	99.6	111.33	90.86	121.08	0.6
0.5%	16,553	99.7	111.37	90.89	121.18	0.6
0.2%	20,255	99.79	111.47	90.93	121.27	0.6
Urban WO Project EAD ($1,000's)		**$3,434***	**$6,836**	**$10,138**	**$3,162**	**--**

** For the final EAD used in this documentation, the Urban IP 99.9% ACE stage was modified in HEC-FDA to mimic the Rural IP, roughly 12 feet below the 20% ACE stage. The resulting WO project EAD was used in this document and can be found in Table 5-5.*

5.6 EAD Future Conditions and Equivalent Annual Damages

The without-project equivalent annual damage reflects the damage value associated with the without-project condition over the period of analysis and under changing hydrology, hydraulic, and economic conditions in the study area. Essentially, equivalent annual damages are expected annual damages that have been converted to a single present worth value and then amortized over the analysis period using the federally mandated discount rate of 4%. The majority of development within Newman is planned outside of the current 0.2% (1/500) annual chance floodplains (and the current FEMA 1% (1/100) annual chance floodplain). With the current state of the real estate market and development plans being halted all across California, it's not safe to assume that Newman will continue to grow at the same rate (approximately 7%) it had from 1987-2007. All new development that does happen to occur within existing floodplains will likely build with the first floor foundation moderately out of the areas 1% floodplain, so any damages would only occur for very infrequent events (0.5% and 0.2% annual chance). Sensitivity runs have been made within FDA regarding future growth and even if Newman did continue to grow at its past rate, very little would be added to the total damages/benefits (less than 1% of the total) and would not impact the plan formulation process. Because of all these circumstances, the PDT is assuming there will be no significant development within the floodplain in the foreseeable future. Therefore, future conditions are assumed to be the same as present conditions effectively making expected annual damages the same as equivalent annual damages and will be referred to as such from this point forward.

5.7 Project Performance- Without Project Conditions

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In addition to damages estimates, HEC-FDA reports flood risk in terms of project performance. Three statistical measures are provided, in accordance with ER 1105-2-101, to describe performance risk in probabilistic terms. These include annual exceedance probability, long-term risk, and assurance by event.

- Annual exceedance probability measures the chance of having a damaging flood in any given year.
- Long-term risk provides the probability of having one or more damaging floods over a period of time.
- Assurance is the probability that a target stage will not be exceeded during the occurrence of a specified flood.

Project performance for the Rural and Urban Impact areas were calculated in two different ways within HEC-FDA. The Rural project performance statistics are based upon the top of channel elevation at the first point that water leaves the creek during a flood event. For the Urban impact area a different methodology was used, instead basing project performance on the stage when damages reach 5% of the 1% event damages. The reason that the urban model did not use the top of channel methodology is because the town is miles away from the channel and the index point used is along the railroad where water first enters the urban impact area. Using the 5% residual damages for the 1% annual chance event seemed to give us reasonable results for AEP (15%) in the urban area as flooding begins between the 1/5 (20%) and the 1/10 (10%) annual chance event. Two different methods were used here, because the flooding patterns are different. Table 5-7 is attempting to communicate the existing flooding problem and how it differs between impact areas.

Table 5-7: Project Performance by EIA
Without Project Conditions

Economic Impact Area	Annual Exceedance Probability		Long-Term Risk			Assurance by Events			
	Median	Expected	10 Year Period	30 Year Period	50 Year Period	10%	2%	1%	0.20%
Rural	24%	24%	94%	99%	99%	6%	2%	1%	1%
Urban	14%	15%	81%	98%	99%	13%	0%	0%	0%

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6.0 With Project Conditions –Flood Damage Reduction Benefits

Project Benefits – The Role of Economics in the Plan Formulation Process

This section will describe how benefits of flood damage reduction of various potential alternatives were estimated. In this section, benefits and project performance outputs will be limited to flood damage reduction components. Non-monetary outputs such as environmental measures, which may vary for the final array of alternatives, are not included but may factor in the plan formulation decision process.

6.1 2009 Preliminary Incremental Alternatives Analysis

An economic analysis was performed in 2009 which served as a screening to get to the final array of alternatives. After 2009, the Hydraulic and Economic models were updated and re-run for the final array. The results provided in this section summarize the screening results from the old models and therefore, the without project condition damages will not be the same as those provided in section 5.0 of this report. The 2009 analysis has not been updated for price level, so it remains in October 2008 prices and interest rates.

On Orestimba Creek, flood damage reduction measures have been considered and screened during several phases of the study. In Table 6-1 below, you'll find a matrix of most of the different measures that have been evaluated throughout the screening process and variations of the alternatives that have been screened. In this section of the economic appendix, flood damage reduction benefits have been explicitly calculated for the measures that might be feasible and have been carried forward in the plan formulation.

Benefits were calculated on incremental basis, and these increments are described in more detail in the main report. In summary, there were 3 different categories of increments being considered for Orestimba. First were the pieces of the project which included a chevron levee, channel modification, interceptor channel, or some combination therein. Second was the location of chevron levee to be placed either north along the CCID Canal, then east along Stuhr Rd; or further north along the CCID Canal and then east along Lundy Rd. The third increment category was the design level of the project/levee to the mean WSEL of a specific event (i.e. 1%, 0.5%, 0.2% annual chance event design).

The goal of this incremental benefit analysis is to answer three simple questions: what, where and how big should the project be? Is there a federal interest to construct a continuous project providing flood damage reduction to all impact areas? And what could be the optimal size of project for these areas?

For a more detailed description of these preliminary alternatives and other conceptual alternatives, please refer to the plan formulation portion of the main report.

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6.1.1 Project Conditions- Model Simulations

Benefits were determined by incorporating residual with-project floodplains and rating curves into the FDA model that represent various with project improvements. Flood risk management benefits equal the difference between the without project damage conditions and the with project residual damages.

The reduction in project flood plains in both extent and depth from the larger without project flood plains accounts for the decrease in damages of the given alternative.

6.1.2 Average Annual Equivalent Damages –With Project Conditions

All benefit values in the remaining tables of this report included average annual equivalents, which because of our assumptions, equal Expected Annual Damages for the Orestimba Study.

6.1.3 Alternatives Evaluated – Preliminary Screening Net Benefit Analysis

Incremental benefit evaluation to determine which plans to move forward for optimization into the final array was formulated based on reasonable separable project features and sizing. Features were identified and categorized based on potential flood reduction and magnitude of cost. Levee Design Height (height based on depth of water for the given flood event at levee location) was used to select reasonable increments for benefit evaluation. 2%, 1%, 0.5% and 0.2% annual chance design heights were considered. As mentioned earlier, details of the project components and selection can be found in the main report. With project residual damages and benefits were modeled for all of the increments/alternatives listed in Table 6-1. In total, seventeen different project increment combinations were modeled and analyzed economically during this screening process. Annual benefits in the table, represent the difference between the without and with project equivalent annual damages for each alternative. Costs are based upon preliminary reconnaissance costs, but are all at the same level of detail for this screening purpose. Because this analysis was done in 2009 and only serves as a screening to in order to choose plans to further optimize, price levels were not updated from October 2008.

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Table 6-1: Preliminary Screening Annual Benefits and Costs by Alternative
Oct 2008 Prices ($1,000's), 4.625% Interest Rate

Project Condition	Economic Impact Area	Equivalent Annual Damages	Total Damages	Annual Benefits	Annual Costs	Net Benefits	B/C Ratio
WITHOUT	Rural	$1,166					
	Urban	$2,260	$3,426				
1/100 Short Levee	Rural	$1,261					
	Urban	$119	$1,380	$2,046	$502	$1,544	4.07
1/200 Short Levee	Rural	$1,255					
	Urban	$119	$1,374	$2,052	$506	$1,546	4.06
1/500 Short Levee	Rural	$1,263					
	Urban	$114	$1,377	$2,049	$524	$1,525	3.91
1/200 Long Levee	Rural	$1,258					
	Urban	$1	$1,259	$2,167	$899	$1,268	2.41
4000 cfs Channel	Rural	$496					
Improvements (4,000cfs)	Urban	$896	$1,392	$2,034	$472	$1,562	4.31
1/200 Short +	Rural	$1,154					
Interceptor Channel (IC)	Urban	$0	$1,154	$2,273	$799	$1,474	2.85
HYBRID 1 - 1/200	Rural	$379					
(1/200 Stuhr+4000cfs+IC)	Urban	$0	$379	$3,047	$1,312	$1,735	2.32
HYBRID 2 - 1/200	Rural	$399					
(1/200 Stuhr+4000cfs)	Urban	$43	$442	$2,984	$827	$2,157	3.61
1/100 Farm Rd.	Rural	$1,215					
	Urban	$84	$1,299	$2,127	$122	$2,006	17.48
1/200 Farm Rd.	Rural	$1,210					
	Urban	$33	$1,243	$2,183	$132	$2,051	16.53
1/500 Farm Rd.	Rural	$1,203					
	Urban	$0	$1,203	$2,223	$139	$2,084	16.03
HYBIRD 3 - 1/50	Rural	$469					
(1/100yr Farm+4000cfs)	Urban	$12	$481	$2,945	$542	$2,403	5.43
HYBIRD 3 - 1/100	Rural	$468					
(100yr Farm+4000cfs)	Urban	$0	$468	$2,959	$542	$2,417	5.46
HYBIRD 3 - 1/200	Rural	$468					
(200yr Farm+4000cfs)	Urban	$0	$468	$2,958	$545	$2,413	5.43
HYBIRD 3 - 1/500	Rural	$444					
(500yr Farm+4000cfs)	Urban	$22	$466	$2,960	$610	$2,350	4.85
HYBRID 4	Rural	$457					
(1/200 Farm+4000cfs + IC)	Urban	$0	$457	$2,970	$1,089	$1,881	2.73
1/200 Dry Dam	Rural	$307					
	Urban	$0	$307	$3,119	$4,069	-$950	0.77

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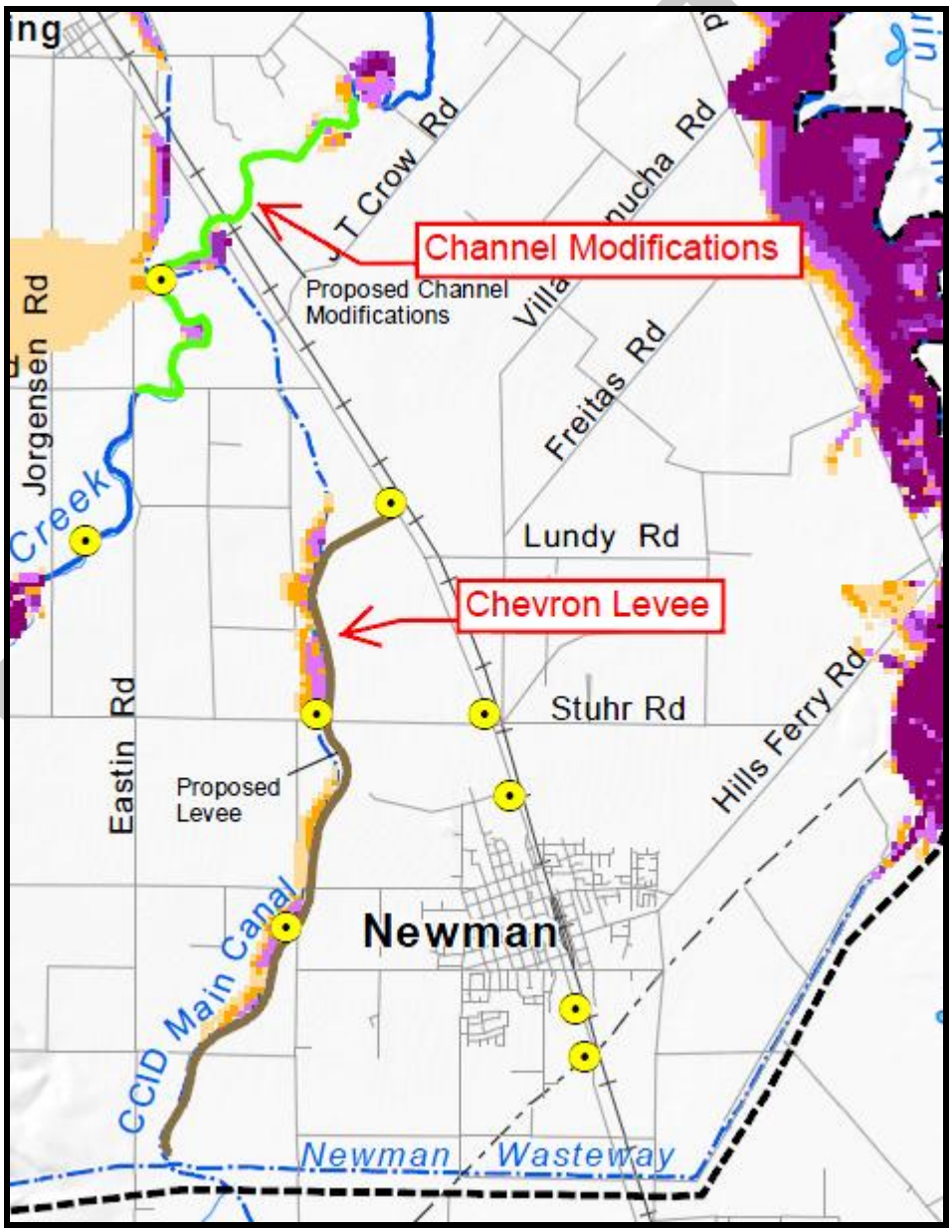
6.1.3.1 Alternatives Carried forward from Preliminary Screening for Further Evaluation

As a result of the preliminary screening, the following alternatives were carried forward for additional, more detailed, analysis and optimization as they appeared to have the highest incremental net benefits. Locations for these alternative measures are shown in Figure 6-1.

- No Action
- Chevron Levee (Farm Rd.Levee)
- Chevron Levee + Channel Modifications (Hybrid 3)

Figure 6-1: Location of the Chevron Levee and Channel Modifications



6.1.4 Optimization of the Chevron Levee Height

The chevron levee height was optimized by inserting incrementally higher levees into HEC-FDA and comparing the increased benefits to the estimated incremental costs. Costs were estimated by Cost Engineering for a levee equal to the mean 2% (1/50) annual chance WSEL and the mean 0.5% (1/200) annual chance WSEL + 3ft. These two values were then used to create a linear interpolation between the two points in order to estimate the cost of incrementally higher levees. These costs include only those costs that are variable depending on the height of the levee (mostly fill material). The index point used for this incremental analysis was the Stuhr Rd. and CCID canal intersection, so the benefits here appear higher than those reported in the without project chapter of this report, but this is due to the rating curve and stage uncertainty as discussed above in section 5.5. The final benefits used for economic justification will be based on the without project conditions as summarized in Table 5-5. In addition, costs reported here do not reflect Total Project First Costs, instead these costs represent only those variable costs in relation to levee height. Total Project First Costs can be found in Table 7-1. This analysis is solely used for optimization of the levee height in order for costs and residual benefits to be determined in more detail on only one plan. As shown in Table 6-2 below, the optimal elevation for the top of levee at this index point is determined to be around 112.75 feet, which equates to a levee 5.5 to 8 feet tall depending on the ground elevation changes along the levee alignment. It is noted here that this height is higher than the mean 0.2% (1/500) WSEL, but because of the alluvial fan type of flooding, the mean 0.2% (1/500) WSEL is only 9 inches higher than the mean 2% (1/50) mean WSEL.

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Table 6-2: Optimization of the Chevron Levee height at Stuhr Rd and CCID Canal Crossing

Return Period	Levee Elevation (ft.)	*Annual Benefits ($1,000's)	*Annual Costs ($1,000's)	*Net Benefits ($1,000's)
1/50	111.21	6,079	749	5,330
	111.25	6,188	753	5,435
	111.5	6,412	777	5,636
	111.75	6,612	800	5,812
1/500	112	6,785	823	5,962
	112.25	6,910	847	6,063
	112.5	6,990	870	6,120
	112.75	**7,035**	**893**	**6,142**
	113	7,056	917	6,139
	113.25	7,064	940	6,124
	113.5	7,066	964	6,103
	113.75	7,067	987	6,080
	114	7,067	1,010	6,057
	114.25	7,067	1,034	6,034
1/200+3ft	114.8	7,067	1,085	5,982

**The Benefits and Costs shown here are different than those presented in Chapter 3 of the main report, because these show the actual values used for the sensitivity, while the main report has adjusted those values to reflect total project benefits and costs. Annual Benefits, Annual Costs and Net Benefits shown here do not reflect actual benefits and total costs used for final net benefit and BCR calculations. The index point used for this height optimization exercise is different from the one used for economic justification. Benefits and costs used for economic justification can be found in Table 7-1. More information about different index points and the effect on damages in this study area is shown in Section 5.5.*

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6.1.4.1 Sensitivity of Optimization Height to Index Location

The optimization of the levee height must use an index point at a location where the levee would be located to come up with a proper levee elevation. The particular index point location for the optimization was chosen because it was the first point that flooding overtopped the existing CCID canal (near Stuhr Rd), which is adjacent to the chevron levee's location. This was the original location for the economic evaluation as well, but the index was changed later based on rating curve sensitivity for high probability events (see section 5.5) and likely overestimation of EAD. Because the CCID Canal location and the eventual urban economic analysis index location (intersection of Lundy Rd. and the Railroad) have rating curves with nearly identical slopes for lower probability events (2% (1/50) annual chance event and above), the difference in an optimization height was assumed negligible. To confirm this assumption, a sensitivity analysis was performed using the Lundy Rd. index location and the optimal heights were found to be within 0.2 ft of each other and well within error bands in stage/ground elevations. The

optimized height is approximately 1.5ft above the existing mean 2% (1/50) WSEL, which seems reasonable for an alluvial fan floodplain given uncertainty in ground elevations and stages.

6.1.5 Incremental Analysis of the Channel Modifications

Although the channel modification (and associated "Hybrid" Plans) appeared to be incrementally justified during the preliminary screening of alternatives, more detailed cost estimates showed the increment to be significantly more costly. Because the channel modifications are a second increment to the project after the chevron levee, the benefits for this increment come from the Rural EIA and the ability of the modified creek to better contain some of the more frequent event flows which cause more significant flooding under existing conditions. See Figure 6-1 for the location of the Channel Modifications and see the Hydraulics Appendix for floodplains and more detailed information about this residual flooding. Updated incremental benefits for the Channel Mods as part of the "Hybrid" plan are shown in the table below.

Table 6-3: Incremental Benefits of Channel Modifications
October 2011 Prices ($1,000's), 4% Interest Rate

Alternative	Annual Damages	Annual Benefits	Incremental Benefits
Without Project	5,413	0	0
1. Chevron Levee	2,285	3,128	3,128
2. Chevron Levee + Channel Mods	1,800	3,613	484
3. Local Plan (Taller Levee + Mods)	1,800	3,613	0

Updated floodplains and economics showed the incremental annual benefits for the channel modifications to be around $500 thousand. Updated (but not completed) costs for the channel modifications were estimated to be around $1.3 million in annual costs ($28 million first costs) on the lower end. These costs are on the low end because they did not yet include environmental mitigation, OMRR&R or real estate costs, which could add another $1 million in annual costs to the increment. Before these additional costs are added to the channel modifications, it has an incremental benefit-to-cost ratio of 0.39 to 1, and thus "The Hybrid" plan was dropped from the federal interest as being economically infeasible. Development of more detailed MCACES level costs for this increment for the final array of alternatives was forgone.

6.2 The Final Array of Alternatives

Economic efficiency is measured based on the maximization of project net benefits. Net benefits are determined as the difference between the annual benefits and the annual costs of an alternative. While net benefits were very similar for many of the preliminary plans, it was

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determined that the Farm Rd alternative was more economically efficient than a Stuhr Rd option. The interceptor channel was also removed as it did not provide a positive incremental net benefit. The team decided to move forward into the final array with the following 3 alternatives:

1. No Action Plan
2. Chevron Levee: Chevron levee at optimized height (TOL elevation of 112.75 feet. (Alts 7-9 in Table 6-1).
3. Local Plan: Chevron Levee set at a height equal to the mean 0.5% (1/200) WSEL + 3 Feet; TOL elevation of 114.8 feet. (Not listed in Table 6-1)

These alternatives were analyzed in more detail using updated hydraulic floodplain modeling, economic modeling and costs. A map showing the locations for the chevron levee and channel modifications (which dropped out) are shown in Figure 6-1 above. For a more detailed description of these alternatives, please see the main report.

6.3 Annual Benefits for the Final Array of Alternatives

The mean annual benefits for the final 3 alternatives can be found by Economic Impact Area in the tables below. Note that there is no incremental benefit for the Local Plan because the incrementally higher levee height does not provide an additional measurable benefit to the city of Newman and is mainly to comply with State of California requirements Senate Bill 5 requirements for urban and urbanizing areas.

Residual Damage in the Urban EIA with the Chevron Levee in place consist of existing storm drainage damages caused by rain events above a 10% (1/10) annual chance frequency.

It's noted that the damages/benefits for the final array are higher than those reported in the 2009 screening phase (Table 6-1). This increase is mainly due to an updated hydraulic model in which flooding happens slightly more frequently and shows flooding occurring in areas of Newman that were not previously flooded during the screening phase.

Table 6-4: Annual Benefits – The Final Array – Rural EIA
October 2011 Prices ($1,000's), 4% Interest Rate

Alternative	Annual Damages	Annual Benefits	Incremental Benefits
1. No Action	2,284	0	0
2. Chevron Levee at 112.75ft	2,085	198	198
3. Chevron Levee at 114.8ft	2,085	198	0

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Table 6-5: Annual Benefits – The Final Array – Urban EIA
October 2011 Prices ($1,000's), 4% Interest Rate

Alternative	Annual Damages	Annual Benefits	Incremental Benefits
1. No Action	3,130	0	0
2. Chevron Levee at 112.75ft	200	2,930	2,930
3. Chevron Levee at 114.8ft	200	2,930	0

Table 6-6: Annual Benefits – The Final Array – TOTAL Study Area
October 2011 Prices ($1,000's), 4% Interest Rate

Alternative	Annual Damages	Annual Benefits	Incremental Benefits
1. No Action	5,413	0	0
2. Chevron Levee at 112.75ft	2,285	3,128	3,128
3. Chevron Levee at 114.8ft	2,285	3,128	0

6.4 Probability Distribution – Damages Reduced

In accordance with ER 1105-2-101, flood damages reduced were determined as mean values and by probability exceeded. The tables below show the benefits for each alternative for the 75%, 50% and 25% probability that benefit exceeds indicated value. The damage reduced column represents the mean benefits for each increment and the 75%, 50% and 25% represent the probability that the flood damage reduction benefits exceed the number in that column for that increment. For example, Alternative 1, the Chevron Levee, has an average (mean) benefit of $3.1 million, but a 50% chance that benefits will be greater than $$2.7 million, 75% confidence that benefits will be equal or greater than $1.3 million and 25% confidence that benefits will exceed $4.4 million. This range is the probability distribution of damages reduced and represents the uncertainty in the benefit estimates and incorporates all the uncertainties in hydrology, hydraulics, and economics in the HEC-FDA model. The uncertainty in damages reduced should be considered when selecting an optimal plan during the plan formulation process. Judgment should be used to determine if an alternative meets a reasonable level of confidence regarding positive net benefits and identifying if changes in net benefits from alternative to alternative are significant. As noted in section 5.5, the use of different index points for the Urban EIA can impact this range of uncertainty significantly.

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Table 6-7: Probability Distribution of Damages Reduced – Rural EIA
October 2011 Prices ($1,000's), 4% Interest Rate

Alternative	Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
	Without Project	With Project	Damage Reduced	75%	50%	25%
1. No Action	2,284	2,284	0	0	0	0
2. Chevron Levee at 112.75ft	2,284	2,085	198	19	121	321
3. Chevron Levee at 114.8ft	2,284	2,085	198	19	121	321

Table 6-8: Probability Distribution of Damages Reduced – Urban EIA
October 2011 Prices ($1,000's), 4% Interest Rate

Alternative	Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
	Without Project	With Project	Damage Reduced	75%	50%	25%
1. No Action	3,130	3,130	0	0	0	0
2. Chevron Levee at 112.75ft	3,130	200	2,930	1,263	2,558	4,043
3. Chevron Levee at 114.8ft	3,130	200	2,930	1,263	2,558	4,043

Table 6-9: Probability Distribution of Damages Reduced – TOTAL Study Area
October 2011 Prices ($1,000's), 4% Interest Rate

Alternative	Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
	Without Project	With Project	Damage Reduced	75%	50%	25%
1. No Action	5,413	5,413	0	0	0	0
2. Chevron Levee at 112.75ft	5,413	2,285	3,128	1,282	2,679	4,363
3. Chevron Levee at 114.8ft	5,413	2,285	3,128	1,282	2,679	4,363

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6.5 Project Performance – With Project Conditions

Table 6-10 and Table 6-11 below show a comparison of project performance under both with and without project conditions by economic impact area.

The annual exceedance probability measures the chance of having a damaging flood in any given year. As larger increments are analyzed, the annual exceedance probability (AEP) drops.

The long-term risk numbers measure the chance of having one or more damaging flood over a giver period of time. As shown in Table 6-11 building the chevron levee reduces the chance of getting damaged (within the Urban EIA) over the next 30 years from 100% under the without project condition to only 1% with the project.

The assurance probability measures the probability of not being damaged if a given event were to occur. As with the other measures, project conditions reduce the risk and larger projects have a greater reduction in risk than small projects. The Assurance for the 1% annual chance event is often targeted to determine if a project meets Corps criteria for levee certification. It is important to note the relationship between AEP and Assurance in determining project accomplishment. For example, in the rural impact area, adding the channel modifications takes the area from a 1% annual chance of non-damage to a 5% chance of non-damage due to a 1% annual chance flood event. To be 90% confident that the 1% annual chance event can pass without causing damage in the rural impact area, a larger project with a smaller AEP must be constructed. This often causes confusion in how to identify the performance of a project in a single traditional term such as "100-year level of protection," and as per the guidance ER 1105-2-101, the Corps has dropped all reference to describing level of protection.

It is noted that the Assurance for the chevron levee in the urban area is extremely high even for low frequency events. This is due to the relatively small change in stages going from frequent to non-frequent events in an alluvial fan floodplain. While Assurance appears high, the federal interest chevron levee still does not meet FEMA levee certification criteria as it falls about 1.5 feet short of the FEMA certification criteria. According to EC-1110-2-6067, FEMA levee certification requires a levee to be either: a) 3ft above the mean 1% annual chance WSEL and has 90% Assurance for the 1% annual chance event OR b) 2ft above the mean 1% annual chance WSEL and 95% Assurance for the 1% annual chance event. The levee for Alternative 3 (Local Plan) would meet FEMA levee certification criteria.

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Table 6-10: Project Performance – Rural EIA

Alternative	Annual Exceedance Probability		Long-Term Risk			Conditional Non-Exceedance Probability by Events			
	Median	Expected	10 Year Period	30 Year Period	50 Year Period	10%	2%	1%	0.20%
1. No Action	24.31%	24.22%	94%	99%	99%	6%	2%	1%	1%
2. Chevron Levee at 112.75ft	24.31%	24.22%	94%	99%	99%	6%	2%	1%	1%
3. Chevron Levee at 114.8ft	24.31%	24.22%	94%	99%	99%	6%	2%	1%	1%

Table 6-11: Project Performance – Urban EIA

Alternative	Annual Exceedance Probability		Long-Term Risk			Conditional Non-Exceedance Probability by Events			
	Median	Expected	10 Year Period	30 Year Period	50 Year Period	10%	2%	1%	0.20%
1. No Action	14.43%	15.13%	81%	98%	99%	13%	0%	0%	0%
2. Chevron Levee at 112.75ft	0.01%	0.04%	0%	1%	2%	99%	99%	99%	98%
3. Chevron Levee at 114.8ft	0.00%	0.00%	0%	0%	0%	99%	99%	99%	99%

6.6 Other Benefits

Recreation Benefits

At this time, no recreation benefits have been computed as recreation has not been identified as a federal project purpose for Orestimba Creek.

Environmental Benefits

The alternatives could provide environmental outputs in addition to flood damage reduction. These benefits are non-monetary and were not part of the economic analysis. Details of the Environmental Quality (EQ) account outputs of the various alternatives can be found in the main report.

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Regional Economic Development (RED)

The US Army Corps of Engineers (USACE) planning guidance notebook (ER 1105-2-100) states that while National Economic Development (NED) and Environmental Quality (EQ) accounts are required, display of Regional Economic Development (RED) is discretionary. The Corps 1991 NED Procedures Manual states there should be no doubt that RED benefits are real and legitimate benefits. The concern, from a federal perspective, is that they are often offset by RED activity in other regions. But for the local community, these benefits are important and can help them in making their preferred planning decisions.

Existing guidance from USACE offers limited detail in describing either the definition or the procedures to determine RED. Principles and Guidelines (P&G 1983) states *that the RED account registers changes in the distribution of regional economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output and population.*

A detailed writeup of the RED analysis performed for Orestimba can be found in Attachment C.

Other Social Effects (OSE)

The OSE account describes the potential social effects of the project that are not covered by the National Economic Development (NED), Regional Economic Development (RED), and Environmental Quality (EQ) accounts. The four accounts comprise the Principles and Guidelines evaluation framework by which, according to ER 1105-2-100, any project's effects, beneficial and adverse, can be evaluated and the alternative subsequently "selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse."

A detailed writeup of the RED analysis performed for Orestimba can be found in Attachment D.

Additional Flood Related Risks

In addition to the monetary losses to categories listed above, flooding from Orestimba Creek could have other damage impacts and place many public services at risk, and if reduced would provide additional non-monetary benefit. Emergency costs (about 6% of total damages) evaluated in this appendix were limited to evacuation, relocation and temporary assistance based on examples of similar flood risks found on other flood damage studies in Northern California. Administrative costs and increased public services such as police and fire were not included in these emergency cost estimates primarily due to lack of available data regarding any comparable historical flooding within the area. Nationwide, where depth of flooding and duration of event were much greater, some studies have estimated total emergency costs (including temporary relocation, evacuation, public administration, additional emergency healthcare and increased labor) as high as 15% of the total without-project damages. While the emergency costs listed for

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Orestimba do not capture the total potential loss, these non-quantified losses are an incrementally-small portion of the overall losses and would not change the feasibility or formulation of any of the alternatives.

Potential traffic delays and temporary interruption in public services were also not quantified. State Highway 33 runs through the study area and may be closed shortly (a few days) from flooding along Orestimba Creek. Minor roads within the flood plain may also be closed for short durations due to flooding, but like Highway 33, alternate routes would not add significant time loss or additional resource consumption to the NED account. Because of the short durations and light normal traffic, losses for any traffic disruption that may occur were not analyzed.

Other non-monetary risks could also occur from a flood event but are not included in the NED evaluation. General reductions in risks to health, safety and public welfare are typically associated with flood conditions and are further reasons why flood protection serves the federal interest and the public good. Within the Orestimba Creek floodplain there are some public structures that could result in a loss of public services due to flooding at least one-foot above the first floor, but would not significantly impact plan formulation.

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7.0 Benefit-Cost Analysis

7.1 Annual Costs

With benefits calculations complete, annual costs need to be derived to complete the benefit cost analysis. Economic feasibility and project efficiency are determined through benefit cost analysis. For a project or increment to be feasible, benefits must exceed costs and the most efficient alternative is the one that maximizes net benefits (annual benefits minus annual costs).

For the benefit-cost analysis, these project costs need to be described in terms of annual costs. The project costs were amortized over the 50-year period of analysis using the current federal discount rate of 4%. Interest during construction was based on a 2 year construction schedule from 2015 to 2017 assuming uniform expenditure over the construction period. Detailed and itemized costs for the alternatives can be found in the Cost Appendix. Operation, Maintenance, Rehabilitation, Remediation and Repair (OMRR&R) were added for the total annual costs for each alternative.

7.2 Net Benefits

7.2.1 The NED Plan

With the Channel Modifications increment dropping from the Federal Interest, the optimized Chevron Levee becomes the NED Plan. This levee would be about 4-5 feet tall, depending on ground elevation changes along the levee alignment.

7.2.2 The Tentatively Recommended Plan

The only difference between the Tentatively Recommended Plan and the NED Plan is the height of the chevron levee. The height of the chevron levee for the local plan must meet State of California requirements (per Senate Bill 5) of being at least 3 feet above the with-project mean 0.5% (1/200) WSEL. This levee would be about 6-7 feet tall or approximately 2 feet taller than the federal interest levee.

7.2.3 Benefits and Costs

A more rigorous and detailed MCACES cost estimate was performed for the NED Chevron Levee and the LPP (Alternatives 2 and 3 respectively). Benefits and costs for these alternatives are provided in Table 7-1 below.

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Table 7-1: Total Annual Benefits and Costs by Alternative
October 2011 Prices ($1,000's), 4% Interest Rate
Based on a 50-year Period of Analysis

ITEM	FRM Costs/Benefits	
	NED Plan (Alt 2)	Tentatively Recommended Plan (Alt 3)
Investment Costs:		
First Costs	35,219	44,056
Less Cult Res	(281)	(353)
Less Sunk PED costs	0	0
Interest During Construction	2,141	2,679
Total	***37,079***	***46,382***
Annual Cost:		
Interest and Amortization	1,726	2,159
OMRR&R	164	180
Subtotal	***1,890***	***2,339***
Annual Benefits:	***3,128***	***3,128***
Net Annual FRM Benefits	***1,238***	***789***
FRM Benefit-Cost Ratio	***1.66***	***1.34***

The NED Plan is Alternative 2, the stand-alone Chevron Levee at the optimized elevation of 112.75 feet. The NED and it has an annual net benefit of $1.2 million and a Benefit-to-Cost Ratio (BCR) of 1.6. The Tentatively Recommended Plan is Alternative 3, the stand-alone Chevron Levee at an elevation of 114.8ft. The Recommended Plan has net annual benefits of $0.8 million and a BCR of 1.3

7.2.3.1 Net Benefits and BCR sensitivity to uncertainty

The table below summarizes the Net Benefits and BCR ranges for each of the final array of alternatives. The low annual benefit represents the 75% confidence (that benefits will exceed the indicated value), the mid represents the 50% and the high annual benefit represents the 25% confidence level. The low annual cost represents the 25% confidence (that costs will be less than the indicated value), the mid annual cost represents the 50% confidence and the high cost represents the 75% confidence. Net Benefit and BCR mean values and ranges were calculated in a Monte-Carlo simulation using a triangular distribution in the annual benefits and the annual costs. The mean Net Benefit and BCR represent the mean result from this Monte Carlo

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simulation. The low to high range represent the 90% confident interval (5%-95%), given our inputs.

The ranges in annual benefits, annual net benefits and BCR's include risk and uncertainty (R&U) in Hydrology, Hydraulics and Economics. The 50% annual benefit is very close to the annual benefit as calculated without R&U. The 75% confidence is more conservative and assumes that R&U is weighted on the low side (minus depths, minus structure value, add foundation heights, etc.). The 25% confidence annual benefit is more liberal and assumes R&U is weighted on the high side (add flow, add depths, add structure value, subtract foundation heights, etc.). In other words, we are most confident that Net Benefits and BCR will exceed the low values and become less confident as you move toward the high values, with the best estimate being the mean values. R&U analysis on the Orestimba Creek Feasibility Study is in accordance with ER-1105-2-101 and EM-1110-2-1619.

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Table 7-2: Net Benefits and Benefit-to-Cost Ratio Ranges – Final Array of Alternatives
October 2011 Prices ($1,000's), 4% Interest Rate

Alternative	Total First Cost (1,000)[1]			IDC ($1,000)[2]	Annualized Cost + O&M ($1,000)[3]			Annual Benefits ($1,000)[4]			Annual Net Benefits ($1,000)[5]			Benefit to Cost Ratio[5]		
	Low (25%)	Mid (50%)	High (75%)	Mid	Low (25%)	Mid (50%)	High (75%)	Low (75%)	Mid (50%)	High (25%)	Low	Mean	High	Low	Mean	High
SB-1: No Action	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
NED	33,736	34,843	36,017	2,205	1,669	1,723	1,781	1,282	2,679	4,363	22	1,054	2,133	1.0	1.6	2.2
LPP	41,285	42,927	44,260	2,719	2,042	2,123	2,189	1,282	2,679	4,363	-377	657	1,739	0.8	1.3	1.8

1 Cost Range: Min= 25% Mid=50% Max= 75% (confidence costs are less than given value)
2 IDC based on equal annual spending over a 2 year construction schedule.
3 First Costs plus IDC amortized over 50 years at 4% plus annual O&M. Annual O&M costs: NED = $164k, LPP = $180k
4 Benefit Range: Min=75% Mid=50% Max=25% (confidence benefits are greater than given value given all R&U)
5 Values are a result of Monte Carlo simulations using triangular distributions of annual benefit and annual cost confidence intervals as inputs. Mean = Mean result from Simulation. The 5% tails on the low and high end of the simulation result are not included.

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Attachment A: Without Project Hydrologic and Hydraulic Relationships Used in the FDA Model

Along with the economic stage-damage functions, hydrologic and hydraulic functions are part of the flood damage analysis model. The probability-discharge and stage-discharge relationships were provided and developed by the H&H members of the Orestimba study team. These relationships in Attachment A represent without project conditions.

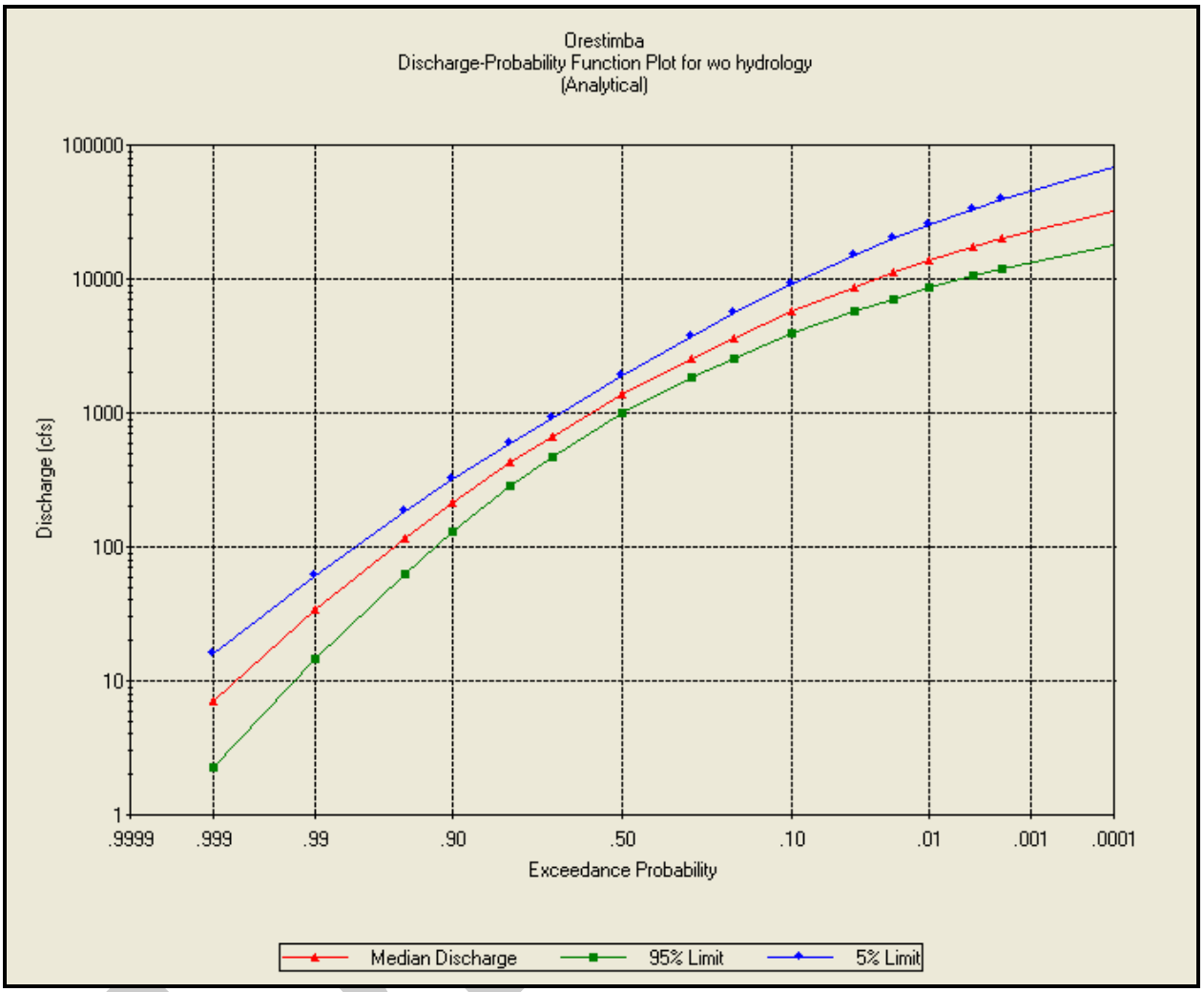
Probability Curves

For both Rural and Urban Areas, Exceedence probability-discharge curves were developed for the HEC-FDA model. An analytical Log Pearson Type III curve was used for this study (Mean=3.0782, Std. Dev.=0.5636, Skew=-0.6000, N=45). The discharge values in these relationships represent total flows both in channel and out in the floodplain. Table A1 displays the probability function used for both damage areas in the study.

Table A1 – Probability-Discharge Rural and Urban Impact Areas

Exceedance Probability	Discharge (cfs)	Confidence Limit Curves Discharge (cfs)			
		95%	75%	25%	5%
0.9990	7	2	4	12	16
0.9900	34	15	21	49	62
0.9500	116	63	83	155	184
0.9000	214	129	160	274	317
0.8000	424	282	335	524	597
0.7000	673	471	546	820	928
0.5000	1,362	989	1,124	1,656	1,891
0.3000	2,567	1,850	2,098	3,194	3,737
0.2000	3,642	2,578	2,938	4,629	5,521
0.1000	5,684	3,890	4,481	7,471	9,170
0.0400	8,701	5,717	6,676	11,863	15,017
0.0200	11,163	7,143	8,417	15,576	20,100
0.0100	13,738	8,589	10,201	19,556	25,654
0.0040	17,232	10,492	12,577	25,085	33,516
0.0020	19,978	11,951	14,414	29,521	39,926
0.0001	31,720	17,916	22,046	49,170	69,137

Figure A1 – Probability Discharge Curve



Rating Curves- Stage vs. Discharge

The following Table A2-E show the stage-discharge functions with uncertainty used in the HEC-FDA model. Stage represents elevation in channel and discharge is flow in channel. Curves were developed for both Rural and Urban impact areas.

Table A2 – Stage-Discharge Rural and Urban Areas

Event	Flow (cfs)	Urban IP		Rural IP	
		Stage (ft.)	Std. Dev. (ft.)	Stage (ft.)	Std. Dev. (ft.)
99.9%	0	84.1*	0.6	107.72	1.5
20.0%	3,634	96.12	0.6	119.74	1.5
10.0%	5,679	99.39	0.6	120.44	1.5
5.0%	7,946	99.48	0.6	120.75	1.5
2.0%	11,208	99.5	0.6	120.98	1.5
1.0%	13,831	99.6	0.6	121.08	1.5
0.5%	16,553	99.7	0.6	121.18	1.5
0.2%	20,255	99.79	0.6	121.27	1.5

*99.9% stage for Urban was modified for HEC-FDA runs to simulate the rural curve in the channel.

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Attachment B: Agricultural Economic Analysis

The Planning Guidance Notebook of the USACE (ER 1105-2-100) and the IWR Report 87-R-10 provide guidance and rules on the treatment of agricultural crops. These documents serve as the basis for the agricultural analyses. Further, damages expressed as annual values are calculated utilizing the FY12 discount rate of 4 percent with an analysis period of 50 years. All benefits and costs are expressed at an October 2011 price levels. The base operational year is 2015.

ER 1105-2-100, Appendix E, beginning on page E-113 includes specific guidance for studies where the primary damages occur to agricultural crops. Primary damages in this evaluation focus on the crop damage, loss of stored crops, and loss of farm equipment. These damages are directly related, and evaluated with special consideration for the expected time of seasonal flooding as well as the variability associated with crop prices and yields. The identified hydrologic/hydraulic variables, discharge associated with exceedence frequency and conveyance roughness and cross-section geometry, also apply to agricultural studies. Although the crop damage is directly related to the duration of flooding, damage to commodity storage and equipment is based on stage-damage relationships and is computed accordingly. Procedurally, the damage assessment is coordinated with the residential and non-residential structure/content damage analysis conducted using HEC-FDA, which is a USACE-certified planning model.

Farm Budget and Crop Data

Agricultural crop acreage was developed by the Sacramento District COE with the assistance of the Stanislaus County Agricultural Commissioner's Office using a Geographic Information System (GIS) platform. GIS mapping of agriculture allows for the overlay of floodplains generated by FLO-2D, which is a hydraulic engineering model, onto a separate GIS layer of crop acreages in order to identify the number of acres and types of crops flooded. .

Various crop budgets were obtained from the University of California at Davis' Agricultural & Resource Economics web site. Historical crop yields and values for various floodplain crops were obtained from the U.S. Department of Agriculture, National Agricultural Statistics Service web site of the Stanislaus County's Agricultural Commissioner's Annual Crop Report. Agricultural land restoration costs are based on previous USACE studies and farm budget reports. Monthly flood probabilities were derived based on the percentage of historical annual peak discharges occurring in each month as documented by the Water Management Section, Sacramento District COE; monthly probabilities are displayed in Table 1.

Agricultural Economic Damages Related to Flooding in Orestimba Creek Vicinity, California

The analysis below outlines the general concepts and procedures used in the computation of the agricultural damages incurred by assumed flood events within the study area.

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Procedures used in the Estimation of Agricultural Damages

The discussion below indicates considerations used in the computation of agricultural damages within the Orestimba Study Area.

The current land use for the Study Area was secured from the County Assessor data identified as the agricultural land area for each flood event.

The land/crop uses were categorized into five general categories for analytical and reporting purposes. The five general categories of land/crop use are:

1. Truck and Specialty Crops – including processing tomatoes
2. Field Crops – including row crops like corn, broccoli, and beans
3. Orchard – including walnuts and almonds
4. Alfalfa and irrigated pasture
5. Other – including lands irrigated and native pasture and lands that are idle, semi-agricultural, and native vegetation

Agricultural damages due to flooding for each acre are computed by adding four elements:

1) The cumulative direct production or annual variable costs incurred prior to flooding
2) The net value of the crop affected by the flood event
3) Depreciated value of perennial crops lost as a direct result of flooding
4) The land clean-up and rehabilitation resulting from flooding

Direct Production Costs

Cultural costs are incurred periodically throughout the crop year. Examples of these direct production costs include: seedbed preparation, chemical and fertilizer application, hired labor, seed, planting, and weed and pest control. These individual crop costs for the five crops are computed on a monthly basis to determine the amount of expended cultural costs at the time of the flood event. An example of the monthly production costs is included in Table 4 for the production of blackeye beans in the study area.

Net Value of Crop

The second component represents the net income of the crop plus return to fixed items of production such as land, labor and management, real estate taxes, and fixed costs associated with pre-harvest and harvest activities. The net value of the crop is the amount of revenue that the producer may not get if a significant flood event were to occur on his property.

For purposes of this analysis, the value of the crop is determined computationally by using a three to five year average for both yields and prices in order to alleviate some of the short-term variability that is common in agricultural production. The prices and yields are evaluated in an MS Excel spreadsheet analysis using the @Risk add-in software developed by the Palisades Corporation; this software allows uncertainty around key variables to be explicitly considered. For example, a triangular distribution which describes the low, high and median prices and yields was used to derive the appropriate crop values for use in this analysis.

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It is noted that short-term planning prices and yields should not be used for planning capital purchases that extend beyond the next production year. Review of land grant university's agricultural economics new releases indicate that the use of short-term yields and prices is not recommended because current supply/demand conditions rarely continue for long periods of time and are poor indicators of future trends. Instead, intermediate to long term planning prices and yields are most appropriate for evaluating alternative plans. *USDA Agricultural Projects to 2020*, published in February, 2011 by the Office of the Chief Economist, World Agricultural Outlook Board, USDA substantiates this claim. It indicates that projections based on specific assumptions surrounding macroeconomic conditions, public policy, weather/climate, and international development, with no domestic or external shocks to global markets, suggest that the long-run development for global agriculture reflects a resumption of steady world economic growth following the global recession and continued demand for biofuels. This analysis combined with the aforementioned assumptions support increases in consumption, trade, and prices. Based on the USDA analysis it is believed that the most recent prices used in this analysis may conservatively estimate benefits of flood projects. It is, however, difficult to quantify the price and yield increases, especially while also estimating cost of production increases, to arrive at a long-term net income per acre value. Accordingly, the most recent prices, yields, and cost of production are used in this analysis and considered appropriate for this level of evaluation.

Seasonality

Within the computational framework used for the crop damage analysis, the season of the year that the flood occurs greatly impacts the amount of crop damages sustained. If flooding occurs early within the year, the producer may be able to re-prepare the seedbed and plant, and ultimately may realize a return on his efforts. Conversely, a flood of substantial proportion occurring at harvest time will most certainly result in complete loss for the entire year.

The probability of a storm occurrence in any particular month was provided by the District hydrologist for the study area vicinity and describes the likelihood of a storm occurring for each month throughout the year. These monthly probabilities were used as input into the crop damage analysis.

. The monthly probability of flood occurrence was derived from peak annual flow data secured from the Water Management Section, USACE, Sacramento District. Due to year-to-year variability flood occurrences may be as much as 4 weeks early or later than the flood occurrence midpoint. These flood occurrence probabilities for the Newman study area are displayed below showing the flood event probabilities with uncertainty associated with each month:

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Table 1 - Monthly Flood Occurrence Probabilities

Month	Probability		
	Scenario Midpoint	Scenario Beginning	Scenario Ending
January	0.216	0.144	0.333
February	0.333	0.216	0.135
March	0.135	0.333	0.039
April	0.039	0.135	0.055
May	0.055	0.039	0.031
June	0.031	0.055	0.002
July	0.002	0.031	0.000
August	0.000	0.002	0.009
September	0.009	0.000	0.009
October	0.009	0.009	0.027
November	0.027	0.009	0.144
December	0.144	0.027	0.216

Multiplying the direct production costs and the value of crop at risk for each month times the monthly probability provides the probable damages expected if a flood event occurred in any particular month. Uncertainty parameters were used in the overall computation of both direct production losses and the net incomes for each crop affected.

Value of Perennial Crops

Damage caused by long-term duration flooding may result in permanent loss of perennial crops. The damage to perennials susceptible to flooding is computed based upon the assumption that the crop stands are at various ages, ranging from year 1 throughout their economic useful life. Accordingly, damage caused by long-term duration flooding is computed based upon a stand that is at the mid-point of its economic useful life. For example, a crop such as Almonds has a productive economic life of approximately 25 years. It is assumed that the stand is 12-13 years of age when the flood occurs. Using this assumption, half of the costs to establish the tree has been depreciated with half of the establishment costs remaining at risk.

Clean-up and Rehabilitation

Erosion and deposition of debris and sediment may be caused by floods of any duration or time of year. Additionally, drainage and irrigation ditches may become clogged with silt and debris. Interviews with cooperative extension agents and local farmers have been conducted over the past several years. Clean-up and rehabilitation of farm acreage is a genuine flood loss and is accounted for in the computation of agricultural flood damages accordingly.

Restoration of Field Cropland after Flooding

The requirement to restore agricultural land after it has been inundated by a flood will necessitate the removal of accumulated trash and debris, the addressing of sediment deposition, and the re-working of the fields to incorporate the sediment and to re-level the irrigated cropland. The

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restoration costs are based on estimates of cultural procedures from the University of California, Davis and range, for this type of flooding, from a cost of $0 to $208 for open and perennial planted cropland. The level of restoration requirement is consistent with the post-flood demands identified in other USACE studies.

Table 2 – Per Acre Field Cropland Restoration Costs

Operation	$ Cost/per Acre
Debris/Trash Removal	40.00
Subsoil and Roll (2X)	44.00
Chisel Field (2 times)	25.00
Laser Level (25%)	44.00
Triplane (2X)	22.00
Repair/Replace Irrigation System	33.00
Total	208.00

The average clean-up and restoration costs over the entire floodplain are estimated to be $96 per acre. However, based on the spreadsheet analysis using the Palisades @Risk software and a triangular distribution of low, high and median restoration costs the estimate is $115 per acre for this analysis. It is noted that the restoration costs include only those costs that re-establish the land to a condition prior to the incurrence of any of the expected annual production costs. Accordingly, restoration costs do not provide for fertilizing, applying herbicide, or any pre-planting activities that are expected to occur during the normal growing season.

Pollutants

In an article in the Los Angeles Times dated March 22, 2010 writer John Flesher discussed the possible environmental hazards associated with flooding in the Fargo North Dakota area. These impacts are similar to what could be expected in the Newman, California area and are related for informational purposes and, to the extent possible, are included in this economic analysis.

> *Floodwaters can be noxious brews of pesticides, sewage, garbage and animal carcasses that foul drinking water, spread disease and damage fish habitat. Although the Red River didn't do nearly as much damage this year as during record-breaking floods in 2009, authorities say danger could persist.*
>
> *"Fuels, chemicals, all kinds of things find their way into the water system and it's a huge environmental risk," said Keith Berndt, engineer for Cass County, which includes Fargo and West Fargo.*
>
> *"We don't want people to use used sand for old sand bags in their kids' sand boxes or anywhere else they could come in direct contact with it," said Myron Bergland, environmental health manager for Fargo-Cass Public Health.*

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Last year's disaster (2009) swept pollutants into the Red and its tributaries, although the sheer volume of water and accelerated flow rate weakened the effect, said David Glatt, environmental chief for the North Dakota Department of Health. Even as officials were ready to declare victory in this year's flood fight, Glatt emphasized the importance of safeguarding drinking water supplies, particularly in rural areas where private wells may have been submerged.

No large-scale water-quality testing was conducted in 2009, but officials monitored hospital emergency rooms and found no upswing in visits that would have indicated an outbreak of flood-related sickness, Glatt said. Officials credited experience and public education with preventing serious environmental health problems.

"We've had a little familiarity with floods in recent history," Glatt said. "People have had an opportunity to prepare and minimize the harm."

Cities in the region have reduced their exposure to contaminated water over the years by elevating wellheads or surrounding them with dikes to keep floodwaters out. But numerous wastewater treatment systems were overwhelmed during last year's flooding, forcing officials to dump raw sewage into the rivers. A few have requested permission to do likewise this year if necessary.

Private well users are particularly vulnerable. State and local agencies have provided information about protecting residential wells and stand ready to help disinfect contaminated ones. Fargo-Cass Public Health last week warned owners of submerged wells not to use the water for drinking or cooking until it can be tested. Agencies also urged people to secure household and farm chemicals, fuel tanks and other potential sources of pollution.

Dead livestock is a particular threat in Great Plains ranch country. Some 90,000 head of cattle were lost during last year's calamity. They're a potential source of pathogens that can pollute wells and surface waters.

"Even a typically normal, healthy cow has E. coli bacteria in its gut," Bergland said. "You need to properly dispose of the bodies before they drift away in the water."

State agencies, including the North Dakota National Guard, helped retrieve bloated carcasses and advised ranchers how to deal with them. It's not as simple as it sounds. If buried, the bodies must be placed above the water table under at least 4 feet of loamy, clay soils. If burned, only organic fuels such as wood can be used and a state permit is required.

Once immediate flood dangers have passed, ecological aftereffects can persist for months or years.

Phosphorus fertilizers that wash into rivers and lakes can stimulate growth of algae blooms that reduce oxygen levels and kill fish. Heavy soil erosion along riverbanks degrades fish habitat and spawning areas, particularly in streams that feed larger rivers such as the Red.

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"Think of trying to breathe in a dust storm," said Henry Van Offelen, a scientist with the Minnesota Center for Environmental Advocacy. "That's what a big sediment plume in water is for fish."

But the environmental setbacks are not always a total loss. Some of the leftover bag sand can be used in landfills to prevent liquid pollution from seeping into groundwater.

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Special Consideration for Specialty, Truck Crops, and Selected Field Crops

Vegetable crops raised for direct human consumption are vulnerable to passing on the E.Coli bacteria to humans through contamination from animals. In 2006 an E. coli outbreak traced to bagged spinach was blamed for the deaths of three people and for sickening hundreds more across the U.S. Authorities ultimately identified a central California cattle ranch next to a spinach field as being the source of the bacteria. In 2007 salad mix packaged by a major food processor tested positive for E.coli and triggered a recall in at least nine states. The ultimate cost to the processor and the producers are unknown but is determined to be of significant proportions and is deemed to be life threatening.

Between 1999 and 2006, there were 12 outbreaks of E. Coli traced to California leafy greens resulting in 539 reported illnesses. Of those 12 outbreaks, 10 were on fresh-cut leafy greens and those 10 outbreaks involved 531 of the illnesses. In addition to E. Coli, a recent announcement from the Centers for Disease Control and Prevention on June 11 of 2008 confirms that a salmonella outbreak has struck at least 167 people in 17 states. The Food and Drug Administration estimates that an average of 2 to 4 million cases of salmonellosis occur annually in the U.S. This particular outbreak (in 2008) was linked to raw tomatoes infected by microscopic bacteria that live in the intestinal tracks of people and animals. The infection is spread by the ingestion of raw or undercooked food and water that is contaminated with feces carrying the bacteria. Contaminated goods usually stem from animal origin but are not limited to and often include vegetation and water. In the 2008 incident, restaurants and supermarkets stopped selling tomatoes altogether or only carried tomatoes deemed safe by the FDA.

Even slight flooding of fields has the associated probability of carrying animal waste in the floodwater, and accordingly, may carry the E.coli and salmonella bacteria. In an article titled *Transmission of Escherichia coli 0157:H7 from Contaminated Manure and Irrigation Water to Lettuce Plant tissue and Its Subsequent Internalization,*[10] the authors stated:

> " *Application of E.coli 0517:H7-contaiminated manure to the production field or irrigation with E.coli 0157:H7-contaminated water may result in contamination of the crop in the field. Studies have indicated the E.coli can survive for extended periods in manure and water. We have demonstrated that lettuce grown in soil containing contaminated manure, or irrigated with contaminated water, results in contamination of the edible portion of the lettuce plant. Moreover, the results suggest that edible portions of a plant can become contaminated without direct exposure to a pathogen, but rather through transport of the pathogen into the plant by the root system.*"

The National Organic Producer regulation provides guidelines on the use of manure that is applied to croplands. There are guidelines associated with the management practices of using manure, which consider both the state of the manure and the intended use of the product to which the manure is being applied.

[10] Subject article written by Ethan B. Solomon, Sima Yaron, and Karl R. Matthews, Department of Food Science, Rutgers University, New Brunswick, New Jersey, appeared in "Applied and Environmental Microbiology," January 2002, p. 397-400, Vol 68, No. 108901.

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The producer must manage plant and animal materials to maintain or improve soil organic matter content in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances. Animal and plant materials include:

(1) Raw animal manure, which must be composted unless it is:

(i) Applied to land used for a crop not intended for human consumption;
(ii) Incorporated into the soil not less than 120 days prior to the harvest of a product whose edible portion has direct contact with the soil surface or soil particles; or
(iii) Incorporated into the soil not less than 90 days prior to the harvest of a product whose edible portion does not have direct contact with the soil surface or soil particles;

For purposes of this analysis, any flooding of truck crop acreage will result in the assumption that the vegetables are not fit for human consumption and valued as a total loss. It is deemed to be inappropriate to assume any salvage of vegetable matter for human consumption considering the risks associated with these deadly bacteria.

Planting of lands that have previously been flooded are not expected to be adversely affected since the organic materials are assumed to be incorporated into the soil well in advance of the time constraints currently provided by national guidelines.

Agricultural Inventory

The study area contains approximately 18,400 acres of agricultural lands that are subject to flooding. About 3,400 acres of the affected floodplain is devoted to high value orchard production; about 8,500 acres are planted with tomatoes used for processing, broccoli, and beans in addition to other crop types; the remaining acreage is devoted primarily to field crops such as pasture and alfalfa hay. These agricultural products have been consolidated into five different farm budget analyses. In addition to the damages revealed through farm budget analysis, damages to cropland and associated restoration costs have been included in the analysis.

Note in tables throughout the Agricultural Attachment, a flood frequency refers to the annual chance of a flood event. For example, “100” means a 1% (1/100) annual chance exceedance (ACE) event.

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Table 3. Acreage Inundated by Flood Event- Without Project

	----------Flood Frequency----------						
ACRES	5	10	20	50	100	200	500
FRUITS AND NUTS	1,408	2,304	2,800	3,082	3,212	3,316	3,441
FIELD CROPS	1,479	3,387	4,727	6,120	6,709	7,285	7,746
PASTURE & ALFALFA	542	2,237	2,873	3,639	3,937	4,314	4,764
RICE	0	0	0	0	0	0	0
TRUCK CROPS	1,073	1,332	1,631	1,922	2,249	2,476	2,724
VINE CROPS	0	0	0	0	0	0	0
OTHER	2,737	3,327	3,755	3,163	4,330	4,478	4,599
	7,239	12,587	15,786	17,926	20,437	21,869	23,274

Typical Farm Budget Example

A typical farm budget analysis employed for this analysis is shown in Table 4 below. It is provided to illustrate the cultural practices and cost considerations that are in a typical farm budget analysis process. These farm budgets secured from the UC Davis Crop Budget website are the basis used in the computation of the direct production costs that are used for the agricultural economic evaluation.

Totals do not necessarily add due to rounding of monthly data

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Table 4 – Blackeye Bean Farm Budget Analysis

	U.C. COOPERATIVE EXTENSION												
	MONTHLY COSTS PER ACRE TO PRODUCE BLACKEYE BEANS												
	SAN JOAQUIN VALLEY – 2008												
	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL
Cultural:		*	*	*	*	*	*						
Land Prep – Disc 2X							19						19
Land Prep – Shape Beds							17						17
Land Prep – List Beds							9						9
Irrigate – Pre-Irrigation							24						24
Irrigate – Make/Close Tail Ditch							2	2	1		1		6
Weed Control – Apply & Incorporate Preplant Herbicide(Treflan, Dual), 1Pass							22						22
Plant: Beans + Inoculant								24					24
Weed Control – Cultivate								5					5
Irrigate – Water and Labor 5X								20	46	46			112
Insect Control – Lygus (Warrior) Air									22	22			43
Pickup Truck – (bean business)	5					5	5	5	5	5	5	5	37
TOTAL CULTURAL COSTS	**5**	**0**	**0**	**0**	**0**	**5**	**97**	**55**	**73**	**72**	**6**	**5**	**318**
Cut and Rake Beans:											35		35
Thresh Beans:												72	72
Haul Beans to Warehouse												17	17
Clean, Bag& Grade												92	92
Store & Insurance												24	24
Assessments	6												6
TOTAL HARVEST COSTS											**35**	**205**	**246**
Interest on Operating Capital @ 7.65%							1	1	1	2	2	3	9
TOTAL OPERATING COSTS/ACRE:	**11**	**0**	**0**	**0**	**0**	**5**	**98**	**56**	**75**	**74**	**43**	**213**	**573**
OVERHEAD:													
Office Expense/Crop Insurance	3	0	0	0	0	3	3	3	3	3	3	3	25
Land Rent												225	225
Property Taxes/Insurance			21						20				41
Investment Repairs													1
TOTAL CASH OVERHEAD COSTS	3	0	21	0	0	3	3	3	23	3	3	228	292
TOTAL CASH COSTS/ACRE	**14**	**0**	**21**	**0**	**0**	**8**	**101**	**59**	**98**	**77**	**46**	**441**	**865**

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Using farm budget analysis, the per-acre damage values for major crop types in the study area have been determined. These values are presented in Table 5 below.

Table 5 - Per Acre Crop Value and Damage Estimate

Selected Crop Type	Gross Receipts*	Per Acre Damage**
Field Crop – Corn Silage	$1,051.00	$294.00
Truck Crop – Processed Tomatoes	$2,642.00	$639.00
Alfalfa Hay	$1,488.00	$543.00
Orchard – Walnuts	$3,763.00	$430.00

* Gross Receipts are based on a three year average of yields and prices received for the selected crops. Data were secured from current Stanislaus County Crop and Livestock Reports.

** Per Acre Damage is based on the monthly probability of flooding, the amount of annual costs incurred prior to the flood event, the loss of net income incurred as a result of the re-establishment of lost alfalfa and orchard acreage, removal of trash, and re-establishing the land to pre-flood condition.

A Palisades software program @Risk was used for evaluation of gross receipts. The @RISK software allowed for the modeling of uncertainties associated with crop yield and price. Table 6below reflects the statistics related to selected crops evaluated in this analysis.

Table 6
Statistical Evaluation of Selected Crops using @Risk
Based on Four-Year Prices and Yields

Selected Crop Type	Minimum	Maximum	Mean	Standard Deviation
Alfalfa Hay	$1,064	$1,984	$1,469	199.33
Almonds	$3,654	$4,650	$4,075	224.46
Common Beans	$1,143	$1,341	$1,237	43.03
Corn Silage	$680	$1,187	$925	122.50
Cotton	$984	$1,312	$1,148	75.05
Small Grain Silage	$361	$646	$502	70.12
Tomatoes - Processing	$1,797	$3,709	$2,823	440.53
Walnuts	$2,868	$4,527	$3,654	374.68

Damages to Farm Equipment and Storage

Equipment damages for each flood event were computed based upon the value of the on-farm equipment as indicated in the "University of California Cooperative Extension Sample Costs to Establish and Produce Associated Crops" and applied within the Orestimba Creek study area. The equipment listed in the crop farm budgets had an associated value for the each assumed crop enterprise. The value of equipment was used in the computation on an acre enterprise basis. An example of a hypothetical field and row-crop farm cultivating 1,200 acres of processing tomatoes appears in Table 7 below.

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Table 7
Equipment Valuation
Hypothetical Farm
Processing Tomato Enterprise
October, 2007 Price Levels

Yr	Description	Price	Yrs Life
06	110 HP 2WD Tractor	66,445	10
06	130 HP 2WD Tractor	69,163	10
06	155 HP 2WD Tractor	99,594	10
06	200 HP Crawler	172,650	10
06	425 HP Crawler	221,197	10
06	92 HP 2WD Tractor	44,015	10
06	ATV	4,017	10
06	Bait Applicator	2,473	20
06	Bed Shaper - 3 Row	13,292	10
06	Cultivator - Alloway 3 Row	10,236	10
06	Cultivator - 3 Row	11,868	5
06	Cultivator - Sled 3 Row	4,980	10
06	Decapper - 15'	7,952	10
06	Disc - Stubble 18'	49,847	5
06	Disc - Finish 25'	44,743	10
06	Ditcher - V	8,631	12
06	Harvester - Tomato - Used	46,108	8
06	Harvester - Tomato	331,980	8
06	Incorporator - 15'	24,345	10
06	Lister - 6 Row	20,176	5
06	Mulcher - 15'	20,507	9
06	Pickup Truck - 1/2 Ton	17,655	7
06	Pickup Truck - 3/4 Ton	17,655	7
06	Planter - 3 Row	21,025	7
06	Rear Blade - 8'	2,269	15
06	Rice Roller - 18'	14,139	10
06	Ringroller - 30'	7,952	10
06	Saddle Tank - 300 Gallon	2,374	10
06	Saddle Tank - 300 Gallon	2,374	10
06	Saddle Tank - 300 Gallon	2,374	10
06	Spray Boom - 25'	1,781	5
06	Subsoiler - 16' - 9 Shank	35,605	5
06	Trailer Dolly	1,451	15
06	Trailer Dolly	1,451	15
06	Trailer Dolly	1,451	15
06	Trailer Dolly	1,451	15
06	Triplane - 16'	22,253	10
06	Vine Diverter	16,046	10
06	Vine Trainer	4,800	10
06	TOTAL	1,448,325	
	60% of New Cost *	868,995	

* Used to reflect a mix of new and used equipment

Farm machinery prices for the equipment is adjusted based on the year the budget was reported by UC Davis, California. Table 8 provides the indices used to update the cost of equipment to current dollars. In the case of tomatoes, the most applicable budget was provided in October 2007 dollars. This cost ($886,995) is updated by multiplying the cost by the appropriate factor of 1.15 (189/165). The resultant, $1,020,044 is then divided by 1,200 acres to yield an equipment value of $850 per acre. This number ($850) is then multiplied by the total number of truck crop acres that are flooded in the study area for each flood event to estimate the value of the equipment within the flood plain for each annual chance flood event.

Table 8. Index of Prices Paid- Machinery
1990-92 = 100

Year	Index
2005	152
2006	158
2007	165
2008	175
2009	184
2010	189
2011	194

Flood Notification Time Adjustment

It is recognized that, given adequate warning time, a certain amount of farm motorized vehicles may be driven to higher ground thereby reducing the chances of flood damage. It is assumed that 30 percent of the motorized vehicles, including tractors, ATV's, and trucks could be moved which would decrease the expected losses accordingly. Based on this assumption the value of equipment subjected to flood is reduced from $595 for each acre of tomatoes flooded.

Using the above methodology, equipment values per acre are computed for each agricultural class. The values computed are: Orchard Land, $759; Field and Truck Crops, $595; Vine Grapes, $593; and Alfalfa, $129. The equipment value per acre for each agricultural class is multiplied by the number of acres in Table 3 above to arrive at the total value of equipment inundated per event. Due to the depth of flooding, it is assumed that a flood event would cause a ten percent loss in the equipment valuation.

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Table 9
Without Project Damages by Event
Agricultural Equipment Loss by Flood Event
October, 2011 Price Levels

	---------- Flood Frequency----------						
EQUIPMENT LOSSES	**5**	**10**	**20**	**50**	**100**	**200**	**500**
FRUITS AND NUTS	52,237	85,478	103,880	114,342	119,165	123,024	127,661
FIELD CROPS	56,202	128,706	179,626	232,560	254,942	276,830	294,348
PASTURE & ALFALFA	21,951	90,599	116,357	147,380	159,449	174,717	192,942
RICE	0	0	0	0	0	0	0
TRUCK CROPS	40,774	50,616	61,978	73,036	85,462	94,088	103,512
VINE CROPS	0	0	0	0	0	0	0
OTHER	104,006	126,426	142,690	120,194	164,540	170,164	174,762
TOTAL	275,170	481,825	604,531	687,512	783,558	838,823	893,225

* Seventy-five percent of the Pasture and Alfalfa Class is assumed to be used for alfalfa hay and equipment is appropriately adjusted.

From discussions with local farmers, most of the commodities grown in the study are sold or stored in an area outside of the inundation area. The exception to this is the hay that is stored for use by area livestock. For purposes of this analysis it is assumed that the hay, when cut, is stacked at the edge of the field. Accordingly, the hay is accumulated from its first cutting at the beginning of May to its last cutting at the end of October. It is expected that the hay is used up proportionately during the five-month period of November through March of the following year. Using these assumptions, the annual storage at risk per acre is computed below in Table 10.

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Table -10
Value of Alfalfa Hay Subject to Flooding
October, 2011 Price Levels
Without Project

	----------Accumlation Phase----------							----------Depletion Phase----------				
	Apr	May	Jun	Jul	Aug	Spt	Oct	Nov	Dec	Jan	Feb	Mar
Value of Hay	0	189	378	567	756	945	1134	1323	1058	793	528	265
Probability*	0.047	0.06	0.03	0	0	0.01	0.009	0.027	0.144	0.216	0.275	0.135
Computed Loss**	0.00	10.40	11.72	1.13	0.00	4.73	10.21	35.72	152.35	171.29	145.20	35.78
Ave Annual Loss***		$578.51										

* Probability is the estimated probability of a flood event happening in a given month.
** Computed loss is the value of alfalfa hay expected to be lost given a flood event during a given month.
*** Average annual loss is the weighted average of monthly computed losses.

The number of acres of alfalfa presented in Table 11 below was used as a basis to compute losses that are expected to occur for each flood event. Alfalfa hay is assumed to represent approximately 75 percent of the total hay and pasture acreage in the study area. The acreage figures were adjusted accordingly. In addition, because the depth of flooding is very shallow, not all hay is expected to be unsalvageable. It is assumed that not more than 50 percent of the hay would come into direct contact with floodwater and the computation was adjusted to reflect that estimate.

Table 11
Without Project Damages by event
Alfalfa Hay Loss by Selected Flood Event
October, 2011 Price Levels

AG CLASS	5	10	20	50	100	200	500
Pasture & Alfalfa	542	2,237	2,873	3,639	3,937	4,314	4,764
Value of Hay per Acre at Risk	579	579	579	579	579	579	579
Adjust for Alfalfa Hay Only	407	1,678	2,155	2,729	2,953	3,236	3,573
Total Value of Hay at Risk	235,166	970,602	1,246,553	1,578,909	1,708,207	1,871,782	2,067,031
Adjusted for Direct Contact with Water	117,583	485,301	623,277	789,455	854,104	935,891	1,033,515

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Table 12
Agricultural Damages by Flood Event
Without Project Damages by event

Total Estimated Dollars of Damages by Event*

	---------- Flood Frequency----------						
CROP LOSS	**5**	**10**	**20**	**50**	**100**	**200**	**500**
FRUITS AND NUTS	1,293,238	2,116,207	2,571,780	2,830,794	2,950,199	3,045,722	3,160,533
FIELD CROPS	306,082	692,294	957,111	1,229,748	1,354,587	1,495,910	1,588,125
PASTURE & ALFALFA	219,817	907,253	1,165,193	1,475,857	1,596,716	1,749,615	1,932,120
RICE	0	0	0	0	0	0	0
TRUCK CROPS	942,978	1,170,593	1,433,362	1,689,100	1,976,475	2,175,968	2,393,916
VINE CROPS	0	0	0	0	0	0	0
OTHER	69,559	86,850	98,873	84,829	114,613	118,943	122,892
TOTAL	2,831,674	4,973,197	6,226,318	7,310,328	7,992,590	8,586,157	9,197,587
EQUIPMENT LOSSES							
FRUITS AND NUTS	52,237	85,478	103,880	114,342	119,165	123,024	127,661
FIELD CROPS	56,202	128,706	179,626	232,560	254,942	276,830	294,348
PASTURE & ALFALFA	21,951	90,599	116,357	147,380	159,449	174,717	192,942
RICE	0	0	0	0	0	0	0
TRUCK CROPS	40,774	50,616	61,978	73,036	85,462	94,088	103,512
VINE CROPS	0	0	0	0	0	0	0
OTHER	104,006	126,426	142,690	120,194	164,540	170,164	174,762
TOTAL	275,170	481,825	604,531	687,512	783,558	838,823	893,225
ALFALFA STORAGE LOSSES							
ALFALFA HAY LOSS	117,583	485,301	623,277	789,455	854,104	935,891	1,033,515
GRAND TOTAL	**3,224,427**	**5,940,323**	**7,454,125**	**8,787,294**	**9,630,251**	**10,360,871**	**11,124,327**

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Analysis of Project Alternatives

Three project alternatives are considered for in-depth analysis in this evaluation, including the no action alternative.

No Action. The Corps is required to consider the option of "No Action" as one of the alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA). No action assumes that no project would be implemented by the Federal Government or by local interests to achieve the planning objectives. No Action, which is synonymous with the "Without Project Condition", forms the basis from which all other alternative plans are measured. The No Action has no costs or flood damage reduction benefits.

Channel Mods Only – In order to increase the level of protection to the agricultural area, modifications to enlarge the Orestimba Creek channel were examined. The channel modifications would enlarge the channel flow cross-section for additional capacity. The existing channel would be widened at several specific sites where the channel capacity is most constricted. The goal of this alternative would be to accommodate flows up to 4,000 cfs within the Orestimba Creek channel; flows higher than this design level would overtop the creek channel and flow overland.

Chevron Levee Only – The plan includes a chevron levee that would specifically protect the City of Newman by directing floodflows away from the urban area. The levee would divert floodflows that break out of Orestimba Creek and flow overland across the alluvial fan. The levee would be comprised of two segments. The first segment of the levee would be constructed by raising the existing elevation of an east-west road by several feet. The second segment would be comprised of enlarging the existing berm of an irrigation canal that runs north to south to prevent floodflows from overtopping the canal bank and flowing in to town.

Cheveron Levee + Channel Mods – The plan would include a chevron levee constructed along an unnamed farm road about one mile north of Stuhr Road, and improvement of the east bank of the CCID Main Canal from the farm road south to Newman Wasteway, a distance of about four miles. Hybrid 3 would also include increasing the capacity of Orestimba Creek from its present minimum of 1,700 cfs to a uniform minimum capacity of 3,500 cfs.

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Channel Modification Only

Implementation of Alternative 2 results in the following acreage inundated by flood event. (Table 11)

Table 11. Acreage Inundated by Flood Event Frequency – Channel Modification

	---------- Flood Frequency----------						
ACRES	5	10	20	50	100	200	500
FRUITS AND NUTS	590	1,797	2,632	3,200	3,366	3,504	3,644
FIELD CROPS	995	1,779	3,197	5,637	6,420	6,946	7,348
PASTURE & ALFALFA	358	747	1,786	2,932	3,642	3,949	4,424
RICE	0	0	0	0	0	0	0
TRUCK CROPS	824	1,208	1,490	1,831	2,170	2,398	2,649
VINE CROPS	0	0	0	0	0	0	0
OTHER	2,697	3,128	3,397	3,938	4,264	4,438	4,566
TOTAL	5,464	8,659	12,502	17,538	19,862	21,235	22,631

Damages to crops, equipment, and hay stored in the field for Channel Mods Only are presented in Table 12 below. The methodology for the computation of the damages to each category is the same as explained in the "Without Project" discussion previously presented.

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Table 12
Agricultural Damages by Flood Event
Channel Modification Project Damages by Event

Total Estimated Dollars of Damages by Event*

	---------- Flood Frequency----------						
CROP LOSS	5	10	20	50	100	200	500
FRUITS AND NUTS	541,911	1,650,531	2,417,473	2,939,177	3,091,646	3,218,398	3,346,987
FIELD CROPS	213,003	367,039	642,407	1,131,225	1,290,704	1,428,343	1,510,102
PASTURE & ALFALFA	145,193	302,958	724,342	1,189,122	1,477,074	1,601,583	1,794,227
RICE	0	0	0	0	0	0	0
TRUCK CROPS	724,151	1,061,619	1,309,448	1,609,127	1,907,048	2,107,420	2,328,005
VINE CROPS	0	0	0	0	0	0	0
OTHER	67,971	79,607	87,718	103,154	112,186	117,313	121,311
TOTAL	1,692,229	3,461,755	5,181,388	6,971,804	7,878,658	8,473,057	9,100,632
EQUIPMENT LOSSES							
FRUITS AND NUTS	21,889	66,669	97,647	118,720	124,879	129,998	135,192
FIELD CROPS	37,810	67,602	121,486	214,206	243,960	263,948	279,224
PASTURE & ALFALFA	14,499	30,254	72,333	118,746	147,501	159,935	179,172
RICE	0	0	0	0	0	0	0
TRUCK CROPS	31,312	45,904	56,620	69,578	82,460	91,124	100,662
VINE CROPS	0	0	0	0	0	0	0
OTHER	102,486	118,864	129,086	149,644	162,032	168,644	173,508
TOTAL	207,996	329,292	477,172	670,894	760,832	813,649	867,758
ALFALFA STORAGE LOSSES							
ALFALFA HAY LOSS	77,666	162,056	387,460	636,076	790,105	856,707	959,755
GRAND TOTAL	1,977,890	3,953,103	6,046,020	8,278,774	9,429,595	10,143,413	10,928,145

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Levee Only

Implementation of Alternative 100- Infinite Levee results in the following acreage inundated by flood event. (Table 13)

Table 13. Acreage Inundated by Flood Event- Levee Only

	---------- Flood Frequency----------						
ACRES	5	10	20	50	100	200	500
FRUITS AND NUTS	1,408	2,282	2,781	3,061	3,192	3,300	3,428
FIELD CROPS	1,479	2,921	3,974	5,351	5,879	6,385	6,816
PASTURE & ALFALFA	542	1,846	2,208	2,589	2,848	3,179	3,543
RICE	0	0	0	0	0	0	0
TRUCK CROPS	1,073	1,309	1,602	1,893	2,137	2,369	2,624
VINE CROPS	0	0	0	0	0	0	0
OTHER	2,737	3,279	3,519	3,757	3,976	4,280	4,464
TOTAL	7,239	11,637	14,084	16,651	18,032	19,513	20,875

Damages to crops, equipment, and hay stored in the field for the levee only are presented in Table 14 below. The methodology for the computation of the damages to each category is the same as explained in the "Without Project" discussion previously presented.

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Table 14
Agricultural Damages by Flood Event
Levee Only Project Damages by Event

Total Estimated Dollars of Damages by Event*

	---------- Flood Frequency----------						
CROP LOSS	5	10	20	50	100	200	500
FRUITS AND NUTS	1,293,238	2,096,000	2,554,328	2,811,506	2,931,829	3,031,026	3,148,593
FIELD CROPS	306,082	586,659	790,351	1,061,097	1,166,197	1,266,770	1,352,919
PASTURE & ALFALFA	219,817	748,676	895,491	1,050,012	1,155,054	1,289,296	1,436,923
RICE	0	0	0	0	0	0	0
TRUCK CROPS	942,978	1,150,381	1,407,876	1,663,614	1,878,047	2,081,934	2,306,034
VINE CROPS	0	0	0	0	0	0	0
OTHER	69,559	84,726	91,671	98,230	104,524	112,775	118,236
TOTAL	2,831,674	4,666,442	5,739,717	6,684,459	7,235,651	7,781,801	8,362,705
EQUIPMENT LOSSES							
FRUITS AND NUTS	52,237	84,662	103,175	113,563	118,423	122,430	127,179
FIELD CROPS	56,202	110,998	151,012	203,338	223,402	242,630	259,008
PASTURE & ALFALFA	21,951	74,763	89,424	104,855	115,344	128,750	143,492
RICE	0	0	0	0	0	0	0
TRUCK CROPS	40,774	49,742	60,876	71,934	81,206	90,022	99,712
VINE CROPS	0	0	0	0	0	0	0
OTHER	104,006	124,602	133,722	142,766	151,088	162,640	169,632
TOTAL	275,170	444,767	538,209	636,456	689,463	746,472	799,022
ALFALFA STORAGE LOSSES							
ALFALFA HAY LOSS	117,583	400,476	479,010	561,665	617,853	689,661	768,628
GRAND TOTAL	3,224,427	5,511,686	6,756,936	7,882,579	8,542,967	9,217,934	9,930,355

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Channel Modification and Levee

Implementation of Alternative 140-Channel Mod and Levee results in the following acreage inundated by flood event. (Table 15)

Table 15. Acreage Inundated by Flood Event- 140-Channel Mod and Levee

	Flood Frequency						
ACRES	5	10	20	50	100	200	500
FRUITS AND NUTS	590	1,798	2,625	3,183	3,349	3,490	3,631
FIELD CROPS	995	1,779	3,065	5,019	5,659	6,070	6,471
PASTURE & ALFALFA	358	747	1,676	2,320	2,662	2,932	3,280
RICE	0	0	0	0	0	0	0
TRUCK CROPS	824	1,208	1,480	1,804	2,062	2,289	2,550
VINE CROPS	0	0	0	0	0	0	0
OTHER	2,697	3,128	3,388	3,724	3,949	4,257	4,438
TOTAL	5,464	8,660	12,234	16,050	17,681	19,038	20,370

Damages to crops, equipment, and hay stored in the field for the Channel Mod and Levee are presented in Table 16 below. The methodology for the computation of the damages to each category is the same as explained in the "Without Project" discussion previously presented.

Table 16
Agricultural Damages by Flood Event
Channel Mod and Levee Project Damages by Event

Total Estimated Dollars of Damages by Event*

	Flood Frequency						
CROP LOSS	5	10	20	50	100	200	500
FRUITS AND NUTS	541,911	1,651,450	2,411,043	2,923,562	3,076,032	3,205,540	3,335,047
FIELD CROPS	213,003	359,905	614,946	995,766	1,122,109	1,204,412	1,285,978
PASTURE & ALFALFA	145,193	302,958	679,730	940,915	1,079,619	1,189,122	1,330,259
RICE	0	0	0	0	0	0	0
TRUCK CROPS	724,151	1,061,619	1,300,659	1,585,398	1,812,135	2,011,628	2,241,001
VINE CROPS	0	0	0	0	0	0	0
OTHER	67,971	79,607	87,241	96,691	103,198	111,696	116,956
TOTAL	1,692,229	3,455,540	5,093,619	6,542,333	7,193,092	7,722,397	8,309,241

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EQUIPMENT LOSSES							
FRUITS AND NUTS	21,889	66,706	97,388	118,089	124,248	129,479	134,710
FIELD CROPS	37,810	67,602	116,470	190,722	215,042	230,660	245,898
PASTURE & ALFALFA	14,499	30,254	67,878	93,960	107,811	118,746	132,840
RICE	0	0	0	0	0	0	0
TRUCK CROPS	31,312	45,904	56,240	68,552	78,356	86,982	96,900
VINE CROPS	0	0	0	0	0	0	0
OTHER	102,486	118,864	128,744	141,512	150,062	161,766	168,644
TOTAL	207,996	329,329	466,720	612,835	675,519	727,633	778,992
ALFALFA STORAGE LOSSES							
ALFALFA HAY LOSS	77,666	162,056	363,596	503,307	577,502	636,076	711,572
GRAND TOTAL	1,977,890	3,946,925	5,923,935	7,658,475	8,446,113	9,086,106	9,799,805

Summary of Alternatives

The Summary results of alternatives considered are presented below in Table 17 below.

Table 17. Acreage Inundated by Flood Event

Alternative	---------- Flood Frequency----------						
	5	10	20	50	100	200	500
WITHOUT PROJECT	7,239	12,587	15,786	17,926	20,437	21,869	23,274
CHANNEL MOD	5,464	8,659	12,502	17,538	19,862	21,235	22,631
CHEVRON LEVEE	7,239	11,637	14,084	16,651	18,032	19,513	20,875
CHEV LEV &CHNLMOD	5,464	8,660	12,234	16,050	17,681	19,038	20,370

Damages to crops, equipment, and hay stored in the field for all alternatives are presented in Table 18 below. The methodology for the computation of the damages to each category is the same as explained in the "Without Project" discussion previously presented. It should be noted that under "Damages (Computed)" risk and uncertainty was computed separately for the categories of Crop Damage, Equipment Losses, and Storage. The second part of the table below titled "Damages (Mean and Standard Deviation) was computed using the composite of all categories in the risk and uncertainty evaluation and is the basis for computing the average annual damages.

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Table 18
Agricultural Damages by Flood Event
Project Damages by event

Total Estimated Dollars of Damages by Event

Alternative	---------- Flood Frequency----------						
DAMAGES (Computed)							
	5	10	20	50	100	200	500
WITHOUT PROJECT	3,224,427	5,940,323	7,454,125	8,787,294	9,630,251	10,360,871	11,124,327
CHANNEL MOD	1,977,890	3,953,103	6,046,020	8,278,774	9,429,595	10,143,413	10,928,145
CHEVRON LEVEE	3,224,427	5,511,686	6,756,936	7,882,579	8,542,967	9,217,934	9,930,355
CHEV LEV &CHNLMOD	1,977,890	3,946,925	5,923,935	7,658,475	8,446,113	9,086,106	9,799,805
DAMAGES (Mean and Standard Deviation)							
	5	10	20	50	100	200	500
WITHOUT PROJECT	3,172,999	5,751,129	7,210,529	8,473,608	9,283,425	9,977,548	10,696,297
Standard Deviation	276,868	752,257	959,292	1,196,660	1,298,911	1,418,212	1,559,440
CHANNEL MOD	1,933,740	3,887,499	5,897,551	8,032,357	9,113,893	9,798,342	10,536,360
Standard Deviation	180,150	348,927	652,068	999,221	1,215,419	1,315,409	1,462,877
CHEVRON LEVEE	3,172,999	5,356,222	6,571,062	7,660,741	8,293,649	8,934,641	9,609,775
Standard Deviation	277,041	644,414	776,448	907,230	994,969	1,100,599	1,216,981
CHEV LEV &CHNLMOD	1,933,740	3,879,978	5,785,177	7,465,447	8,218,589	8,830,765	9,508,704
Standard Deviation	180,026	348,830	622,925	833,795	944,444	1,033,415	1,144,877

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Attachment C: Regional Economic Development (RED)

Regional Economic Impact of Funding Flood Risk Management Construction Orestimba Creek Project

The US Army Corps of Engineers (USACE) planning guidance notebook (ER 1105-2-100) states that while National Economic Development (NED) and Environmental Quality (EQ) accounts are required, display of Regional Economic Development (RED) is discretionary. The Corps 1991 NED Procedures Manual states there should be no doubt that RED benefits are real and legitimate benefits. The concern, from a federal perspective, is that they are often offset by RED activity in other regions. But for the local community, these benefits are important and can help them in making their preferred planning decisions.

Existing guidance from USACE offers limited detail in describing either the definition or the procedures to determine RED[11]. Principles and Guidelines (P&G 1983) states that *the RED account registers changes in the distribution of regional economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output and population.*

Input-output models are characterized by their ability to evaluate the effects of industries on each other, through both the assumptions that any industry uses the outputs of others as its inputs, and that the outputs of any industry are partly used by other industries. Most typical measures of economic activity examine only the total output or employment of an industry, or the amount of final consumption demand provided by a given industry. The input-output model provides a much more comprehensive view of the inter-related economic impacts.

Specifically, levee and floodwall construction projects as well as procurement activities directly create employment and purchases of goods and services throughout the County of Stanislaus and the State of California; however, economic activities associated with flood related construction funds do not end with construction and procurement. These activities also create jobs and output in other industries in the State and County.

The econometric analysis allows for the evaluations of the full range of economic impacts related to specific economic activities (construction and procurement) by calculating the direct, indirect, and induced benefits of the activities in the specific geographical designation (Stanislaus County and State of California).

* Direct Benefits consist of economic activity contained exclusively within the designated sector(s). This includes all expenditures made by the companies or organizations in the industry and all employees who work directly for them.

* Indirect Benefits define the creation of additional economic activity that results from linked businesses, suppliers of goods and services, and provision of operating inputs.

* Induced Benefits measure the consumption expenditures of direct and indirect sector

[11] The Institute of Water Resources released a draft White Paper titled *Review or Guidance and Procedures of Regional Economic Development and Other Social Effects, August 2006.* The analysis of RED for this study is consistent with this draft document.

employees. Examples of induced benefits include employees' expenditures on items such as retail purchases, housing, doctors and dentists, banking, and insurance.

Additionally, the input-output model can be used to quantify the multiplier effect that occurs when new employment is added in a geographical area via the designated economic activities. The multiplier effect is generated when new employment is added in one sector, but generates additional employment in other sectors which supply goods and services (indirect impact) and consumer services to employees (induced impact).

The measurement of the economic impacts in this analysis was performed based on an input-output model called RECONS based upon the interconnectivity of sectors previously used in IMPLAN developed at the University of Minnesota specifically for use in regional analysis. RECONS was developed by the USACE Institute for Water Resources (IWR). This following discussion and report summarizes the results of the RECONS analysis on the Modesto Metropolitan Statistical Area (MSA). The USACE IWR and the Louis Berger Group developed the regional economic impact modeling tool called RECONS (Regional ECONomic System) to provide estimates of regional and national job creation and retention and other economic measures such as income, value added, and sales. The modeling tool automates calculations and generates estimates of jobs and other economic measures such as income and sales associated with USACE's American Recovery and Reinvestment Act (ARRA) spending and annual Civil Work program spending. This is done by extracting multipliers and other economic measures from more than 1,500 regional economic models that were built specifically for USACE's project locations. These multipliers were then imported to a database and the tool matches various spending profiles to the matching industry sectors by location to produce economic impact estimates. The Tool was intended for use as a means to document the performance of direct investment spending of the USACE as directed by the ARRA. The Tool also allows the USACE to evaluate project and program expenditures associated with the annual expenditure by the USACE.

The economic impacts presented show the Modesto Metropolitan Statistical Area (MSA) and the State of California's inter-related economic impacts resulting from an infusion of flood reduction construction funds.

The Modesto MSA is geographically identified by the US Census Bureau for purposes of providing information concerning the US Census demographics. Below is a map showing the Modesto MSA and the location of Newman within the MSA.

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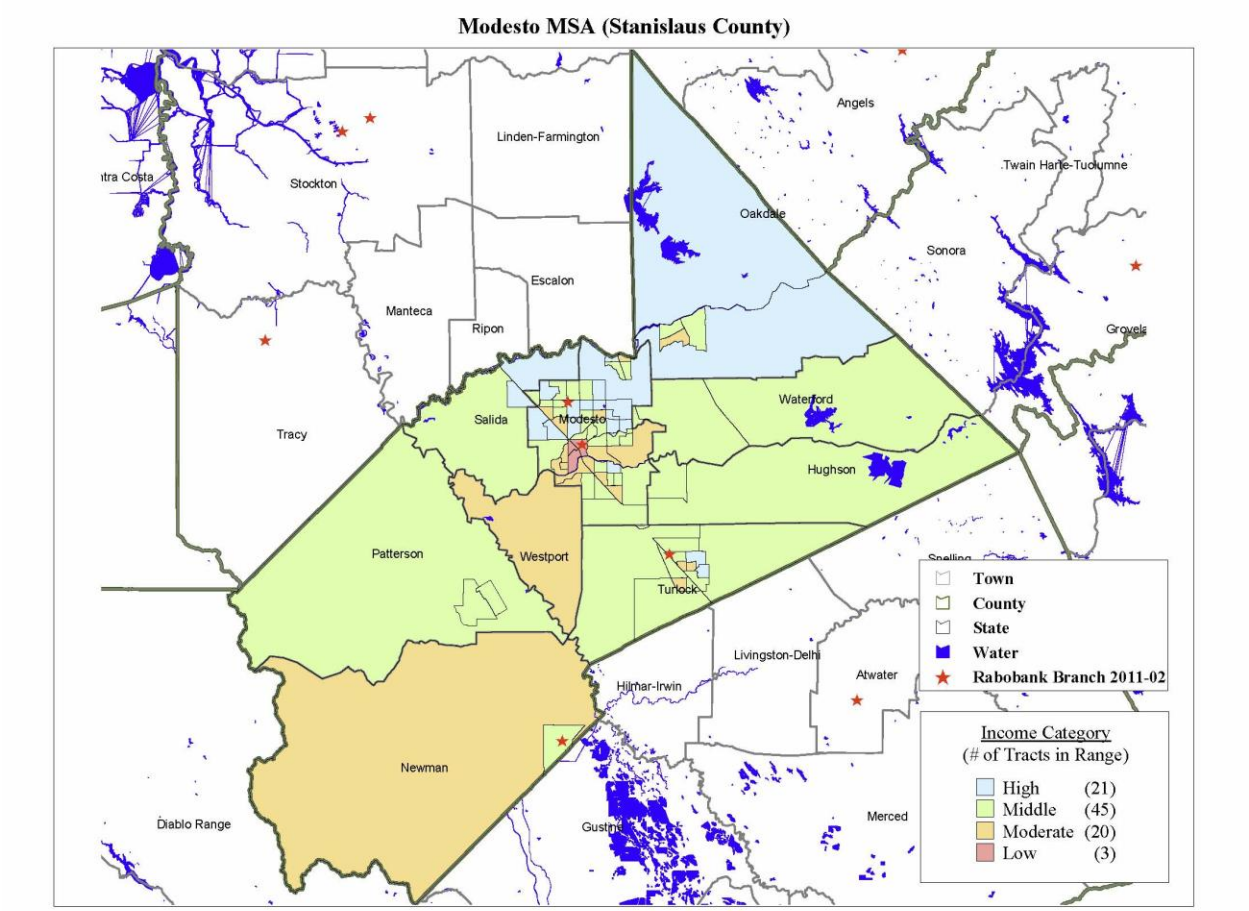
Figure 1:



For this analysis the Modesto MSA and State of California were both used as the geographical designation to assess the overall economic impacts of the construction funds. This places a frame around the economic impacts where the activity is internalized in this frame and leakages (payments made to imports or value-added sectors which do not in turn re-spend the dollars within the area) are not included in the total impacts.

In this section, the evaluation of measurable monetary RED benefits (beyond the NED benefits described in prior sections) and the results of the RECONS models used in determining RED will be described.

Table 1 below reflects the complexities of the Modesto California MSA in 2008. As shown by the Table, 64,844 persons are employed in the Statistical Metropolitan Area of Modesto California providing an output to the nation of $8,214,000,000 annually.

Table 1. Regional Output, Labor Income, Gross Regional Product, and Employment for Modesto Statistical Metropolitan Area (SMA), 2008.

Section	Output (millions)	Labor Income (millions)	GRP (millions)	Employment
Accomodations and Food Service	$190	$62	$94	3,507
Administrative and Waste Management Services	$179	$80	$109	2,682
Agriculture, Forestry, Fishing and Hunting	$698	$176	$326	6,260
Arts, Entertainment, and Recreation	$49	$14	$21	753
Construction	$539	$222	$243	3,686
Education	$262	$222	$250	4,491
Finance, Insurance, Real Estate, Rental and Leasing	$503	$111	$350	3,523
Government	$1,203	$859	$1,077	11,767
Health Care and Social Assistance	$594	$335	$385	6,389
Imputed Rents	$678	$89	$431	3,901
Information	$342	$37	$75	603
Management of Companies and Enterprises	$37	$14	$19	233
Manufacturing	$1,115	$152	$233	2,698
Mining	$243	$56	$147	555
Professional, Scientific, and Technical Services	$258	$118	$144	2,421
Retail Trade	$574	$240	$390	7,058
Transportation and Warehousing	$268	$101	$141	2,476
Utilities	$166	$28	$77	201
Wholesale Trade	$315	$120	$206	1,639
Total	**$8,214**	**$3,036**	**$4,718**	**64,844**

Note: Data in Table 1 is in millions of dollars except for employment measured per person.

Table 2 is based on the average annual regional expenditures that are expected over the remaining construction period from FY 2015 through FY 2017. Over these two years a total of 43,532,000 is anticipated to be spent to complete the construction effort and place the project beneficial status. The average annual construction expenditure is $ 21,766,000 ($43,532,000/ 2 years). [12]

However, two cost categories included in the $21,766,000 are not considered in the RED. Interest during construction, normally determined by the long term bond interest rate that the

[12] The cost estimate$43,532,000 was provided by the Cost Estimation Section of the Sacramento District, USACE. It is currently undergoing review by the Cost Estimators in Walla Walla District. In an effort to expedite this analysis, the $43,532,000 estimate is used. This estimate is deemed sufficient for purposes of regional economic development analysis. Should the costs from Walla Walla District change significantly (more than 3%) from this estimate the analysis will be redone to reflect those changes.

federal government must repay its bond holders, is not considered as a direct regional expenditure. Additionally, the transfer payment for land (the actual price the land) is not considered as having any multiplier effect on the regional economy and therefore subtracted from the total remaining costs of the project. Together these costs total $1,645,000. The annual expenditures for the remaining on-the-ground project costs of $20,943,500 is assumed to be spent over the construction period of 2 years (2015-2017). The average annual expenditure of $20,943,500 is provided below to indicate the number of jobs, income, and output which can be expected within the Modesto MSA, the State of California, and the Nation.

Direct expenditures expected for construction of earthen levees are spent primarily in two sectors of the economy, construction labor, accounting for 54% of the project expenditures, equipment which accounts for 35% of the project expenditures. Local capture rates are computed with RECONS to show where the output from expenditures are realized. As shown in Table 2, over 89% of the output from construction labor and equipment are expected to be obtained from the Modesto SMA. Virtually all labor and other materials will be obtained within the State of California.

Table 2: Input Assumptions (Spending and LPCs)

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Aggregate Materials	10%	$2,052,463	38%	74%	98%
Other Materials	1%	$251,322	76%	99%	100%
Equipment	35%	$7,330,225	60%	96%	100%
Construction Labor	54%	$11,309,490	76%	99%	100%
Total	**100%**	**$20,943,500**	**-**	**-**	**-**

The project is expected to annually expend $20,943,500 on the construction of the project. Of this total project expenditure 76% of the labor expenditures will be captured within the regional impact area. The rest will leak out to the state or the nation. The expenditures made by the USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table 3 is the overall economic impacts for this analysis.

It should be noted that the number of jobs is significant to the Modesto SMA that is currently faced with high unemployment. The number of jobs gained within the region (325) and within the State of California (530) demonstrates the multiplier effect of this infusion of construction funds for this project. Statewide, the gross regional product ($33,725,999) is 83 percent greater than the gross regional product within the Modesto SMA.

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Table 3: Overall Summary Economic Impacts - NED

Impacts	Impact Areas	Regional	State	National
Total Spending		$20,943,500	$20,943,500	$20,943,500
Direct Impact				
	Output	$15,756,153	$25,246,486	$29,133,165
	Job	237.33	336.70	354.88
	Labor Income	$10,518,365	$15,083,337	$16,254,315
	GRP	$11,910,559	$17,953,342	$19,936,718
Total Impact				
	Output	$26,882,557	$52,950,852	$81,237,156
	Job	326.03	529.83	684.54
	Labor Income	$14,180,323	$24,283,164	$32,526,330
	GRP	$18,423,909	$33,725,999	$47,159,765

Table 4: Economic Impact at Regional Level -NED

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$920,109	4.78	$374,339	$507,478
319	Wholesale trade businesses	$704,332	3.67	$268,068	$459,346
333	Transport by rail	$256,731	0.73	$63,696	$148,656
334	Transport by water	$94,844	0.15	$12,854	$34,756
335	Transport by truck	$631,756	5.48	$221,827	$294,153
36	Construction of other new nonresidential structures	$190,377	1.25	$81,760	$86,131
365	Commercial and industrial machinery and equipment rental and leasing	$4,391,023	13.64	$928,841	$1,813,059
5001	Labor	$8,566,980	207.64	$8,566,980	$8,566,980
	Total Direct Effects	$15,756,153	237.33	$10,518,365	$11,910,559
	Secondary Effects	$11,126,404	88.70	$3,661,958	$6,513,349
	Total Effects	**$26,882,557**	**326.03**	**$14,180,323**	**$18,423,909**

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Table 5: Economic Impact at State Level - NED

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$1,614,580	8.38	$661,389	$895,557
319	Wholesale trade businesses	$1,662,051	8.65	$633,517	$1,085,299
333	Transport by rail	$1,268,861	3.59	$318,415	$742,781
334	Transport by water	$839,551	1.41	$142,293	$307,657
335	Transport by truck	$1,382,819	11.99	$507,510	$674,784
36	Construction of other new nonresidential structures	$248,978	1.64	$107,552	$113,376
365	Commercial and industrial machinery and equipment rental and leasing	$7,025,636	21.83	$1,508,651	$2,929,880
5001	Labor	$11,204,010	279.22	$11,204,010	$11,204,010
	Total Direct Effects	$25,246,486	336.70	$15,083,337	$17,953,342
	Secondary Effects	$27,704,367	193.14	$9,199,827	$15,772,657
	Total Effects	**$52,950,852**	**529.83**	**$24,283,164**	**$33,725,999**

Table 6: Economic Impact at National Level - NED

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$2,011,784	10.44	$829,677	$1,118,962
319	Wholesale trade businesses	$2,073,622	10.79	$790,565	$1,354,297
333	Transport by rail	$2,058,332	5.83	$517,099	$1,206,205
334	Transport by water	$2,073,622	3.69	$356,790	$759,887
335	Transport by truck	$2,030,642	17.60	$753,923	$1,003,094
36	Construction of other new nonresidential structures	$251,322	1.69	$108,584	$114,466
365	Commercial and industrial machinery and equipment rental and leasing	$7,324,350	22.76	$1,588,186	$3,070,317
5001	Labor	$11,309,490	282.08	$11,309,490	$11,309,490
	Total Direct Effects	$29,133,165	354.88	$16,254,315	$19,936,718
	Secondary Effects	$52,103,991	329.65	$16,272,016	$27,223,047
	Total Effects	**$81,237,156**	**684.54**	**$32,526,330**	**$47,159,765**

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Table 7 is based on the average annual regional expenditures that are expected over the construction period from FY 2015 through FY 2017 for the Locally Preferred Plan. Over these two years a total of 51,939,000 is anticipated to be spent in the Modesto MSA region in order to complete the construction effort and place the project beneficial status. The average construction expenditure is $ 25,969,500 ($51,939,000/ 2 years). These costs do not reflect the IDC or transfer payment for land but only those costs that are considered as construction on-the-ground project costs.
The average annual expenditure of $25,969,500 is provided below to indicate the number of jobs, income, and output which can be expected within the Modesto MSA, the State of California, and the Nation for the locally preferred plan.

Direct expenditures expected for construction of earthen levees are spent primarily in two sectors of the economy, construction labor, accounting for 54% of the project expenditures, equipment which accounts for 35% of the project expenditures. Local capture rates are computed with RECONS to show where the output from expenditures are realized. As shown in Table 7, over 89% of the output from construction labor and equipment are expected to be obtained from the Modesto SMA. Within the State of California virtually all labor and other materials will be obtained.

Table 7: Input Assumptions (Spending and LPCs) - LPP

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Aggregate Materials	10%	$2,545,011	38%	74%	98%
Other Materials	1%	$311,634	76%	99%	100%
Equipment	35%	$9,089,325	60%	96%	100%
Construction Labor	54%	$14,023,530	76%	99%	100%
Total	**100%**	**$25,969,500**	**-**	**-**	**-**

The annual expenditure of $25,696,500 is estimated on the construction of the locally preferred project. Of this total project expenditure 76% of the labor expenditures will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by the USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table 8 is the overall economic impacts for this analysis.

It should be noted that the number of jobs is significant to the Modesto SMA which is currently faced with high unemployment. The number of jobs gained within the region (382) and within the State of California (584) demonstrates the multiplier effect of this infusion of construction funds for this project. Statewide, the gross regional product ($34,360,560) is almost 65 percent greater than the gross regional product within the Modesto SMA.

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Table 8: Overall Summary Economic Impacts - LPP

Impacts	Impact Areas	Regional	State	National
Total Spending		$25,969,500	$25,969,500	$25,969,500
Direct Impact				
	Output	$17,235,070	$24,786,323	$25,904,042
	Job	281.12	387.46	396.04
	Labor Income	$12,217,635	$16,636,353	$17,096,366
	GRP	$13,453,760	$18,672,913	$19,299,916
Total Impact				
	Output	$29,943,879	$52,158,103	$73,481,823
	Job	382.20	584.10	699.94
	Labor Income	$16,408,865	$25,725,826	$31,913,390
	GRP	$20,918,542	$34,360,560	$44,132,163

Table 9: Economic Impact at Regional Level - LPP

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$658,057	3.42	$267,725	$362,946
319	Wholesale trade businesses	$13,287	0.07	$5,057	$8,666
333	Transport by rail	$9,372	0.03	$2,325	$5,427
334	Transport by water	$1,325	0.00	$180	$486
335	Transport by truck	$288,143	2.50	$101,175	$134,162
36	Construction of other new nonresidential structures	$235,318	1.55	$101,061	$106,463
365	Commercial and industrial machinery and equipment rental and leasing	$5,440,239	16.90	$1,150,783	$2,246,282
5001	Labor	$10,589,329	256.66	$10,589,329	$10,589,329
	Total Direct Effects	$17,235,070	281.12	$12,217,635	$13,453,760
	Secondary Effects	$12,708,809	101.08	$4,191,229	$7,464,782
	Total Effects	**$29,943,879**	**382.20**	**$16,408,865**	**$20,918,542**

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Table 10: Economic Impact at State Level - LPP

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$1,162,086	6.03	$476,059	$644,603
319	Wholesale trade businesses	$31,555	0.16	$12,028	$20,605
333	Transport by rail	$46,614	0.13	$11,698	$27,288
334	Transport by water	$11,803	0.02	$2,001	$4,325
335	Transport by truck	$634,713	5.50	$233,000	$309,801
36	Construction of other new nonresidential structures	$308,946	2.03	$133,466	$140,695
365	Commercial and industrial machinery and equipment rental and leasing	$8,688,047	26.99	$1,865,542	$3,623,037
5001	Labor	$13,902,560	346.59	$13,902,560	$13,902,560
	Total Direct Effects	$24,786,323	387.46	$16,636,353	$18,672,913
	Secondary Effects	$27,371,780	196.64	$9,089,473	$15,687,647
	Total Effects	**$52,158,103**	**584.10**	**$25,725,826**	**$34,360,560**

Table 11: Economic Impact at National Level - LPP

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$1,430,723	7.43	$590,005	$795,742
319	Wholesale trade businesses	$38,899	0.20	$14,830	$25,405
333	Transport by rail	$74,716	0.21	$18,770	$43,784
334	Transport by water	$28,805	0.05	$4,956	$10,556
335	Transport by truck	$920,961	7.98	$341,881	$454,868
36	Construction of other new nonresidential structures	$311,634	2.10	$134,650	$141,944
365	Commercial and industrial machinery and equipment rental and leasing	$9,074,774	28.19	$1,967,745	$3,804,086
5001	Labor	$14,023,530	349.87	$14,023,530	$14,023,530
	Total Direct Effects	$25,904,042	396.04	$17,096,366	$19,299,916
	Secondary Effects	$47,577,780	303.90	$14,817,024	$24,832,248
	Total Effects	**$73,481,823**	**699.94**	**$31,913,390**	**$44,132,163**

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Business Interruptions

A review of literature disclosed information which could be used to estimate the relationship between business output/sales and square footage of inundated business. The number of workers per square foot at affected businesses was estimated using data from the Energy Information Administration (2006). Non-residential occupancy types from the structural inventory identified in the damage assessment portion of the economic analysis were matched with the square footage of each business category and divided by the square feet per employee to

arrive at the estimated number of employees per business. The business types were matched to IMPLAN sectors and daily production values per employee were taken from IMPLAN estimates. Table 12 displays the Employee and Output (2010$) Relationships for Non-Residential Categories within the 100 year floodplain.

Table 12. Employee and Output (2010$) Relationships for Non-Residential Categories

Non-Residential Category	Principle Business Categories	Square Feet per Employee	Daily Output Per Employee	Number of Affected Employees*
C-FOOD	Food Sales	877	$209	6.2
C-MED	Health Care; Inpatient; Outpatient	501	165	50.6
C-HOTEL	Lodging	2,074	265	2.7
C-OFF	Office	434	324	82.4
C-REST	Food Service	528	159	52.7
C-RET	Retail (Other than Mall)	1,246	115	159.7
C-SERV	Service	1,105	268	83.8
IND-LT	Other	956	921	232.5
IND-WH	Warehouse and Storage	2,306	272	72.8
PUB-GOV	Public Order and Safety; Office	451	235	68.1
PUB-REC	Public Assembly	1,645	132	4.2
PUB-SCH	Education	791	153	5.2

*Affected Employees are based on the structures that are inundated under a 100 year flood event.

Based on these data and assumptions, the non-residential categories itemized above provided the basis for estimating the square feet per employee and the daily output per employee for the Newman Study area floodplain. The conclusions included the displacement of 821 employees with an average output of $410 per day.

Analysis of the structures within the without project floodplain indicates that the depth of flooding ranged primarily from .5 to 1.5 feet. Using the FEMA BCA Tool (2009) which provides the depth-damage function based on the depth of flooding versus the business interruption, the number of business interruption days were estimated at 30 to 60 days. Accordingly, business interruption was estimated between $10 and $20 million for a 100-year event flood. Both the NED and LPP are expected to provide flood risk reduction which is capable of preventing damages to businesses in Newman, California should a 1% flood event occur.

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Attachment D: Other Social Effects (OSE)

This report presents the results of the Other Social Effects (OSE) account analysis associated with the Orestimba Creek Feasibility Study Report. The Study includes levee modification alternatives specifically designed to decrease flood risks for rural areas and the City of Newman in western Stanislaus County, California. The most recent flood events to occur within the project area were in 1995 and 1998.

The OSE account describes the potential social effects of the project that are not covered by the National Economic Development (NED), Regional Economic Development (RED), and Environmental Quality (EQ) accounts. The four accounts comprise the Principles and Guidelines evaluation framework by which, according to ER 1105-2-100, any project's effects, beneficial and adverse, can be evaluated and the alternative subsequently "selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse."

This report analyzes the social effects related to the With-Project condition and the Without Project condition (No Action Plan). The .01 flood event is the basis for the analysis of impact. Particular effects evaluated as a part of the OSE include social effects such as health and safety, security of life, community impacts, and displacement of persons and businesses.

This investigation is intended to look at the social climate of the study area. In a sense, this study is meant to provide a glimpse as to the vulnerability of the population that calls Newman their home.

Historic Flooding - Newman

Flood overflows from Orestimba Creek into the town of Newman, California have been experienced 14 times in the past 56 years; the last being in 1998. Since then, however, high water within the Orestimba Creek channel has caused issues concerning road closures, and traffic re-routing. In 2006 and 2009 high water flowing over local rural roadways was the cause of two deaths due to motorists attempting to cross. In town, historic flooding has caused extensive damage due to sediment laden water diverted along roadways and railroad embankments eventually flowing through the downtown area and surrounding residential streets. Not to discount the damage, the town has been fortunate to have survived all these flood events without a loss of life. One of the contributing factors to this is the fact that the diversion of water into Newman takes many hours to manifest itself, allowing sufficient time for town folk to prepare for the eventuality.

Social Issues

Social vulnerability is a term described by both the sensitivity of a population to natural hazards such as floods and its ability to respond to and recover from the impacts of the flood event. In emergency planning, social vulnerability is captured under the heading of "special needs populations." What is the homeless population and where are they? How many tourists are in

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town that may need help in evacuating? How full are the large hospitals, outpatient clinics, and mental health care facilities? What about nursing homes? Prisons? The healthy poor are rarely considered as a special needs population, even though they lack the financial resources to respond to emergencies.

There is anecdotal evidence for understanding the characteristics of people that make them more sensitive to the effects of floods and their ability to adequately respond and recover. Race/ethnicity, socioeconomic class, and gender are among the most common characteristics that define vulnerable populations, along with age, migration, and housing tenure. For example, the elderly may be more vulnerable in the event of a flood due to physical limitations that influence their inability or unwillingness to comply with mandatory evacuation orders. Additionally, older people may experience declining cognitive abilities to process hazard information necessitating specially targeted risk communication or warning messages. Elderly residents also may be impacted more severely as a result of having fewer resources to repair damaged homes due to their fixed income status. Thus, the greater the proportion of elderly in a community, the more vulnerable it is and the longer it will take for the community to fully recover from the flood event.

As the effects of flooding in and around Newman California are evaluated, we must recognize that flooding in the area has been experienced in recent history and that a flood event is relatively shallow in nature. It is expected that there will not be "roof-top" photographs of stranded residents as a result of flooding. However, the impacts of the flood event can be devastating to individuals, families, and businesses.

With and Without Project Condition Measure of Effects

Corps assessments of beneficial and adverse effects are based on comparisons of the *Project* alternative to the *Without Project* alternative conditions expected to prevail in the future in the absence of a proposed water resources project. The social effects of the alternatives have both direct effects and indirect effects. Direct effects result immediately from constructing the project. Indirect effects result from the effects of the project on the existing social environment in the study area.

Methodology

In evaluating the social impacts it must be recognized that the study area is an area in transition seeing growth patterns that are quite significant.

The population and other social related demographics of the area will be discussed and related to their vulnerability within the context of the one percent likelihood of occurrence (100 year flood event). Discussion of the impacts of the project alternatives will be added where appropriate.

Additionally, the impact of actual project construction activities may include issues of which the local administrators should be aware. Construction efforts are expected to take place over a period of two construction seasons with the increase in skilled workers that are expected to come

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from outside the community of Newman. Goods and services will be required such as food and lodging for a portion of the workers who will be welcomed by local businesses. Anecdotal evidence however indicates that with transient workers come issues that may be negative. Congestion of roads, cafes, and other places of business may place a strain on local residents that appreciate the more casual and slower paced lifestyle of the small community. Additionally, just the appearance of a number of "strangers" in town will give some residents reason to pause and be concerned for their personal safety and for the well-being of their children and property. Community leaders need to be aware of these issues and plan ahead for ways to mitigate possible apprehension of the permanent residents.

A flood event of any size can cause significant problems with all residents of the community. However, certain groups within the community are more vulnerable to the flood event and therefore could disproportionately affect reconstruction efforts. These groups will be identified and discussed concerning their capabilities to cope with the hazards related to a flood event.

The following discussions will address demographic groups or group characteristics which are particularly vulnerable to change. These include: income levels, gender, race and ethnicity, age, employment loss, rural vs urban, residential property, renters, education, population growth, and medical services. These characteristics provide the foundation for the social effects analysis.

Study Area

The study area is the Orestimba Creek floodplain which includes the community of Newman and surrounding the rural area located in Stanislaus County. The mild Mediterranean climate, rich soils, and ample water make it one of the best agricultural areas, positioning the area as a global center for agribusiness.

Founded by Simon Newman in 1888, the City of Newman is located on the west side of California's Central Valley. Officially incorporated in 1908, with the official slogan of "The Cream Pitcher of the Pacific", Newman is home to approximately 10,000 people and continues to grow. Located directly on California's Highway 33 and five miles from Interstate 5; George Hatfield State Park is located three miles southeast of town and the San Luis Reservoir approximately twenty minutes south.

The characteristics of the people that live within the County of Stanislaus need to be discussed to provide a basis for social analysis. Stanislaus County has a land area of 1,494 square miles and includes a water area of 20.9 square miles. It's county population in July 2008 totaled 510,694 (91% urban, 9% rural), with a population density of 341 people per square mile. There is an estimated institutionalized population of 3,440.

Races in Stanislaus County, and the City of Newman California in 2010 include the following:

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	Stanislaus County	Newman
• White	50.0%	35.7%
• Hispanic	38.9%	60.0%
• Other race	1.9%	1.6%
• Black	2.8%	1.2%
• American Indian	.7%	.4%
• Asian	5.0%	1.1%
• Other Pacific Islander	0.5%	

Approximately 78 percent of Stanislaus County's population resides in incorporated places. The city of Newman is located 22 miles from Turlock 25 miles from Modesto, both located in Stanislaus County. Regional services, such as higher education, elder care, or medical services are provided to Newman residents by these larger metropolitan areas.

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Table 1
Population Estimates for Cities, Counties and State, 2001-2009
with 2000 Benchmark

COUNTY/CITY	4/1/2000	1/1/2002	1/1/2004	1/1/2006	1/1/2008	1/1/2009
Stanislaus County						
Ceres	34,609	35,800	37,470	40,723	42,520	42,998
Hughson	3,980	4,249	5,250	6,092	6,144	6,193
Modesto	188,861	199,426	206,908	206,993	208,497	210,088
Newman	7,092	7,567	8,340	10,084	10,510	10,739
Oakdale	15,503	16,283	17,178	17,761	19,205	19,608
Patterson	11,606	13,079	14,221	19,171	21,090	21,168
Riverbank	15,826	17,072	18,261	21,099	21,606	21,805
Turlock	55,811	60,484	64,434	67,519	69,689	70,256
Waterford	6,924	7,194	7,883	8,171	8,703	8,816
Balance Of County	106,785	111,106	113,701	114,004	114,349	114,712
Incorporated	340,212	361,154	379,945	397,613	407,964	411,671
County Total	446,997	472,260	493,646	511,617	522,313	526,383

Source: California Department of Finance, Demographics Section

Many unincorporated places are located in the predominately rural areas within Stanislaus County. A sense of small town pride and informal communications network is evident throughout the area. Fourteen unincorporated places are included in the 2000 Census. They include Salida (pop 2,560); West Modesto (pop 6,096); Shackelford (pop 5,170); Bret Harte, (pop 5,161); Keyes (pop 4,575); Bystrom (pop 4,518); Empire (pop 3,903); Denair (pop 3,446); East Oakdale (pop 2,742); Del Rio (pop 1,168); Park (pop 1.094); Grayson (pop 1,077); Westley (pop 747); and Hickman (pop 457).

Stanislaus County has seen a significant increase in population over the past decade. Review of the State census reveals that three cities within the County rank within the top 30 Cities experiencing the highest percentage of growth. The cities of Patterson and Hughson have seen growth over the past decade of 82.4 and 55.6 percent respectively. Newman has seen a 51.4 percent increase in population from April 2000 to January 2009. Much of the increase can be justified by recognizing that a significant portion of the increase in population work in more urbanized settings but choose to live in the rural, relatively lower cost areas that are within commuting distance.

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According to 2000 Census data, 35,640 of the County's workers commuted to other counties for employment and 19,427 workers who lived in other counties commuted to Stanislaus County daily. This data suggests that Stanislaus County provides affordable residential opportunities for workers having employment in the San Francisco Bay Area and larger metropolitan areas. The main counties for

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commuters from Stanislaus County were San Joaquin (13,993 workers), Alameda (6,840 workers), and Santa Clara (3,822 workers). An estimated 8,827 workers commute into Stanislaus County daily and an estimated 4,962 workers leave Stanislaus County to work in Merced. (US Census Bureau 2000). The mean commute time experienced by commuters living in Newman is 36.6 minutes with approximately 26.2 percent carpooling. Based on the data below one could infer that some of the communities, including Newman, had experienced growth due the influx of people working in the Bay area seeking affordable housing.

Table 2
Number of Stanislaus Commuters Traveling to and from Selected Counties

County	Commuting Daily from Listed County	Commuting Daily to Listed County	Net Daily Outflow
Sacramento	393	749	356
Contra Costa	174	996	822
Alameda	342	6,840	6,498
Santa Clara	169	3,822	3,653
Merced	8,827	4,962	- 3,865
Fresno	234	278	44
Mariposa	311	37	- 274
Tuolumne	887	483	- 404
Calaveras	305	108	- 197
San Joaquin	6,640	13,993	7,353
Total	19,427	35,640	16,213

Data from the California Employment Development Department collected from US Census, 2000

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Table 3

4/2000-1/2009 City Population Percent Change Rankings

California Cities Ranked by the 4/2000-1/2009 Percent Change in Population					
Rank	***City***	***County***	***4/2000 Total Population***	***1/2009 Total Population***	***Percent Change***
1	Lincoln	Placer	11,205	40,060	257.5
2	Beaumont	Riverside	11,384	32,403	184.6
3	Murrieta	Riverside	44,282	100,714	127.4
4	Brentwood	Contra Costa	23,302	51,908	122.8
5	Twentynine Palms	San Bernardino	14,764	30,832	108.8
6	Elk Grove	Sacramento	72,191	141,430	95.9
7	La Quinta	Riverside	23,694	43,778	84.8
8	**Patterson**	**Stanislaus**	**11,606**	**21,168**	**82.4**
9	Coachella	Riverside	22,724	41,000	80.4
10	Rio Vista	Solano	4,571	8,222	79.9
11	Temecula	Riverside	57,716	102,604	77.8
12	California City	Kern	8,385	14,828	76.8
13	Lake Elsinore	Riverside	28,930	50,267	73.8
14	Yuba City	Sutter	36,758	63,647	73.2
15	Imperial	Imperial	7,560	12,970	71.6
16	Victorville	San Bernardino	64,029	109,441	70.9
17	Lathrop	San Joaquin	10,445	17,671	69.2
18	American Canyon	Napa	9,774	16,503	68.8
19	Indio	Riverside	49,116	82,230	67.4
20	Kerman	Fresno	8,548	14,064	64.5
21	Desert Hot Springs	Riverside	16,582	26,552	60.1
22	Dublin	Alameda	30,023	47,922	59.6
23	Menifee	Riverside	42,445	67,705	59.5
24	Wheatland	Yuba	2,272	3,548	56.2
25	Adelanto	San Bernardino	18,130	28,265	55.9
26	**Hughson**	**Stanislaus**	**3,980**	**6,193**	**55.6**
27	San Jacinto	Riverside	23,779	36,477	53.4
28	**Newman**	**Stanislaus**	**7,092**	**10,739**	**51.4**
29	San Marcos	San Diego	54,977	83,149	51.2
30	West Sacramento	Yolo	31,615	47,782	51.1

Source: California Department of Finance, Demographics Section

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Labor Force:

The total Stanislaus labor force in 2004 is estimated at 226,124, with an unemployment rate of 9.1%. Total private wage or salary workers estimated to be 77% of the labor force with 15% of the labor force rated as government workers. Approximately 8% of the labor force was considered to be self-employed, not incorporated. The average wage per job for Stanislaus County in 2003 was estimated at $31,492 for the 179,131 jobs within Stanislaus County. By 2005 the average wage per job increased to $34,560.

The California Employment Development Department preliminary data for January, 2012 indicate a current labor force of 234,200 with 194,700 employed and an unemployment rate of 16.9% for the County of Stanislaus. December 2011 data indicate employment by industry; with retail trade employing 8,600; professional and business services employing 6,400; durable goods industry, 5,800; and non-durable goods, 5,800. State and Local government employed about 12% of the civilian employed population.

Income:

Median Household Income for Stanislaus County has increased significantly over the past couple of decades. In 1989 average income was $29,793, increasing by 35% to $40,101 in 1999. By 2008 the County's median household income increased from $40,101 in 1999 to $50,359 or 26%. Comparatively, the State of California's median household income is $61,021 in 2008 verses Stanislaus County's $50,359. The City of Newman's median household income grew from $39,460 in the year 2000 to $49,554 in 2008. The 2000 Census reported the persons living at or below the poverty level in Stanislaus County at 16.0 percent.

MEDIAN INCOME AND POVERTY STATUS, 2000 CENSUS

			Income in 1999 below poverty level a/			
	Median income in 1999 dollars		Percent of population for whom poverty status is determined			
County	Households	Families	All ages	Related children under 18 years	65 years and over	Percent of families
Stanislaus	40,101	44,703	16.0	20.5	8.8	12.3
California	$47,493	$53,025	14.2	19.0	8.1	10.6

Housing:

The estimated median house or condo value rose in the City of Newman from $107,700 in 2000 to $240,000 by 2008. The new house construction building permits shown in Table 4 indicate a significant increase in construction beginning 2003 through 2007. It is presumed that much of the construction was to accommodate families whose workers commuted to areas outside the immediate area, who had purchased affordable housing in Newman.

The housing crisis that has befallen Newman appears to be similar to that of Merced, California. In a recent news article in US News and World Report Merced was highlighted as follows:

> *The housing crisis that has rocked Merced, California was initially linked to rising property values in relatively nearby metropolitan areas like San Francisco. As real estate became increasingly unaffordable in the bigger cities, many would-be home buyers started exploring options in smaller markets, such as Merced.*
>
> *"A number of people said, 'Hey, I have got a couple of choices: I can get a 1,000-foot condo in San Francisco, or I can move east and I can get myself a fairly significant*

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home for the same price,' " says John Walsh, the president of DataQuick. Although this trend increased real estate demand in Merced, prices appreciated even faster as exotic mortgage products and investor interest hit the market.

Area home prices jumped nearly 129 percent from 2002 to 2006. But after the euphoria subsided, home prices crashed more than 72 percent through the third quarter of 2009. This rapid deflation dragged about 64 percent of single-family home mortgages underwater by the fourth quarter of 2009, according to Zillow. Walsh says it could be 10 to 20 years before Merced home prices reach former peak levels.

Source: Luke Mullens, US News and World Report, dated March 19, 2010.

As shown in Figure 1, the median price of homes sold in Newman reached a peak of over $400,000 in the first quarter of 2006. Within 3 years the median price of homes sold had dropped to about $125,000. The price level appears to have bottomed and is expected to stabilize or increase over the next 3 to 5 years.

Table 4. Single-family new house construction building permits:

- 1996: 0 buildings
- 1997: 22 buildings, average cost: $87,500
- 1998: 76 buildings, average cost: $115,000
- 1999: 90 buildings, average cost: $120,200
- 2000: 27 buildings, average cost: $123,900
- 2001: 17 buildings, average cost: $140,400
- 2002: 106 buildings, average cost: $132,800
- 2003: 180 buildings, average cost: $150,300
- 2004: 350 buildings, average cost: $168,700
- 2005: 147 buildings, average cost: $204,500
- 2006: 65 buildings, average cost: $210,200
- 2007: 113 buildings, average cost: $222,100
- 2008: 6 buildings, average cost: $101,500
- 2009: 6 buildings, average cost: $198,000
- 2010: 6 buildings, average cost: 192,200

Source: City-Data.com/Newman

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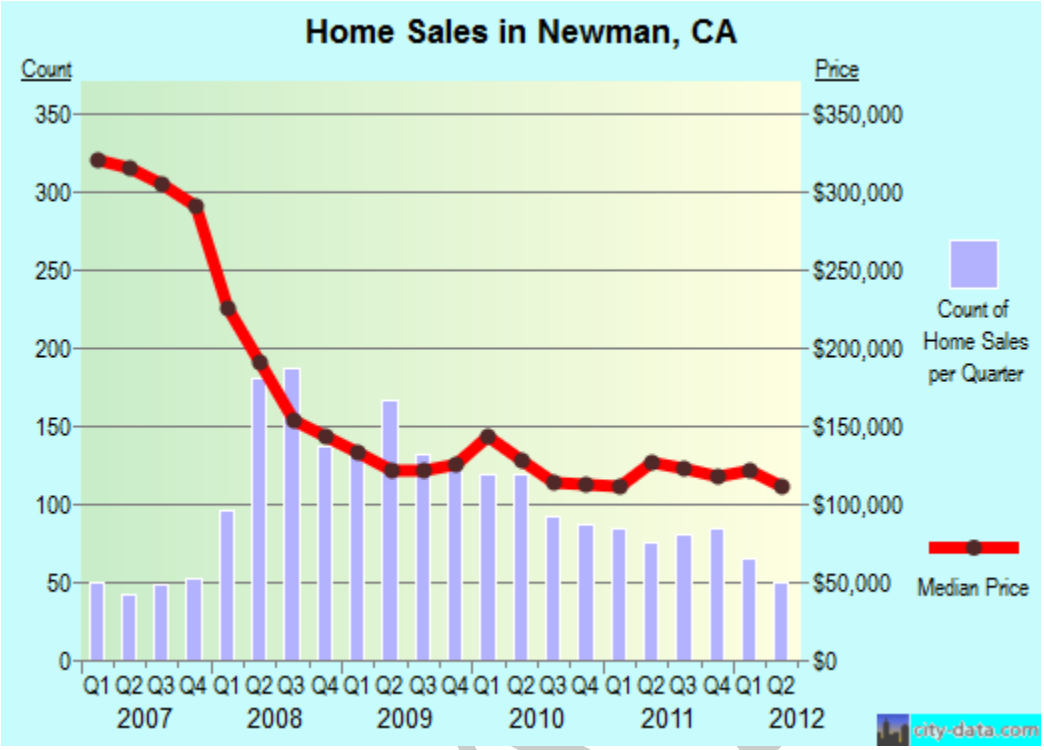
Figure 1. Median Price of Home Sales in Newman CA, 2006-2011



Source: City-Data.com/Newman

Medical:

The City of Newman is strategically located within 21 miles of three major medical facilities. This is important as their services may be required in the event of a natural hazard such as a flood. It is also recognized that over half of the residents aged 65 or over have a disability, which adds to the critical nature of service needs in the area. The City of Newman has a 71 bed nursing facility located at the north end of the city. In the past it has experienced flooding and has emergency plans in place for such an event.

Medical centers and clinics near Newman:
Modesto Rehab Hospital (about 16 miles; Modesto, CA)
Emanuel Medical Center (about 19 miles; Turlock, CA)
Memorial Hospital Los Banos (about 21 miles; Los Banos, CA)
Source: City-Data.com/Newman

Social Vulnerability:

The characteristics that are recognized as having an influence on social vulnerability generally include age, gender, race, and socioeconomic status. Other characteristics include population segments with special needs or those that lack the normal social safety nets necessary in disaster recovery, such as the physically or mentally challenged, non-English speaking immigrants, transients, and seasonal tourists. The quality of human settlements (housing type and construction, infrastructure, and lifelines) and the built environment are also important in understanding social vulnerability, especially as these characteristics influence potential economic losses, injuries, and fatalities from natural hazards.

The discussion below focuses on the measures of social vulnerability that will be evaluated considering both the affect of construction and the affect of a flood event.

Income, political power, prestige: This measure focuses on ability to absorb losses and enhance resilience to hazard impacts. Wealth enables communities to absorb and recover from losses more quickly due to insurance, social safety nets, and entitlement programs. As a measure, median household income of Newman is very close to that of Stanislaus County, $49,359 and $50,359 in 2008 respectively and is not at a proportional disadvantage to the general surrounding area.

Gender: Women can have a more difficult time during recovery than men, often due to sector-specific employment, lower wages, and family care responsibilities. Although data is not specifically available concerning the wage rate of male verse female for the Newman area, it is recognized that a smaller percent of women are employed in the labor force in Newman than in the larger two metropolitan cities of Turlock and Modesto. The percentage of variation of this factor however is quite small.

Race and Ethnicity: Race and Ethnicity imposes language and cultural barriers that affect access to post-disaster funding and residential locations in high hazard areas. It is recognized that Newman has a significant hispanic population (60.0%) which is recognized in the literature as being one of the highest in the State of California.

Age: Extremes of the age spectrum affect the movement out of harm's way. Parents lose time and money caring for children when daycare facilities are affected; elderly may have mobility constraints or mobility concerns increasing the burden of care and lack of resilience. Those over 65 years of age are estimated at 9.7% in the year 2000. This is slightly less than the State average.

Employment loss: The potential loss of employment following a disaster exacerbates the number of unemployed workers in a community, contributing to a slower recovery from the disaster.

Rural/urban: Rural residents may be more vulnerable due to lower incomes, and more dependent on locally based resource extraction economies (e.g., farming, fishing). High-density areas (urban) complicate evacuation out of harm's way.

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Residential property: Rural/urban Rural residents may be more vulnerable due to lower incomes and more dependent on locally based resource extraction economies (e.g., farming, fishing). High-density areas (urban) complicate evacuation out of harm's way.

Residential property: The value, quality, and density of residential construction affects potential losses and recovery. Expensive homes on the coast are costly to replace; mobile homes are easily destroyed and less resilient to hazards.

Infrastructure and lifelines: Loss of sewers, bridges, water, communications, and transportation infrastructure compounds potential disaster losses. The loss of infrastructure may place an insurmountable financial burden on smaller communities that lack the financial resources to rebuild.

Renters: People that rent do so because they are either transient or do not have the financial resources for home ownership. They often lack access to information about financial aid during recovery. In the most extreme cases, renters lack sufficient shelter options when lodging becomes uninhabitable or too costly to afford.

Occupation: Some occupations, especially those involving resource extraction, may be severely impacted by a hazard event. Self-employed fisherman suffer when their means of production is lost and may not have the requisite capital to resume work in a timely fashion and thus will seek alternative employment. Those migrant workers engaged in agriculture and low skilled service jobs (housekeeping, childcare, and gardening) may similarly suffer, as disposable income fades and the need for services declines. Immigration status also affects occupational recovery.

Family structure: Families with large numbers of dependents or single-parent households often have limited finances to outsource care for dependents, and thus must juggle work responsibilities and care for family members. All affect the resilience to and recovery from hazards.

Education: Education is linked to socioeconomic status, with higher educational attainment resulting in greater lifetime earnings. Lower education constrains the ability to understand warning information and access to recovery information.

Population growth: Counties experiencing rapid growth lack available quality housing, and the social services network may not have had time to adjust to increased populations. New migrants may not speak the language and not be familiar with bureaucracies for obtaining relief or recovery information, all of which increase vulnerability.

Medical services: Health care providers, including physicians, nursing homes, and hospitals, are important post-event sources of relief. The lack of proximate medical services will lengthen immediate relief and result in longer recovery from disasters. Census data for 2010 indicate that there are 66 residents in nursing homes in Newman.

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Summary of Flood Related Impacts:
The positive attributes contributing to community resilience of Newman over other area community settings when encountering a flood event are:
1) The logical avenues of escape from a flood event are to the west and south. Six most notable routes include westbound Orestimba Creek Road, and westbound Shiells Road; Southbound Draper Road, Upper Road, Highway 33, and Canal School Road provide a variety of choices for evacuation from Newman. These avenues of escape could play a significant part in alleviating fatalities. Due to the relatively low depth of flooding (less than one-foot at the 100 year event) and the significant travel time of flood water, evacuation should be conducted without significant road congestion occurrence.
2) Due to the general geomorphology of floodplain, depths of flood are generally shallow (averaging less than 1 foot and not exceeding 3 feet in depth except in ditches and low lying areas). Deepest flooding is expected to be isolated primarily to the general business district, with most of the residential flooding being shallow, not exceeding one foot in depth. Therefore, the chance of death by a flood event is considered to be minimal.

3) Household income for Newman is comparable to the surrounding area cities and Stanislaus County. The 2008 median household income for Newman was $49,554 compared to $50,359 for Stanislaus County.
The impediments to community resilience of Newman when encountering a flood event are:
1) Over 50% of the households in Newman speak languages other than English in the home, which may cause communication barriers during emergency periods.
3) Unemployment of greater than 18 percent in March, 2011 compared to 12.3 percent for the State of California. Unemployment is an indicator that there may be financial issues in dealing with re-establishing housing.
4) Housing rentals are approximately 26 percent of Newman's households. The high rental population highlights indications of community cohesion issues. Research indicates that renters do not have the same community pride as owners thereby having more barriers to direct community involvement in redeveloping the community after a flood event.

5) The literature indicates that families having over 4 or more persons have more financial difficulty than those of lesser number. Accordingly, with Newman having over 41 percent of households with families having 4 or more members, community planners need to be aware of pending issues.
6) With over 29 percent of Newman's residents having less than high school education there may be constraints in the ability of those residents to adequately deal with local, state, and federal information requirements surrounding recovery efforts.
7) Newman has grown over 50% in the past 10 years compared to the Stanislaus county growth of less than 18 percent. A rapid growth rate in population is highly correlated with low community cohesion. The sense of belonging, cooperation, and strong sense of community pride are dynamic factors which assist in the restoration of the community after a catastrophic event. Due to the rapid growth in the Newman community bonds and sense of owning community issues may not be as strong as other more slow growing cities.
8) Newman has limited medical facilities available to it's general population compared to the United States. The density of physicians per 10,000 residents is 48% less than the U.S. average.

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This metric indicates very low medical assistance should a destructive flood occur. Fortunately, due to the relative short traveling distance, the cities of Modesto and Turlock may provide some medical assistance to the residents of Newman if necessary.

Emergency Action Plan

The City of Newman has an Emergency Action Plan (EAP) in place intended to reduce the risk of human life loss and injury and minimize property damage during an unusual or emergency event. It defines responsibilities and provides procedures designed to identify conditions that may endanger the community's residents and to specify preplanned actions to be followed to minimize property damage and loss of life in the event of a flood.

As soon as an emergency event is observed or reported, the City Manager shall immediately determine the emergency level. After the emergency level has been determined, the people on the corresponding emergency level notification chart shall be notified immediately.

The Stanislaus County Office of Emergency Services has responsibility for notifying and evacuating downstream people at risk and setting up road closures. If it is determined that conditions do not pose a threat to people or property, the Stanislaus County Office of Emergency Services will be advised to terminate EAP operations. If and when the public needs to be notified, the medium for notification will be the Emergency Broadcast System (EBS) and Reverse 911.

Population at Risk and Life Loss Implications

The risk of lost lives is of primary concern to the Corps of Engineers. Loss of life estimation includes many variables such as warning time, time of day, flood arrival time, escape routes, distance/time to safety, depth of water, etc. The loss of life methodology graph illustrates how these variables effect the loss of life estimation process.

Official Notification: The Warning Issuance Time is defined as the time at which an official evacuation order is released from the responsible emergency management agency to the population at risk. Life-loss estimates are highly sensitive to warning issuance time and other relationships that affect the effectiveness of warning and evacuation processes for the population at risk. The decisions made by someone responsible for initiating flood warnings are influenced by a number of factors, including:

The reliability of the available forecasts and how this changes with lead-time.

The amount of time that the public would need to respond effectively to a warning.

The delay between a warning being initiated and it being received by the public.

- The need to avoid issuing warnings unnecessarily, because of the wasted efforts of those who respond and because a record of false alarms means that fewer would respond to future warnings.
- The need to avoid situations where a warning condition is rescinded only for the warning to be re-issued within a short time, again because of the wasted efforts of the general public and because such occurrences would bring the flood warning service into disrepute.

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Time of Day: The time of day that a flood hits a population center can make a significant difference in the impacts to the affected population. Nighttime is particularly critical as residents normally are asleep and not aware of their surrounding situation. Additionally, darkness affecting escape, adds time which may make the difference between life and death.

Escape Routes: Knowledge of escape routes is critical for survival. In some instances the population may have only one escape route as topographical features may make the other escape routes impossible. Moving to high ground quickly is of paramount importance to escape the affects of the flood.

Distance/Time to Safety: The time it takes to actually move from the point of risk to safe location is considered in determining the risk of loss of life. Being caught in a vehicle is possibly the worst place to be if you encounter a flood. In some instances the best advice is to stop driving. Although the situation may be scary and fleeing in a vehicle may be tempting, the safest thing to do is to get out of the vehicle and move to high ground on foot. Staying in the vehicle increases the chances that it will be swept away and a floating vehicle is difficult to stop.

Depth and velocity of Water: Depth and velocity of floodwaters play an important part in the risk to life. Heavy objects can be literally lifted by water and moved downstream causing risk to property and life. Trees especially can move on top of water and cause serious damage. Seeking high ground is the best way to avoid these floating debris.

Without Project Condition – Floodplain

For purposes of this analysis, the without project 1% floodplain will be considered the geographic area for analysis of the population at risk. The illustration below shows the 1% event floodplain used in the analysis where no project is assumed. As indicated by the floodplain outline, much of the flooded area is the downtown and eastern residential area of Newman. It is assumed that the commercial and industrial occupants are aware of the general flood situation and would be able to respond quickly to a warning order, either during the day or at night. It should be noted that the city of Newman east of the railroad tracks would be expected to be inundated with floodwaters when faced with a 1% event flood. The depths of flooding would range from less than one foot to approximately two feet. Depth of flooding is critical to the analysis relating to life issues, as it is known that the impacts occurring at night have the highest rate of casualties.

Geo-spatial analysis indicates that there are 1,062 residential structures located within the floodplain. Using the 2.64 residents per household figure from the US Census, the total population at risk is calculated to be 2,804 or slightly over 26 percent of Newman's population. Indications are that the flood warning time for residents downstream of Orestimba Creek during a hydrologic event caused by abnormal rainfall will allow approximately 24 hours of warning time to Newman residents prior to peak flows arriving in Newman. Accordingly, notification methods used by Stanislaus County and City of Newman are considered adequate to deal with these floods. It is expected that all notified people in Newman would have sufficient time to move to a safe area. Evacuation routes have been identified by maps provided by the Sponsor.

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There appears to be multiple evacuation routes of substantive capacity to handle the emergency traffic load.

Highly unlikely abnormal flood events may occur overnight which could impact residents as they may not be aware of the impending flood situation. Under this scenario it can be assumed that a small percentage of the population would not be warned in time to escape the full force of the flood event. Depths of the 1% flood event were compiled by the Corps of Engineers. These depths are up to 3 feet in depth with an average of less than 1 foot.

Information received from McClelland and Bowles (2002) concerning risks to life identified the following findings related to the computation of loss of life are:

> For any structure: if event maximum depth < 2 feet or less than the first floor height of structure, then there is no flood lethality zone and the people are considered as part of the Cleared evacuation category;
>
> For 1 story structures, if event maximum depth is 13 feet or higher then the population at risk is assumed to be in a zone which are typically exposed to high life risk. It is understood that even exposure to shallow, high velocity flooding, can sweep people off their feet. However, high velocity flooding at shallow depths is normally not the case. Depending on the nature of the flood, depths of under 13 feet are considered in the safe zone. The safe zone fatalities were normally measured in the hundredths of one percent of the population at risk.

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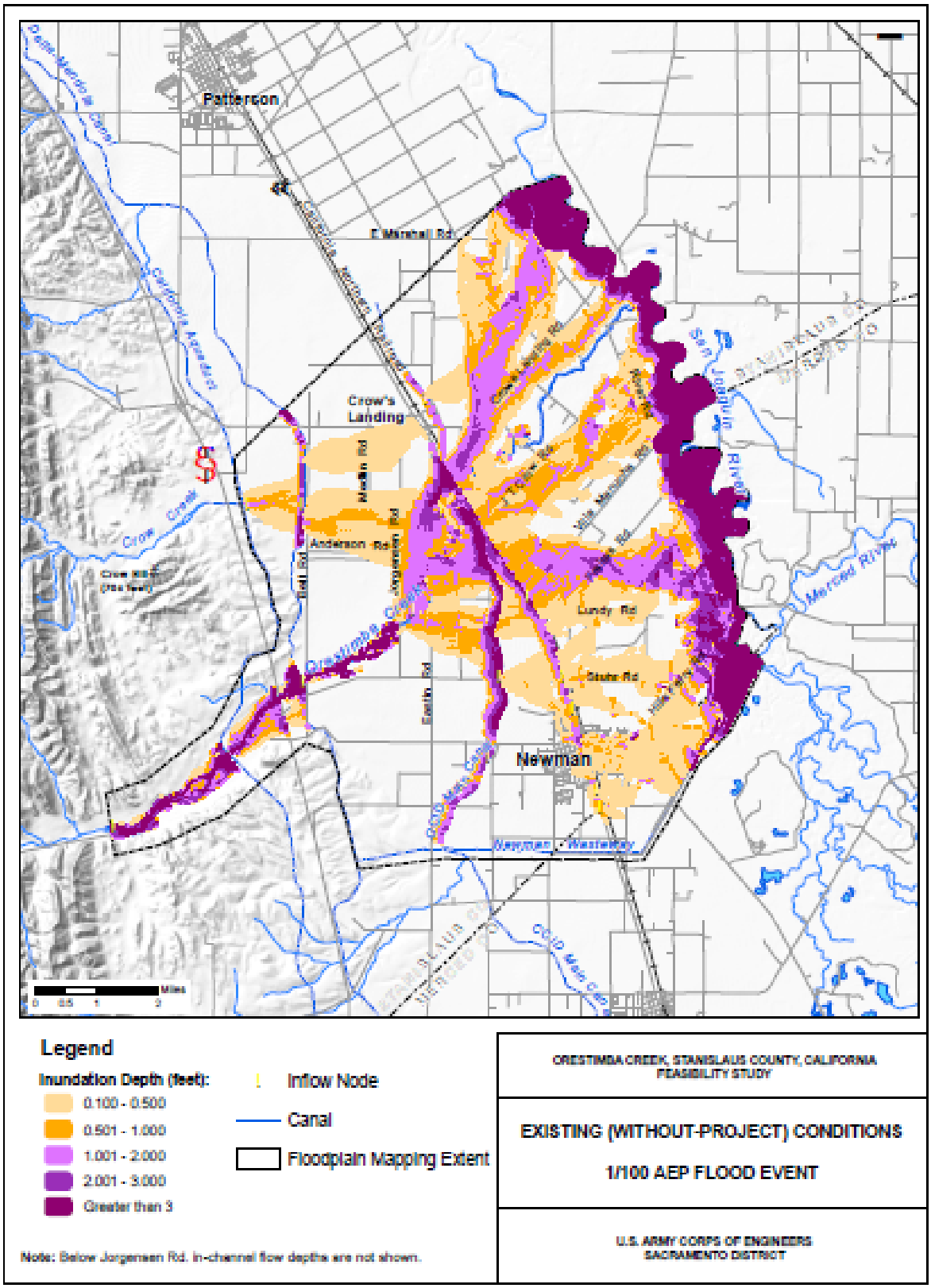
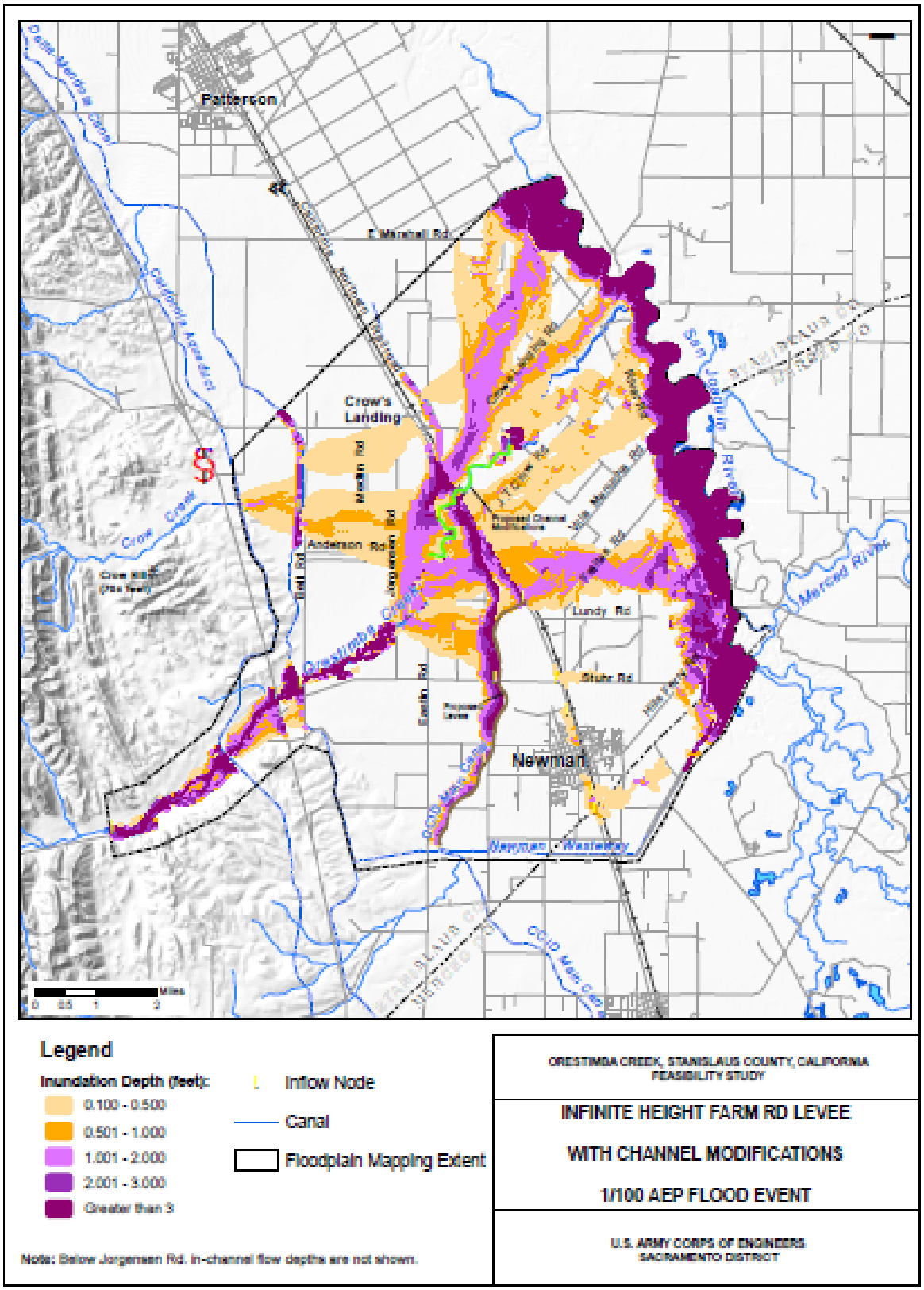
Without Project – 100 year Event



With Project – 100 year Event



Places of Sensitive Nature

Emergency responders are likely to be impacted by the flood event as it is noted that both the Newman City Fire Department and the Newman City Police Department may be inundated under the 1% event flood. Additionally, it should be noted that any facilities providing overnight home care, such as nursing homes, are particularly vulnerable should a flood occur during nighttime hours.

No major regional critical infrastructure is expected to be inoperable due to the shallow flooding in Newman. Police and fire personnel are expected to have sufficient warning time to relocate necessary equipment and still be capable of providing needed services to the community.

Summary Comparison of the With and Without Alternatives

Without Project-

This analysis focuses primarily on the life safety hazards that residents can be expected during a 1% event flood. As seen by the previous maps a significant part of the City of Newman, California is expected to be effected by a flood event under the current situation. It should be noted that the majority of the flooding would occur in the eastern section of Newman, in an area that is predominately residential that has been constructed in the past 10 years. Shallow flooding averaging less than 1 foot is expected which, while causing property damage and associated evacuations, are not expected to result in large numbers of fatalities due to drowning.

One issue to note is that the 66 residents residing in nursing homes in Newman would require evacuation. Movement of the elderly or infirmed is always done with risk involved. Even with 24 hours notification, care providers need to make alternate lodging accommodations as well as conduct physical transfer which may cause injury, disruption of routine, disorientation and anxiety to the elderly. This act of transferring residents is considered the highest risk of life due to a flood event in the City of Newman.

Rural roads have been flooded in the past and are expected to continue to flood. Fatalities have resulted from attempts to cross these roads when flooded. Signage or road closures may decrease the risk to life.

Two considerations may hinder quick rebuilding of Newman as a result of a flood event. The high rate of unemployment will tend to dampen reconstruction efforts due to limited income of those home owners. Secondly, the recent decrease in home values from an average of about $400,000 to slightly more than $110,000 is expected to give owners pause when faced with significant repair costs when compared to the current value of their homes.

With Project-

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Considering a 1% event flood, shallow inundation is expected to occur on the west side of highway 33 in the northern area of Newman. Due to the shallow nature of flooding and the warning time allotted for the event it is expected that most, if not all, residents residing in the area would have adequate time to evacuate. Businesses along the west side of highway 33 would also have time to brace for the shallow flood.

With the project in place the 66 residents in nursing homes in Newman would have a relatively low risk of seeing flood waters in the northern area of the City. However, due to the consequences, should a break in the level occur, it is deemed prudent to have emergency staff on hand during the flood event to transport the nursing home residents, if necessary.

The With Project Alternative does not address rural roads that are subject to flooding. Discussions with local law enforcement and County officials have indicated that there are proactive steps being taken to warn travelers of road closures. Crossing arms which are activated by rising water is creeks have been installed to halt travelers from entering into hazardous crossings.

Reconstruction efforts are expected to be minimal under the "with project" condition within the confines of Newman. The majority of the damages are expected to be incurred by business along highway 33.

Environmental Justice

Executive Order 12898 concerning environmental justice provides direction on the analysis of social and economic effects that would be applicable to the proposed flood risk management project. On February 11, 1994, President Clinton signed EO 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations. It requires that environmental analyses of proposed Federal actions address any disproportionately high and adverse human health or environmental effects on minority and low-income communities. Federal agencies' responsibility under this order also applies equally to Native American programs. In addition, each Federal agency must ensure that public documents, notices, and hearings are readily accessible to the public.

In April 1997, President Clinton signed Executive Order EO 13045, Protection of Children from Environmental Health Risks and Safety Risks. This EO requires Federal agencies to identify, assess, and address disproportionate environmental health and safety risks to children from Federal actions.

According to CEQ and EPA guidelines established to assist Federal and State agencies in examining the potential for environmental justice impacts, the first step in conducting an environmental justice analysis is to define minority and low-income populations. Based on these guidelines, a minority population is present in a project study area if:

- The minority population of the affected area exceeds 50 percent, or

• The minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

The same rule would apply to the presence of a low-income population. A low income population is present if the project study area is composed of 50 percent or more people living below the poverty threshold, as defined by the US Census Bureau, or is significantly greater than the poverty percentage of the general population or other appropriate unit of geographic analysis.

The second step of an environmental justice analysis requires a finding of a high and adverse impact, which is discussed below.

Basis of Significance

While there are no laws specifically associated with limits to socioeconomic impacts, and environmental justice, (EO 12898) and (EO 13045) speaking to the health effects on children are addressed below. The executive orders address the impacts on the demographic, economic, and social factors that could measurably alter the economic conditions (the availability of employment and income), the accessibility of goods, infrastructure, and services, and the quality of life in the area of influence. These types of impacts would be significant to the affected population. More specifically, a proposed project alternative would have a significant socioeconomic impact if it were to result in any of the following effects:

• Long-term increase in population that could not be accommodated by regional infrastructure (for example, housing, utilities, roads, hospitals, and schools) or services (such as police and emergency services);

• A reduction in the availability of affordable housing (which could occur either through a large increase in housing prices or a large decline in the supply of affordable housing);

• Long-term displacement of population that could not be accommodated within the region;

• Long-term displacement or disruption of local businesses that could not be accommodated within the region;

• A loss in community facilities, events, population, or major industry that would result in an overall loss in community cohesion; or

• Disruption of emergency services or creation of a public health risk that could not be avoided by the public, especially if it would particularly affect the health and safety of children.

Likewise, a proposed project alternative would have an environmental justice impact if it were to cause impacts that are “disproportionately high and adverse,” either directly, indirectly, or

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cumulatively. To make a finding that disproportionately high and adverse effects would likely fall on a minority or low-income population, three conditions must be met simultaneously:

- There must be a minority or low-income population in the impact zone;
- A high and adverse impact must exist; and
- The impact must be disproportionately high and adverse on the minority or low-income population.

Environmental Justice- Summary of Impacts

Review of Real Estate records and discussion with USACE Sacramento District Project Development team members disclosed that the construction efforts of the NED alternative were conducted exclusively in agricultural area with no direct impact to residents in the immediate area. The construction of the LPP likewise shows no relocations necessary as part of the project execution. The conclusion, based on environmental justice criteria, is that there is no high and adverse impact due to the construction of either alternative project.

Implementing the proposed alternative would have a beneficial impact on the regional economy due to increased expenditures in the regional economy during the construction period. However, increased construction-related traffic, delays, and detours, as well as an increased population due to the presence of a construction workforce can result in increased social tension during the construction period.

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