

**REDBANK AND FANCHER CREEKS, FRESNO COUNTY, CALIFORNIA
FEASIBILITY STUDY**

Review Plan
March 2025

1. Project Summary

Project Name: Redbank and Fancher Creeks Feasibility Study

Location: Fresno, CA

P2 Number: 510385

Decision and Environmental Compliance Document Type: Feasibility Report with integrated National Environmental Policy Act (NEPA) document

Congressional Authorization Required: Potentially, depending on recommended plan

Project Purpose(s): Water Supply Conservation

Non-Federal Sponsors: Fresno Metropolitan Flood Control District

Points of Public Contact for Questions/Comments on Review Plan:

District: Sacramento District

Major Subordinate Command (MSC): South Pacific Division

Review Management Organization (RMO): Planning Center of Expertise for Water Management and Reallocation Studies

Key Review Plan Dates

Date of RMO Endorsement of Review Plan	26 March 2025
Date of MSC Approval of Review Plan	Pending
Date of IEPR Exclusion Approval	n/a – IEPR is not planned
Has the Review Plan changed since RMO Endorsement?	N/A
Date of Last Review Plan Revision	None
Date of Review Plan Web Posting	Pending

Milestone Schedule and Other Dates

	Scheduled	Actual
FCSA Execution	7 February 2024	7 February 2024
Alternatives Milestone	26 March 2025	26 March 2025
Vertical Team Alignment Memorandum (VTAM)	28 April 2025	TBD
Tentatively Selected Plan	11 April 2029	TBD
Release Draft Report to Public	27 June 2029	TBD
Command Validation Milestone	TBD	TBD
Final Report Transmittal	27 December 2030	TBD
Senior Leader Briefing	10 April 2031	TBD
Chief's Report	15 July 2031	TBD

2. References

Engineer Regulation 1165-2-217 – Water Resources Policies and Authorities – Civil Works Review Policy, 2 September 2025.

Engineer Circular 1105-2-412 – Planning – Assuring Quality of Planning Models, 31 March 2011.

Planning Bulletin 2013-02, Subject: Assuring Quality of Planning Models (EC 1105-2-412), 31 March 2013.

Office of Management and Budget, Final Information Quality Bulletin for Peer Review, Federal Register Vol. 70, No. 10, January 14, 2005, pp 2664-267

Engineering and Construction Bulletin 2024-3 – Technical Lead for E&C Deliverables.

The online USACE Planning Community Toolbox provides more review reference information at:

<https://planning.erdc.dren.mil/toolbox/current.cfm?Title=Peer%20Review&ThisPage=Peer&Side=No>.

3. Review Execution Plan

The general plan for executing all required independent reviews is outlined in the following two tables.

Table 1 lists each study product to be reviewed. The table provides the schedules and costs for the anticipated reviews. Teams also determine whether a site visit will be needed to support each review. The decisions about site visits are documented in the table. As the review plan is updated the team will note each review that has been completed.

Additionally, a number of interim products may benefit from targeted review prior to review of the draft and final report. Targeted review may be completed on an ad hoc basis and are budgeted for, as noted in Table 1.

Table 2 identifies the specific expertise and role required for the members of each review team. The table identifies the technical disciplines and expertise required for members of review teams. In most cases the team members will be senior professionals in their respective fields. In general, the technical disciplines identified for a District Quality Control (DQC) team will be needed for an Agency Technical Review (ATR) team. Each ATR team member will be certified to conduct ATR by their community of practice.

Table 1: Schedule and Costs of Reviews

Product to undergo Review	Review Level	Start Date	End Date	Duration	Cost**	Complete
Targeted Reviews*	DQC	As needed		2-3 weeks	\$15,000	No
	ATR	As needed		3 weeks	\$15,000	No
FWOP conditions	Targeted DQC	12/17/2027	12/23/2027	1 week	5,000	No
	Targeted ATR	12/27/2027	1/10/2028	2 weeks	5,000	No
Drilling and Invasive Program Plan	Targeted DQC	8/9/2025	8/22/2025	2week	10,000	No
	Targeted ATR	8/23/2025	9/13/2025	3 weeks	10,000	No
Semi-Quantitative Risk Assessment	DQC	2/28/2028	3/13/2028	2 weeks	\$35,000	No
	ATR	3/13/2028	4/3/2028	3 weeks	\$40,000	No
Draft Feasibility Report/ Integrated NEPA Document	PDT/Sponsor Review	6/1/2028	6/29/2028	4 weeks	N/A	No
	District Quality Control (DQC)	6/30/2028	10/13/2028	15 weeks	\$60,000	No
	Public Comment under NEPA	6/28/2029	8/10/2029	45 days	TBD	No
	ATR	6/28/2029	8/23/2029	8 weeks	\$70,000	No
	Policy and Legal Compliance Review	7/2/2029	9/10/2029	10 weeks	N/A	No
	PDT/Sponsor Review	9/12/2029	10/3/2029	3 weeks	N/A	No
Final Feasibility Report/ Integrated NEPA Document	DQC	3/19/2030	4/16/2030	4 weeks	\$20,000	No
	ATR	8/5/2030	9/23/2030	7 weeks	\$50,000	No
	Release Final Report under NEPA	12/30/2030	2/12/2031	45 days	N/A	No
	Policy and Legal Compliance Review	12/30/2030	2/20/2031	7 weeks	N/A	No
Review Management Organization (WMRS-PCX) – Coordination and Participation	The WMRS-PCX will participate in key meetings including In-Progress Reviews, Issue Resolution Meetings and SMART Milestone Meetings	N/A	N/A		N/A	No

*Targeted reviews may be performed as needed.

**Review team site visits are not anticipated. This section will be updated to reflect changes if the district determines a site visit is warranted.

Table 2: Review Teams - Disciplines and Expertise

Discipline / Role	Expertise	DQC	ATR	IEPR*
DQC Team Lead	Extensive experience preparing Civil Works decision documents and leading DQC. The lead may serve as a DQC reviewer for a specific discipline (e.g., planning, economics, environmental, etc.).	Yes	N/A	N/A
ATR Team Lead	Professional with extensive experience preparing Civil Works decision documents and conducting ATR. Skills to manage a virtual team through an ATR. The lead may serve on the ATR team for a specific discipline (e.g., planning, economics, or environmental work).	N/A	Yes	N/A
IEPR Manager	Planner with extensive knowledge of IEPR policy and procedures and contract management and oversight skills.	N/A	N/A	Yes
Planning	Skilled water resources planner knowledgeable in water conservation/supply planning investigations and the application of SMART principles and risk informed decision making. Expertise with primary purpose of water conservation/ supply required.	Yes	Yes	No
Economics	Experience with primary purpose water/conservation s methods and tools used in the economic evaluation of water resources projects. Experience assessing impacts to flood risk management, comprehensive benefits and recreation features. Reviewer should have expertise in dam safety.	Yes	Yes	No
Economics using SWAP and CaUWMET	Experience with use/application of the Statewide Agricultural Production (SWAP) Model and the California Urban Water Management Economic Tool (CaUWMET).	Yes	Yes	No
Life Safety	Experience with applying theory, methods and tools used in the life safety evaluation of flood risk management water resources projects. Reviewer should have expertise in dam safety	Yes	Yes	Yes
Environmental Resources	Experience with environmental evaluation and compliance requirements, national environmental laws and statutes, applicable Executive Orders, and other planning requirements related to water resource project (e.g., dams, groundwater recharge). Experience with Endangered Species Act application, HEP modeling, and riparian habitat restoration is required.	Yes	Yes	No
Cultural Resources	Experience with cultural resource survey methods, area of potential effects, National Historic Preservation Act Section 106, and state and federal laws pertaining to American Indian Tribes.	Yes	Yes	No
Hydrology	Engineer with experience applying hydrologic principles and technical tools to project planning, design, construction, and operation.	Yes	Yes	Yes

Discipline / Role	Expertise	DQC	ATR	IEPR*
Hydraulic Engineering	Engineer with experience applying hydraulic engineering principles and analytic tools to project planning, design, construction, and operation. Ideally reviewer will have experience with water conservation/supply and groundwater modeling.	Yes	Yes	Yes
Cost Engineering	Experience using cost estimation software; working knowledge of water resource project construction; capable of making professional determinations using experience.	Yes	Yes	No
Civil Engineering	The reviewer should have recent experience in the design of and plans for various flood risk management measures, such as reservoirs, channels, and canals.	Yes	Yes	Yes
Geotechnical Engineering	Experience with reservoirs, sediment characterization/suitability, slope stability, and seismic design.	Yes	Yes	Yes
Real Estate	Experience developing Real Estate Plans and experience in real estate fee/easement acquisition and residential/business relocations for Federal and/or Federally Assisted Programs for implementation of Civil Works projects.	Yes	Yes	No
Infrastructure and Installation Resilience CoP	A member of the Infrastructure and Installation Resilience Community of Practice knowledgeable of inland hydrology infrastructure resilience assessment policy and practice.	Yes	Yes	No
Water Management	Team member will be experienced with the operational requirements of flood control reservoirs.	Yes	Yes	Yes
Risk and Uncertainty	Expertise in multi-discipline flood risk analysis to ensure consistent and appropriate identification, analysis, and written communication of risk and uncertainty. Experience with Semi Quantitative Risk Analysis (SQRA)	Yes	Yes	Yes

*IEPR is not anticipated for this study. These disciplines would be included if the decision on IEPR changes.

4. Documentation of Reviews

Documentation of DQC. Quality Control will be performed continuously as deliverables are produced. A specific certification of DQC completion will be prepared at the targeted reviews for base conditions (existing and future) and for draft and final report stages. Documentation of DQC will follow the District Quality Manual and the MSC Quality Management Plan. DrChecks and/or Excel will be used for documentation of DQC comments. An example DQC Certification statement is provided in ER 1165-2-217, Appendix D. Documentation of completed DQC, to include the DQC checklist, will be provided to the MSC, RMO and the ATR Team leader. The ATR team will examine DQC records and comment in the ATR report on the adequacy of the DQC effort.

Documentation of ATR. DrChecks will be used to document all ATR comments, responses, and resolutions. Comments should be limited to those needed to ensure product adequacy. All members of the ATR team will use the four-part comment structure (see ER 1165-2-217, Section 5). If a concern cannot be resolved by the ATR team and PDT, it will be elevated to the vertical team to resolve using the issue resolution process in ER 1165-2-217, Section 5.9. Unresolved concerns will be closed in DrChecks by noting the concern has been elevated. ATR documentation will include an assessment by the ATR team of the effectiveness of DQC. The ATR Lead will prepare a Statement of Technical Review (see ER 1165-2-217, Section 5.11, and Appendix D), for the draft and final reports, certifying that review issues were resolved or elevated. ATR will be certified when all concerns are resolved or referred to the vertical team and the ATR documentation is complete.

Documentation of IEPR. n/a

Documentation of Model Review. Planning models require compliance with EC 1105-2-412. Models developed by the Corps of Engineers are certified and models developed by others are approved. Certifications or approvals may be specific to a single study, a regional application or for nationwide application. Completion of a model review is documented in a memorandum from the Director of a Planning Center of Expertise and should accompany reporting packages for study decisions. Two models are pending certification, but certification is expected prior to initiation of review.

5. Supporting Information

Study or Project Background

Study Authority

Section 202(a)(16) of the Water Resources Development Act of 2020 (Public Law 116-460) and Section 8397(a)(2)(C) of the Water Resources Development Act of 2022 authorize a study to evaluate the feasibility of adding water conservation and/or supply as an authorized project purpose.

Study Area

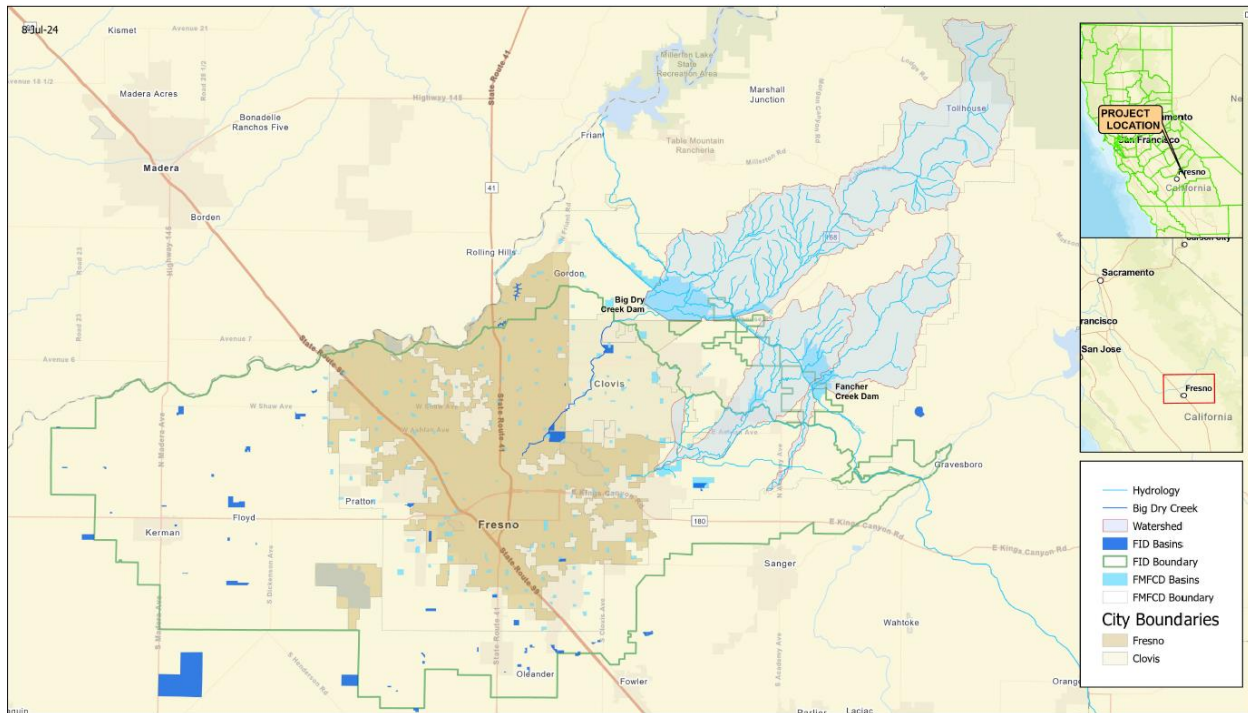
The study area is located in Fresno County, California and encompasses both the cities of Fresno and Clovis and surrounding areas (Figure 1). Fresno and Clovis are in California's Central Valley, an area known for its agricultural productivity and its warm Mediterranean climate. The study area includes not only the geographic boundary of where an eventual project may be built, but the entire area which stands to benefit from, or be impacted by the project, such that full evaluation and comparison of alternatives can be performed.

The study area is home to over 700,000 people and supports both urban development and agriculture. The primary agricultural products are almonds, grapes, pistachios, and livestock (2021 Crop Report). A majority of the study area is composed of low-income communities.

The study will focus on two dams, Big Dry Creek Dam and Fancher Creek Dam, within the Redbank and Fancher Creeks Project Flood Risk Management Project, which was constructed by USACE in 1993.

Big Dry Creek Dam and Reservoir are flood control facilities located on Big Dry Creek, about 15 miles northeast of Fresno. Big Dry Creek Reservoir was authorized by the Flood Control Act of 1941 and constructed in 1948 by the U.S. Army Corps of Engineers. The dam has been owned and operated by the Fresno Metropolitan Flood Control District (FMFCD) since 1987. USACE raised the dam, as a part of the Redbank and Fancher Creeks Project for Flood Risk Management. Construction was completed in 1993. Big Dry Creek Dam is an earthen structure with a crest height of 438.5ft and a total capacity of 30,200 acre-feet. It intercepts flood flows from Big Dry Creek and Dog Creek. The dam is a dry dam and for most of the year, there is no water behind the earthen dam and the land is leased for cattle grazing and used for helicopter practice maneuvers.

The current Water Control Manual, authored by the U.S. Army Corps of Engineers, was written in 1994 and requires excess flood waters be evacuated and does not allow for water conservation. This prevents the FMFCD from storing flows to release throughout the year to the groundwater recharge system. Instead, floodwater is sent northwest down the Little Dry Creek Diversion Channel which drains into the San Joaquin River. **Figure 1 – Study Area Map.**



The area’s largest recorded storms occurred recently in Water Year 2023. During these storms only 20% of the total capacity of Big Dry Creek Reservoir was utilized, corresponding with an approximately 39% loading against the dam. While this only utilized approximately 20% of the reservoir’s capacity, holding these flood flows, even temporarily, resulted in minor boils and seepage around the dam. A 2003 Bureau of Reclamation report identified dam safety concerns related to seepage at Big Dry Creek reservoir and noted that, “modification of the dam for water storage longer than 90 days may require extensive modification of the dam.”

Fancher Creek Dam is approximately 20 miles northeast of the City of Fresno. Fancher Creek Dam is an earthen dam, with a 100cfs ungated outlet, constructed by USACE in 1991. Currently, Fancher Creek Dam is a dry dam. Because the 100cfs outlet is ungated, there are no operations and no water control manual for the reservoir. While Big Dry Creek Dam and Reservoir is the primary focus, the non-Federal Sponsor would also like to investigate operating Fancher Reservoir for water conservation.

Fresno and Clovis are connected to the Central Valley Project, a massive multi-purpose water storage and delivery system. The Central Valley Project, constructed in 1933, stores and transports water in the wetter northern half of California and delivers it to the more water-poor Central Valley regions for irrigation, municipal, and industrial use. The Friant-Kern canal, a 150-mile canal that is part of the Central Valley Project, runs through the eastern boundary of the study area. The non-Federal sponsor is currently planning a Friant-Kern turnout that would spill into Big Dry Creek and increase the water going into the reservoir. The turnout would allow capture of flood releases from Millerton Lake that would otherwise not be directed to other users. The turnout is sized to the 150cfs outlet at Big Dry Creek Diversion Channel allowing flows that enter the reservoir to pass through, rather than be impounded. Notably, these flows would be

directed into the reservoir in the latter portion of the flood season, when Big Dry Creek Dam is not subjected to high flood flows. Construction is anticipated to complete in 2026.

In 2014, the State of California passed the Sustainable Groundwater Management Act to establish a framework to protect groundwater resources. The California Central Valley region faces significant land subsidence stemming from its semi-arid climate, heavy dependence on groundwater for sustaining communities and agriculture, and periodic droughts. Land subsidence in the Central Valley has been ongoing since the 1920s, primarily due to excessive groundwater extraction. However, due to the composition of soil types and proactive measures to promote groundwater recharge, the study area presently exhibits no evidence of land subsidence. However, groundwater levels in the study area generally decline by 1-2 feet per year.

Problem Statements

The following problems in the study area were identified:

WATER SUPPLY

- Existing water supply does not meet the needs of water users.
- There is a critical shortage of groundwater due to long-term overdraft.

Goals and Objectives

Based on the problems identified in the study area, the planning objectives to achieve over the period of analysis in the study area are as follows:

- Increase proportion of project releases that can be used for groundwater recharge.
- Improve water supply reliability
- Increase regional drought resiliency.

Future Without Project Conditions

- Decrease in water reliability, availability, and affordability throughout region due to continued excessive groundwater extraction with insufficient recharge.
- Potential economic stagnation of local agricultural communities due to reduced water availability.
- Probable increase in frequency and duration of droughts throughout the region due to changing conditions.
- Heightened flood risk due to intensified rainstorms.

Types of Measures/Alternatives Being Considered

The following list of measures in Table 3 was identified through collaboration with PDT subject matter experts, the Non-Federal sponsors, and vertical team members during plan formulation iterations prior to and during the planning charrette. Management measures will be further refined and evaluated during the study process.

Table 3 - Management Measures.

Measure	Notes
Water Conservation	
Modify Water Control Manuals	Retained
Modify Big Dry Creek Reservoir for water conservation (longer duration pool)	Retained
Modify Fancher for water conservation space (longer duration pool)	Retained
Evaporation Reduction Measures	SCREENED
Construct Additional Water Storage Elsewhere (Upstream)	SCREENED
Add Infiltration Basins	SCREENED
Passive Wells	SCREENED
Control Structure for Fancher	Retained
Expand Canal Turnout at Friant-Kern Canal (FWOP Turnout, to be completed in 2026)	Retained
Increase Capacity of Big Dry Creek Outlet and Chanel	Retained
Increase Groundwater Recharge Basin Space	SCREENED
Friant-Kern Diversion Point to Fancher	Retained
Induced Recharge	SCREENED - May induce flooding
Irrigation Furrows	SCREENED - Not found to be successful in the region
Dog Creek improvement to increase capacity	SCREENED - No lands rights and limited ability to capture benefits
New Diversion Point from Reservoir	SCREENED - More expensive than using existing diversions, technically challenging for any possible new locations
Send water to Friant-Kern Canal (pumping)	SCREENED - Difficult to implement during flood seasons
In Channel Infiltration System	SCREENED - Does not meet environmental operating principals
Off Channel Systems	SCREENED - Does not meet environmental operating principals
Increase Millerton Lake Storage Capacity	SCREENED - Outside of NFS Jurisdiction
Restrict Water Use	SCREENED - Outside of NFS Jurisdiction
Increase Water Prices to Decrease Demand	SCREENED - Outside of NFS Jurisdiction
BMPs for water conservation	SCREENED - Outside of NFS Jurisdiction
Ecosystem Restoration	
Aeration of "dead pools"	SCREENED - Does not have direct nexus with authorized study purpose

Plantings in Recharge Basins	SCREENED - Does not have direct nexus with authorized study purpose
Plantings in Reservoirs	SCREENED - Does not have direct nexus with authorized study purpose
Improvement of Habitat Along Big Dry Creek	SCREENED - Does not have direct nexus with authorized study purpose
Flood Risk Management	
Modify Copper Ave	SCREENED - No Fed interest in addressing nuisance flooding
Improve Capacity of Little Dry Creek Diversion Chanel	SCREENED - Maintenance is a non-federal responsibility
Education and Outreach	SCREENED - Will not provide significant benefit and sponsor can pursue independent of project modification
Update Emergency Action Plan	SCREENED - No Fed interest in addressing nuisance flooding

An overview of the alternatives included in the initial array is provided below in Table 4. These alternatives will be further developed and evaluated during the planning process.

Table 4 – Initial Array of Alternatives.

Alternative Plan	Abbreviated Description
Alternative 1 - No Action	No Action.
Alternative 2a - Storage at Big Dry Creek Dam	<ul style="list-style-type: none"> • Modify Big Dry Creek Reservoir as needed to hold longer duration pool • Update water control manual (WCM) to allow water conservation
Alternative 2b – Increased Storage at Big Dry Creek Dam SCREENED	<ul style="list-style-type: none"> • Increase Big Dry Creek Reservoir capacity, enlarge reservoir outlet, and expand the turn out from Friant-Kern Canal into the reservoir. • Modify Big Dry Creek Reservoir as needed to hold longer duration pool • Update WCM to allow water conservation
Alternative 3a – Storage at Fancher Creek Dam	Modify Fancher Creek Reservoir to hold conservation pool; update WCM
Alternative 3b – Increased Inflows at Fancher Creek Dam:	<ul style="list-style-type: none"> • Modify Fancher Creek Reservoir to hold conservation pool and update WCM. • Construct a Friant-Kern Diversion Point to Fancher Reservoir to increase water supply
Alternative 4 – Maximize Storage at Big Dry Creek and Fancher Creek Dams	<ul style="list-style-type: none"> • Utilize both Big Dry and Fancher Creek Reservoirs for water conservation by making the necessary modifications to the reservoirs and WCM.

	<ul style="list-style-type: none"> Maximize groundwater recharge potential by expending inlets/outlets to both reservoirs.
Alternative 5 – New Water Storage SCREENED	<ul style="list-style-type: none"> Construct additional water storage facility upstream of Big Dry Creek Dam Not a cost-efficient alternative. Not aligned with water conservation authority, Governor’s initiative to use existing facilities, and ASA(CW) memo to utilize existing facilities.

Estimated Cost/Range of Costs

Costs will be developed prior to the Tentatively Selected Plan milestone. Costs are not expected to exceed \$200 million.

6. Models to be Used in the Study

EC 1105-2-412 mandates the use of certified or approved models for all planning activities to ensure the models are technically and theoretically sound, compliant with USACE policy, computationally accurate, and based on reasonable assumptions. Planning models are any models and analytical tools used to define water resources management problems and opportunities, to formulate potential alternatives to address the problems and take advantage of the opportunities, to evaluate potential effects of alternatives and to support decision making.

The following planning models will be used to develop the decision document:

Table 5: Planning Models.

Model Name and Version	Brief Model Description and How It Will Be Used in the Study	Certification / Approval
USACE Regional Economic Systems (RECONS 2.0)	RECONS is designed to provide accurate and defensible estimates of regional economic impacts and contributions associated with Corps projects, programs, and infrastructure across Corps Civil Works business lines. Regional economic impacts and contributions are measured as economic output, jobs, income, and value added.	Certified
RMC-LifeSim 2.0	RMC-LifeSim is a USACE certified software designed to help study teams better understand the consequences of a flood event. RMC-LifeSim is a spatially distributed, dynamic simulation system for estimating potential life loss and economic damages from flood hazards. RMC-LifeSim will be used to evaluate the life safety risk and help determine incremental risk for structural components of selected plan.	Certified 2021

Risk Management Center (RMC)- TotalRisk 1.0	TotalRisk is a quantitative risk analysis software used to enhance and expedite risk assessments within the Flood Risk Management, Planning, and Dam and Levee Safety communities of practice. It performs risk analysis from user defined hazard, system response, and consequence functions. It can generate various aspects of risk including Total, Incremental, Failure, and Non-Failure. TotalRisk will be used annualize expected life loss estimates (from LifeSim) which will help inform where each alternative plots on the Life Risk Matrix.	TBD – Certification expected by Q4 of 2024
IWR Planning Suite II (2.0.9)	IWR Planning Suite II (version 2.0.9) includes modules to assist with plan formulation and evaluation: Plan Generator; Cost-Effectiveness and Incremental Cost Analysis (CE/ICA); Annualizer; Multi-Criteria Decision Analysis (MCDA); Uncertainty Analysis; and Watershed Wizard.	Certified
Habitat Suitability Index Model: Yellow-headed Blackbird	This model is applicable to grassland habitat types with interspersed wetland types such as vernal pools. This is the most common habitat type in the study area. This model will be used to assess impacts to habitat and calculate mitigation.	Approved for Regional Use
Habitat Suitability Index Model: Riparian Forest	This model is a generalist model applicable to riparian forest cover types composed of woody vegetation primarily with trees greater than 20 feet important to a wide array of wildlife. This is the second most common habitat type in the study area. This model will be used to assess impacts to habitat and calculate mitigation.	Approved for Regional Use
Statewide Agricultural Production Model (SWAP) v6.1	The SWAP model is a regional agricultural production and economic optimization model that simulates the decisions of farmers across 93 percent of agricultural land in California. It anticipated that SWAP model shadow values from recent USBR studies along with water transfer pricing regression estimates will be combined to estimate agricultural related water supply benefits.	Approved for One-Time Use
California Urban Water Management Economic Tool (CaUWMET) v1.0	CaUWMET is the most recent urban water supply economics model developed by the DWR. It is a coupled water supply and demand balance and economic simulation model and optimization tool that estimates the cost of water supply reliability enhancement measures for California urban water contractors. It is anticipated that unit water supply benefit values obtained from CaUWMET will be used to estimate urban water supply benefits.	Approved for One-Time Use

Both the SWAP and CaUWMET are economic tools that were developed by the California Department of Water Resources (DWR). These tools are not certified for routine use in USACE studies. The WMRS-PCX, as the RMO, has approved a one-time use model certification for these tools. USACE may not have reviewers able to provide DQC and ATR of these products; therefore, it may be necessary to identify reviewers outside of USACE. The PDT will work with the WMRS-PCX to identify model reviewers prior to the start of DQC.

EC 1105-2-412 does not cover engineering models used in planning. The responsible use of well-known and proven USACE developed and commercial engineering software will continue. The professional practice of documenting the application of the software and modeling results will be followed. The USACE Scientific and Engineering Technology Initiative has identified many engineering models as preferred or acceptable for use in studies. These models should be used when appropriate. For example, HH&C models need to comply with the requirements of HH&C CoP Enterprise Standard 08101.

These engineering models will be used to develop the decision document:

Table 6: Engineering Models.

Model Name and Version	Brief Model Description and How It Will Be Used in the Study	Approval Status
HEC-HMS 4.10 or greater if 4.11 is released.	The Hydrologic Modeling System (HEC-HMS) is designed to simulate the complete hydrologic processes of dendritic watershed systems. The software includes many traditional hydrologic analysis procedures such as event infiltration, unit hydrographs, and hydrologic routing. HEC-HMS also includes procedures necessary for continuous simulation including evapo-transpiration, snowmelt, and soil moisture accounting. Advanced capabilities are also provided for gridded runoff simulation using the linear quasi-distributed runoff transform (ModClark). Supplemental analysis tools are provided for model optimization, forecasting streamflow, depth-area reduction, assessing model uncertainty, erosion and sediment transport, and water quality.	USACE H&H CoP preferred model
HEC-ResSim 3.5 or greater if released.	The Reservoir System Simulation (HEC-ResSim) software developed by the U.S. Army Corps of Engineers, Institute for Water Resources, Hydrologic Engineering Center (CEIWR-HEC) is used to model reservoir operations at one or more reservoirs for a variety of operational goals and constraints. The software simulates reservoir operations for flood management, low flow augmentation and water supply	USACE H&H CoP preferred model

	for planning studies, detailed reservoir regulation plan investigations, and real-time decision support. HEC-ResSim can represent both large and small scale reservoirs and reservoir systems through a network of elements (junctions, routing reaches, diversions, reservoirs) that the user builds. The software can simulate single events or a full period-of-record using available time-steps. HEC-ResSim is a decision support tool that meets the needs of modelers performing reservoir project studies as well as meeting the needs of reservoir regulators during real-time events.	
HEC-SSP 2.3.1 or greater if released	The U.S. Army Corps of Engineers, Hydrologic Engineering Center's (HEC) Statistical Software Package (HEC-SSP) allows users to perform statistical analyses of hydrologic data. The current version of HEC-SSP can perform flow frequency analyses based on Bulletin 17C (England, et al., 2019), generalized frequency analyses, volume frequency analyses, duration analyses, coincident frequency analyses, curve combination analyses, balanced hydrograph analyses, distribution fitting analyses, mixed population analyses, correlation analyses, and record extension analyses.	USACE H&H CoP preferred model
HEC- RAS 6.3.1 or greater if released.	The Hydrologic Engineering Center's (CEIWR-HEC) River Analysis System (HEC-RAS) software allows the user to perform one-dimensional steady flow, one and two-dimensional unsteady flow calculations, inundation mapping, sediment transport/mobile bed computations, and water temperature/water quality modeling.	USACE H&H CoP preferred model
RMC-Best Fit	The U.S. Army Corps of Engineers (USACE) Risk Management Center (RMC), in collaboration with the Engineer Research and Development Center (ERDC) Coastal and Hydraulics Laboratory (CHL), developed the Bayesian estimation and fitting software (RMC-BestFit) to enhance and expedite flood hazard assessments within the Flood Risk Management, Planning, and Dam and Levee Safety communities of practice.	USACE RMC Preferred Model
RMC-RFA	The U.S. Army Corps of Engineers (USACE) Risk Management Center (RMC) developed the Reservoir Frequency Analysis (RMC-RFA) software to facilitate hydrologic hazard assessments within the USACE	USACE RMC

	Dam Safety Program. RMC-RFA produces a reservoir stage-frequency curve with uncertainty bounds by utilizing a deterministic flood routing model while treating the inflow volume, the inflow flood hydrograph shape, the seasonal occurrence of the flood event, and the antecedent reservoir stage as uncertain variables rather than fixed values. In order to quantify both the natural variability and knowledge uncertainty in reservoir stage-frequency estimates, RMC-RFA employs a two looped, nested Monte Carlo methodology. The natural variability of the reservoir stage is simulated in the inner loop defined as a realization, which comprises many thousands of simulated flood events. Knowledge uncertainty in the inflow volume frequency distribution is simulated in the outer loop, which comprises many realizations.	Preferred Model
GeoStudio 2024.2.1 (11.3.0.23668)	The integrated GeoStudio software is a software product for geotechnical modeling & analysis. GeoStudio analyzes both simple and complex slope stability problems for a variety of slip surface shapes, pore-water pressure conditions, soil properties, and loading conditions as well as simulates groundwater flow in porous media under saturated and unsaturated transient hydraulic conditions. Finally, GeoStudio provides finite element software capabilities for modelling stress and deformation in soil and structures ranging from simple linear elastic simulations to soil-structure interaction problems with nonlinear material models. The models will be used to determine the adequacy of the structure for potential future loading conditions. They will also help determine the TSP remedy design.	Standard of practice.

7. Factors Affecting Level and Scope of Review

All planning products are subject to the conduct and completion of DQC. Most planning products are subject to ATR and a smaller sub-set of products may be subject to Independent External Peer Review and/or Safety Assurance Review. Information in this section helps in the scoping of reviews through the considerations of various potential risks.

8. Review of Work In-Kind Products

The non-federal sponsor may provide a number of products as work in-kind (WIK). WIK is subject to review, as described in ER 1165-2-217. All WIK products will undergo DQC and ATR. USACE environmental and cultural resource leads for the study will serve as the leads for agency

coordination and consultation for environmental and cultural resources activities. Note that the scope of WIK is not finalized and will be negotiated. The final scope of WIK will be determined prior to TSP and the Review Plan will be updated to identify the products that will be provided as WIK.

Objectives of the Reviews

The intended outcome of reviews with particular attention to key technical considerations and associated risks likely to be encountered during the study and/or in later phases of the project are documented below:

- Ensure compliance with all necessary laws, including NEPA.
- Ensure technically sound decision documents.
- Reviews should assess how well a given alternative would perform under a range of inflow scenarios, especially low flow scenarios.
- Assess that models are producing accurate outputs that may be used to evaluate performance of alternative plans.
- Assess that benefits due to various levels of groundwater recharge from the impounded water in the reservoir are appropriately calculated.
- Assess that appropriate level of dam safety risk assessment has been conducted for the two dams, Big Dry Creek and Fancher Creek.

Assessing the Need for IEPR

In accordance with the criteria in ER 1165-2-217, the District has determined that IEPR is not likely to be warranted for the Redbank and Fancher Feasibility Study. The study is not anticipated to meet any of the mandatory IEPR triggers and the Chief of Engineering has determined that SQRA must be performed before a final decision on IEPR can be made. The IEPR triggers and risk-informed decision process is discussed below.

Mandatory IEPR Triggers

- Has the Chief of Engineers determined the project is controversial? *No*
- Has the Governor of an affected state requested an IEPR? *No*
- Is the cost of the project more than \$200 million? *Not likely*

Since the project is not expected to exceed the \$200 million threshold, the project anticipates completing an EA, and the project is not expected to be controversial, IEPR is not required. The project is not anticipated to increase the risk to the downstream populations and the study will not use novel methods for analysis or design. The study includes completion of a semi-quantitative risk assessment (SQRA) to ensure life safety risk is not increased by the tentatively selected plan and will be used to verify the impacts of the recommended plan. The PDT does not anticipate the need for IEPR, but will reassess the decision during the SQRA process if it indicates the need for independent review. This is a unique feasibility study evaluating alternatives to provide water supply in addition to the existing FRM project purpose. In the required risk assessment the need for IEPR may present itself.

Assessing Other Risk Considerations

- **Will the study likely be challenging? If so, describe how?**

This project is not expected to present significant challenges for engineering analysis of the two dam structures, determining environmental impacts, or determining economic, environmental, or other significant effects and benefits. No significant public opposition is expected.

- **Provide a preliminary assessment of where the project risks are likely to occur and assess the magnitude of those risks.**

This study will evaluate the ability of the Big Dry Creek Dam and Fancher Creek Dam to be operated for water conservation. Areas of uncertainty include the hydrologic loading, nature of seepage observed at the toe of Big Dry Creek Dam, stability of both dams' embankments, and downstream consequences.

The NID rates these dams with a High Hazard Potential Classification and the California State Division of Safety of Dams (DSOD) classifies them as Extremely High downstream hazard. These classifications are based on the size of the at-risk population downstream of both dams. The at-risk population is 4 miles downstream from the Fancher Creek Dam structure and there is a planned development immediately downstream of the Big Dry Creek Dam. The study will perform a semi-quantitative risk assessment for both dams to ensure any potential modification to operations or the dam structures does not increase the life safety risk to downstream populations.

- **Is the project likely to be justified by life safety or is the study or project likely to involve significant life safety issues? Briefly describe the life risk, including the District Chief of Engineering's assessment as to whether there is a significant threat to human life associated with aspects of the study or failure of the project or proposed projects.**

This project is not likely to be justified based on life safety benefits. At this time, potential modifications to the Redbank and Fancher Project are not expected to pose a significant threat to human life (public safety), as determined by the SPK Chief of Engineering.

By signing this review plan, the Chief of Engineering agrees with this assessment, fulfilling the requirement of ER 1165-2-217. Life safety of the existing, future without, and future with project will be evaluated to ensure the recommended plan incorporates appropriate measures to allow the dams to be operated for water conservation.

- **Is the information in the decision document or anticipated project design likely to be based on novel methods, involve innovative materials or techniques, present complex challenges for interpretation, contain precedent-setting methods or models, or present conclusions that are likely to change prevailing practices? If so, how?**

The study does not anticipate using novel methodology to determine project feasibility. The study PDT does not currently anticipate significant opposition to a project to add water conservation at the Big Dry Creek Dam or the Fancher Creek Dam.

- **Does the project design require redundancy, resiliency, and/or robustness, unique construction sequencing, or a reduced or overlapping design/construction schedule? If so, how?**

The project design is not expected to require redundancy, resiliency, or robustness, unique construction sequencing, or a reduced or overlapping design/construction schedule.

- **Is the project expected to have more than negligible adverse impacts on scarce or unique tribal, cultural, or historic resources? If so, what are the anticipated impacts?**

The project is not expected to have more than negligible adverse impacts on scarce or unique tribal, cultural, or historic resources. However, additional research is needed to determine the potential effects of this project under Section 106 of the NHPA once sufficient information is available on the plan

- **Is the project expected to have substantial adverse impacts on fish and wildlife species and their habitat prior to the implementation of mitigation measures? If so, describe the impacts?**

The project is not expected to have substantial adverse impacts on fish and wildlife species, or their habitat.

- **Is the project expected to have, before mitigation measures, more than a negligible adverse impact on an endangered or threatened species or their designated critical habitat? If so, what are the anticipated impacts?**

The project is not expected to have more than a negligible adverse impact on endangered or threatened species or their designated critical habitat.

9. Risk Informed Decisions on Level and Scope of Review

Targeted ATR. Will a targeted ATR be conducted for the study?

Yes, targeted ATR will be conducted for major modeling tasks associated with describing the future without project conditions on an ad hoc basis, as described in Table 1.

- **Drilling and Invasive Program Plan (DIPP).** The Risk Management Center is required to review and approve all DIPPs. This may be considered a targeted ATR. Reviewers will be identified and approved by the RMC at the time of review. The district will perform DQC prior to submittal for RMC review. Review will be documented in DrChecks, in accordance with ER 1165-2-217.
- **Semi-Quantitative Risk Assessment.** The Risk Management Center will review the SQRA. This may be considered a targeted ATR. Reviewers are required to be CERCAP certified in risk assessment and will be identified and approved by the RMC at the time of

review. The district will perform DQC prior to submittal for RMC review. Review will be documented in DrChecks in accordance with ER 1165-2-217.

IEPR. The decision on IEPR will be reevaluated following the SQRA of the future with and without project conditions.

10. Policy and Legal Compliance Review

Policy and legal compliance review of draft and final planning decision documents is delegated to the MSC (see Director's Policy Memorandum 2019-01).

(i) Policy Review.

The policy review team is identified through the collaboration of the MSC Chief of Planning and Policy and the HQUSACE Chief of the Office of Water Project Review. The makeup of the Policy Review team will be drawn from Headquarters (HQUSACE), the MSC, the Planning Centers of Expertise, and other review resources as needed.

- The Policy Review Team will be invited to participate in key meetings during the development of decision documents as well as SMART Planning Milestone meetings. These engagements may include In-Progress Reviews, Issue Resolution Conferences, or other vertical team meetings plus the milestone events.
- The input from the Policy Review team should be documented in a Memorandum for the Record (MFR) produced for each engagement with the team. The MFR should be distributed to all meeting participants.
- Teams may choose to capture some of the policy review input in a risk register if appropriate. These items should be highlighted at future meetings until the issues are resolved. Any key decisions on how to address risk or other considerations should be documented in an MFR.

(ii) Legal Review.

Representatives from the Office of Counsel will be assigned to participate in reviews. Members may participate from the District, MSC and HQUSACE. The MSC Chief of Planning and Policy will coordinate membership and participation with the office chiefs.

- In some cases, legal review input may be captured in the MFR for the particular meeting or milestone. In other cases, a separate legal memorandum may be used to document the input from the Office of Counsel.

Each participating Office of Counsel will determine how to document legal review input.

11. Public Comment

This Review Plan will be posted on the District's website. Public comments on the scope of reviews, technical disciplines involved, schedules and other considerations may be submitted to the District for consideration. If the comments result in a change to the Review Plan, an updated plan will be posted on the District's website.

12. Documents Distributed Outside the Government

For information distributed for review to non-governmental organizations, the following disclaimer shall be placed on documents:

“This information is distributed solely for the purpose of pre-dissemination review under applicable information quality guidelines. It has not been formally disseminated by USACE. It does not represent and may not be construed to represent any agency determination or policy.”

13. District Concurrence

The Sacramento District has completed District Quality Control (DQC) of the review plan for the Redbank and Fancher Creeks Project, Fresno County, California Feasibility Study. The PDT has resolved all comments resulting from DQC review.

We, the undersigned, concur with this review plan for the Redbank and Fancher Creeks, Fresno County, California Feasibility Study.

Sacramento District Planning Chief

Date

Sacramento District Engineering Chief

Date

Appendix A - Brief Description of Each Type of Review

This section describes each level of review to be conducted. Based upon the factors discussed in Section 1, this study will undergo the following types of reviews:

District Quality Control. All decision documents and accompanying components will undergo DQC. Accompanying documents include, but are not limited to, risk register, decision log, study issue checklist, and milestone read aheads as required by EP 1105-2-61. This internal review covers basic science and engineering work products. It fulfills the project quality requirements of the Project Management Plan. The DQC team will read all reports and appendices. The review must evaluate the correct application of methods, validity of assumptions, adequacy of basic data, correctness of calculations (error-free), completeness of documentation, and compliance with guidance and standards. Districts are required to check all computations and graphics by having the reviewer place a highlight (e.g., place a “red dot”) on each annotation and/or number indicating concurrence with the correctness of the information shown.

Agency Technical Review. ATR will be performed by a qualified team from outside the home district that is not involved in the day-to-day production of the project/product. These teams will be comprised of certified USACE personnel. The ATR team lead will be from outside the home MSC.

Independent External Peer Review. This is the most independent level of review and is applied in cases that meet criteria where the risk and magnitude of the project are such that a critical examination by a qualified team outside of USACE is warranted. Certain criteria dictate mandatory performance of IEPR and other considerations may lead to a discretionary decision to perform IEPR. For this study, a risk-informed decision has been made that IEPR is not required, and is not recommended. The information in Section 1 – Factors Affecting the Scope of Review – informed the decision to conduct IEPR.

Cost Engineering Review. All decision documents will be coordinated with the Cost Engineering Mandatory Center of Expertise (MCX). The MCX assisted in determining the expertise needed on the ATR and IEPR teams. The MCX will provide the Cost Engineering certification. The RMO is responsible for coordinating with the MCX for the reviews. These reviews occur as part of ATR.

Model Review and Approval/Certification. The use of certified or approved planning models for all planning work is required to ensure the models are technically and theoretically sound, compliant with policy, computationally accurate, and based on reasonable assumptions. Engineering models must comply with standards set by the appropriate Engineering Community of Practice.

Policy and Legal Compliance Review. These reviews culminate in determinations that report recommendations and the supporting analyses and coordination comply with law and policy, and warrant approval or further recommendation to higher authority by the home MSC Commander.

Public Review. The District will post the Review Plan and approval memo on the District’s internet site. Public comment on the adequacy of the Review Plans will be accepted and

considered. Additional public review will occur when the report and environmental compliance document(s) are released for public and agency comment.