US Army Corps
of Engineers
Sacramento District

American River Watershed, California
Folsom Dam Modification Project

Final Limited Reevaluation Report

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SUMMARY

Current efforts to reduce the risk of flooding to the city of Sacramento from the American River began after the floods of 1986. The Corps, in partnering with its non-Federal sponsors, the State of California Reclamation Board (The Reclamation Board) and the Sacramento Area Flood Control Agency (SAFCA), has prepared two comprehensive studies and developed several alternatives for a long-term solution to the flooding problems in Sacramento, but to date none has gained consensus. Congress has, however, authorized two projects from the American River Watershed Investigation (ARWI), the Common Features Project and the Folsom Dam Modification Project. The Common Features Project primarily includes levee modification work along the lower American River and Sacramento River, and upon completion of this project, scheduled in 2004, the chance of flooding will be reduced to 1 in 100 chance in any one year.

This Limited Reevaluation Report (LRR) has been prepared in response to the authorization of the Folsom Dam Modification Project in Section 101(a)(6) of the Water Resources Development Act of 1999. The primary purpose of this report is to demonstrate that the authorized operational and structural modifications to Folsom Dam are economically justified, environmentally acceptable, and technically sound. As part of this evaluation, the design of the authorized plan was refined, and the costs, benefits, and effects were updated. Since a full range of alternatives is presented and evaluated in the 1996 Supplemental Information Report, the formulation and comparison of alternative plans was not conducted as part of this LRR.

The Folsom Dam Modification Project includes two fundamental components: (1) outlet works modifications and (2) surcharge storage. The construction of these two components is being phased for several reasons. First, the design and construction of the outlet works modification component would take about 6 years and can be accomplished with few adverse social or environmental effects. Second, the modification of the use of surcharge storage would provide additional flood control space in the reservoir. Many of the project features that would be needed to implement surcharge may also be needed to implement raising Folsom Dam, one of the alternatives being investigated in the American River Watershed Investigation Long-Term Study. However, some of these features would be different. If the modified use of surcharge is constructed now, Long-Term Study features such as the new emergency spillway tainter gates and dikes may have to be modified again. The phased construction will allow ample time for a decision to be made on the (ARWI) Long-Term Study (LTS). A Chief's of Engineers report on the Long-Term Study will be available in spring 2002.

The outlet component primarily consists of enlarging the eight existing river outlets from 5 feet wide by 9 feet high to 9 feet 4 inches wide by 16 feet 3 inches high. No new outlets would be constructed. The enlarged outlets would increase the release capacity from 34,000 cubic feet per second to 115,000 cubic feet per second (the objective release) at a water-surface elevation of 418 feet (the spillway crest elevation). The outlet works modification component would increase flood protection by reducing the probability of flooding in Sacramento in any one year from 1 chance in 100 to 1 chance in 130. The first cost is $108.8 million. The average annual costs and flood

control benefits amount to $9.2 million and $24.7 million, respectively. The average annual net economic benefits amount to $15.5 million, and the benefit-to-cost ratio is 2.7 to 1. Since the construction work for the outlet works modifications would be restricted to the concrete portion of the dam, there are no significant adverse environmental, recreational, or real estate effects. In addition, the construction of the outlet works modifications is sequenced so that there are no significant operational effects. In addition, road closures are limited to weekends and evenings, so there are no significant traffic effects. Construction could start as early as summer 2001 and could be completed in 2008.

The objective of the surcharge component is to raise the maximum surcharge elevation during a controlled release from elevation 470 feet to 474 feet. The surcharge space would be used before the emergency spillway tainter gates are opened to maintain releases below the probable non-failure point of downstream levees for a longer period. Use of this surcharge operation allows an additional 48,000 acre-feet of space to be credited for flood control. The outlet works modifications with the surcharge component would decrease the risk of flooding in Sacramento to a 1 in 140 chance in any given year. The first cost is estimated to be $38.6 million. The average annual cost is $2.8 million; the average annual flood control benefits are $4.9 million; and the annual net benefits are $2.1 million. The component is economically feasible, and the benefit-to-cost ratio is 1.8 to 1. Mitigation measures would be implemented to reduce any significant environmental or traffic effects. Construction is scheduled to be initiated in 2006 and would be completed in 2008.

The project is fully supported by the non-Federal sponsors, The Reclamation Board and SAFCA, which are financially capable of supporting the project. The project has been closely coordinated with the U. S Bureau of Reclamation (USBR) who owns and operates Folsom Dam and Reservoir. SAFCA, as the non-Federal sponsor, will enter into a cost-sharing agreement with USBR to pay for any portion of the operation, maintenance, repair, and replacement costs related to the new flood control features. The project is economically feasible, environmentally sound, and technically feasible.

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CHAPTER I – INTRODUCTION

PURPOSE AND SCOPE

The purpose of this Limited Reevaluation Report (LRR) is to demonstrate that the project features authorized by Congress in Section 101(a)(6) of the Water Resources Development Act of 1999 (WRDA 99) are economically justified, environmentally acceptable, and technically sound. As part of this evaluation, additional analyses were conducted, and the costs and benefits of the authorized plan were developed. Since a full range of alternatives is presented and evaluated in the 1996 Supplemental Information Report (SIR), the formulation and comparison of alternative plans was not conducted as part of this LRR.

The implementation of the project is being constructed in two phases: (1) outlet works modifications and (2) surcharge component. Upon completion of the Folsom Dam Modification Project, the probability of flooding will be reduced to 1 in 140 chance in any one year. The construction is being phased because many of the project features needed for surcharge may also be needed to implement the Folsom Enlargement Plan, one of the alternatives under consideration in the American River Watershed Investigation Long-Term Study. This study is investigating alternatives for the next step in flood control to meet the long-term minimum goal of the non-Federal sponsors to provide a minimum probability of flooding of 1 in 200 chance in any one year.

LOCATION

Sacramento is located at the confluence of the American and Sacramento Rivers. The American River Watershed (drainage basin) covers about 2,100 square miles northeast of Sacramento and includes portions of Placer, El Dorado, and Sacramento Counties (Plate 1). Runoff from this basin flows through Folsom Reservoir and passes through Sacramento within a system of levees. Folsom Dam and Reservoir are part of the Federal Central Valley Project (CVP) completed by the United State Bureau of Reclamation (USBR).

BACKGROUND

In February 1986, major storms in northern California caused record floodflows in the American River basin. Water releases from Folsom Reservoir reached 134,000 cfs for 24 hours, which is above the non-emergency objective release of 115,000 cfs and was above the design flow for parts of the lower American River levee system. Flows from Folsom Reservoir, together with high flows in the Sacramento River, caused water levels to rise above the design freeboard (safety margin) of the levees protecting the Sacramento area. Emergency repair work was required at several locations along the Garden Highway and in the Pocket area of Sacramento. Had these storms lasted much longer, major sections of levee would likely have failed, causing probable loss of life and billions of dollars in damages.

The effects of the February 1986 storms raised concerns over the adequacy of the existing flood control system, which led to a series of investigations to provide additional flood protection to the Sacramento area. Plate 2 shows the likely area of inundation for a major flood. Many of the flood problems in Natomas have been significantly reduced due to recent levee improvements. (Natomas is just north of downtown Sacramento at the confluence of the American and Sacramento Rivers.)

The U.S. Army Corps of Engineers (Corps), The State of California Reclamation Board (The Reclamation Board), and Sacramento Area Flood Control Agency (SAFCA) completed an initial feasibility study in 1991 for the mainstem American River and Natomas. The scope of that study was to define the flood risks to the Sacramento area and to develop flood protection alternatives consistent with other water resource needs and opportunities in the study area. Many alternatives were evaluated in that study. The resulting plan, recommended in the December 1991 Feasibility Report, was for construction of a flood detention dam just downstream of the confluence of the North and Middle Forks of the American River and levee improvements in the Natomas area sufficient to control runoff from a minimum probability of 1 in 200 chance in any one year. The Reclamation Board and SAFCA have long sought the maximum flood protection possible for the city of Sacramento, with a minimum goal of a probability of 1 in 200 chance in any one year.

Subsequent to completion of the Feasibility Report, Congress provided guidance relating to the American River study in Section 9159 of the Department of Defense Appropriations Act of 1993 (Public Law 102-396). This act authorized the construction of much of the work identified in the Natomas area as described in the Feasibility Report. The act also directed that additional studies be conducted to identify a project for increased flood protection along the American River.

In response to congressional direction, the Corps and its local sponsors, The Reclamation Board and SAFCA, prepared the 1996 SIR to provide additional information. The SIR presented three final candidate plans:

- Folsom Modification Plan (a version of this plan was authorized and is currently analyzed in this LRR),

- Folsom Stepped Release Plan (versions of this plan are under consideration in the Long-Term Study), and

- Detention Dam Plan (this plan was the National Economic Development Plan (NED); however, the plan did not gain local consensus or congressional support).

The Folsom Modification Plan primarily included increasing the release capacity by modifying the spillway and enlarging the eight existing outlets, modifying the lower American River and Sacramento levees, modifying the use of surcharge storage, and increasing the variable flood control space by reoperating the reservoir. The Stepped Release Plan included all the features of the Folsom Modification Plan and in addition

included increasing the objective release to 180,000 cubic feet per second (cfs) and modifying the downstream levee system to handle this increase in flow. The Detention Dam plan included modifying the lower American River and Sacramento levee system, and a concrete gravity dam 508 feet high with a detention capacity of 894,00 acre-feet on the North Fork American River near Auburn.

In Section 101(a)(1) of the Water Resources Development Act of 1996 (WRDA 96), Congress authorized the construction of those features which were common to the three candidate plans identified in the SIR. These features include (1) levee modification along both banks of the lower American River, (2) levee modification along the east bank of the Sacramento River downstream from the Natomas Cross Canal, (3) installation of streamflow gages upstream from Folsom Reservoir and modification to a flood warning system along the lower American River. These project features are currently being implemented. The interim reoperation of Folsom Reservoir for flood control will continue until the completion of Folsom Modification Project.

WRDA 99 authorized modifications to the Common Features Project authorized in WRDA 96. These modifications primarily consist of strengthening and raising levees along the American River. In August 2000, the Corps completed an information paper describing refinements to the modifications in WRDA 99. The WRDA 96 and 99 Common Features Projects are scheduled to be completed in 2004. Once construction of the Common Features Projects has been completed, the chance of flooding in Sacramento will be reduced to 1 in 100 in any given year. The construction of the Common Features Project is part of the without-project condition for the Folsom Dam Modification Project.

Since completion of the 1996 SIR, three information reports have been prepared by both SAFCA and the Corps to provide additional technical information concerning opportunities in the American River watershed. These reports are:

- In March 1998, MBK Engineers, under contract to SAFCA, published the "Folsom Dam Modification Report, New Outlets Plan." This report presented two alternatives that would reduce construction effects, shorten the construction period, and eliminate the temporary reduction in flood protection required by the Folsom Modification Plan in the SIR.

- In August 1999, the Corps published the "American River Watershed, CA, Information Paper" to provide additional information to the SIR. The Information Paper (1) described significant changes in baseline conditions that had taken place since the completion of the SIR and implementation of several flood control features in the Sacramento area, and (2) described and evaluated four supplemental improvement plans (in addition to those in the SIR). The plans included the Folsom Modification Plan, Stepped Release Plan, Folsom Enlargement Plan, and Folsom Modification and Upstream Storage Plan.

- In response to congressional direction in Section 566 of WRDA 99, in January 2000, the Corps prepared the report entitled "Additional Information - Folsom Dam Flood

Control Storage & Downstream Levees," which provided additional information on the Folsom Enlargement Plan and the Stepped Release Plan.

In Section 366 of WRDA 99, Congress authorized the construction of several additional flood control features. The features that have been authorized for the American River Watershed project are described in Section 9159 of the Department of Defense Appropriations Act for fiscal year 1993, in Section 101(a)(1) of WRDA 96, and in Sections 366 and 101(a)(6) of WRDA 99. Section 101(a)(1) authorized the Folsom Dam modifications discussed in this report. (See PROJECT AUTHORIZATION AND GUIDANCE below.)

In 1998, SAFCA completed construction of the North Area Local Project improvements needed to provide flood protection to Natomas basin, a 90-square mile area north of Sacramento, immediately east of the Sacramento River, and extending into Sutter County. Project features consist of levees associated with the Natomas East Main Drain, Arcade Creek, Dry Creek, Pleasant Grove Creek Canal, and Natomas Cross Canal; a pumping plant on the Natomas East Main Drain, and a detention basin at Pleasant Grove Creek. The flood risk to Natomas from the American River would be reduced to 1 in 400 chance in any year.

In addition to the projects described above that have already been authorized, the Corps, The Reclamation Board, and SAFCA are currently conducting a study, authorized in Section 566 of WRDA 1999, to determine the next increment in flood control that would meet the long-standing SAFCA objective of a minimum probability of 1 in 200 chance in any one year. This study is investigating a range of alternatives including enlarging Folsom Dam, increasing the objective release at Folsom Dam, and making advanced flood releases from the dam based on weather forecasting. This study is scheduled for completion in March 2002.

CHAPTER II – EXISTING CONDITIONS

EXISTING FLOOD CONTROL SYSTEM

Over the years, a complex system of levees, upstream dams and reservoirs, and related facilities was built to help reduce flooding in the Sacramento area. Several of the projects are discussed below.

Folsom Dam and Reservoir

Folsom Dam is on the main stem of the American River about 29 miles upstream from the Sacramento River. It is a multipurpose project operated by the USBR as part of the CVP. The dam regulates runoff from about 1,860 square miles of drainage area and has a total (full pool) capacity of about 975,000 acre-feet. The top of the current conservation pool is at elevation 466 feet. The current maximum flood control pool is at elevation 470 feet while maintaining the objective and emergency releases. However, under extreme conditions, the reservoir surcharges up to elevation 475.4 feet (Plate 3). The objective release for flood control from the dam to the lower American River is 115,000 cfs.

Operations

Folsom Dam was constructed with a seasonally designated flood control storage space of 400,000 acre-feet. However, in an interim agreement between the USBR and SAFCA through authorization in WRDA 1996, flood control storage in the reservoir has been changed to a variable space available ranging from 400,000 acre-feet to 670,000 acre-feet, depending on the amount of creditable vacant space in several existing upstream reservoirs in the basin. The USBR and SAFCA are currently working on finalizing this agreement.

Under this reoperation, a flexible rule curve operation is used. This includes varying the flood control space required in Folsom Lake through the crediting of actual space available in reservoirs upstream from Folsom Dam. As upstream reservoirs' creditable space is filled, the variable flood space at Folsom increases to as much as 670,000 acre-feet. Eighteen reservoirs exist in the American River Basin above Folsom. Flood control is not a project function of any of these reservoirs. Of the 18, only 5 are of sufficient size or located at appropriate sites where storage space in them could have a measurable influence on flood operation (Plate 1.) They include French Meadows, Hell Hole, Loon Lake, Union Valley, and Ice House. The drainage basins above the reservoirs have accounted for a minimum of 14 percent of the unregulated flows at Folsom Dam during major flood events.

The maximum creditable upstream space was determined to be 200,000 acre-feet. Any additional space does not benefit Folsom Dam operation during a Federal Emergency Management Agency (FEMA) storm probability with 1 in 100 chance in any one year

because the drainage basins above these reservoirs do not generate a significantly greater volume during the critical period of such an event.

Release Capacity

The existing Folsom Dam has limited capability to make objective flood releases until the reservoir is nearly 75% full. In order to make flood releases of 115,000 cfs, the objective release in the floodway below Folsom, the lake must rise above elevation 418. Currently, a maximum of 34,900 cfs can be released through the power penstocks and low-level outlets (7,500 cfs from the power plant and 27,400 cfs from the outlet works) when the lake level is at the spillway crest of elevation 418 feet. Plate 4 shows the location of the existing lower outlets, tainter gates, and spillway

Dam Safety

Folsom Dam and Reservoir was designed to pass the probable maximum flood (PMF) at the time of its construction. However, with the updated hydrology, the Corps has determined that Folsom Dam's existing spillway capacity is inadequate to protect the dam in the event of an extreme flood. Based on previous evaluations, it is estimated that the Folsom Dam spillway can currently pass approximately 70% of the PMF. This is subject to confirmation by an analysis of the PMF (hydrologic/routing, hydraulic design/model testing, and structural design) to be completed this year. Although dam safety is not currently part of the Folsom Modification Project authorization, dam safety remains an important consideration for any major dam modification project. A PMF fix is currently being evaluated as a dam safety component with the Folsom Dam Enlargement Plan, one of the alternatives being considered in the American River Long-Term study. If a Folsom Dam enlargement plan were authorized, it would likely include enhancements at French Meadows Dam and some combination of new/enlarged outlets, spillway lowering, and/or dam raising (i.e. crest walls). The PMF fix would need to be compatible with the Folsom Dam Outlet Modifications and Surcharge improvements. The main goals of the ongoing PMF studies will be to evaluate, identify, and report out on the best method to satisfy the PMF deficiency; to minimize traffic impacts during implementation; and determine if the changes are cost effective.

There is no current funding to construct a PMF fix, so the PMF deficiency is expected to remain unchanged under the without project condition. There is a potential that the PMF may be fixed through the Federal dam safety program. The USBR is investigating a potential fix and will coordinate its results with the ARWI long Term Study.

American and Sacramento River Levee System

Most of the levees surrounding the Sacramento urban area were first constructed to protect farmlands. These levees were significantly upgraded between 1916 and 1958 and further upgraded in the early 1990's. Additional levee stabilization is currently being accomplished as features of the Federal Sacramento River Flood Control Project, the ARWI Common Features Project, and the North Area Local Project.

FLOOD PROBLEMS

Current estimates are that with Folsom Dam and Reservoir, other upstream reservoirs, and the existing levee system, there is a about a 1 in 85 chance in any year from levee failure and flooding in Sacramento. Upon completion of the levee modifications in the Common Features Project, there will be about a 1 in 100 chance in any year of levee failure and flooding in Sacramento. Plate 2 shows the likely area of inundation for a major flood in Sacramento.

Frequency of Flooding

The chance of levee failure and resultant flooding in Sacramento depends on the frequency of high flows in the American and Sacramento Rivers and on the condition of the existing levee system. System performance is described in two ways: (1) the chance of flooding occurring in any one year (1 in 100 or 1 percent) and (2) the probability of a particular frequency flood event occurring without causing flooding. There is uncertainty as to the flow magnitude for any given flood frequency. Table 1 shows the event conditional non-exceedance of major flooding along the lower American River for four flood events under the without-project conditions (upon completion of the Common Features Project). This information is also shown in Plate 5. As can be seen, even though the project performance is 1 in 100 chance in any one year, the chance of containing the 1 in 50 chance of flooding in any one year is a about 93 percent given the estimation uncertainty. For larger (more rare) storms, the chance of levee failure and flooding increases.

TABLE 1. PROJECT PERFORMANCE[1] UNDER WITHOUT-PROJECT CONDITIONS

Storm		Percent Chance of Flooding	Percent Chance of Not Flooding
Return Period (years)	Exceedance Frequency Per 100 Years (percent)		
50	2.0	7	93
100	1.0	41	59
200	0.5	83	17
400	0.25	98	2

[1] A particular frequency flood event (such as 1 in 100 chance in any one year) will result in a certain river stage in the lower American River levees. If this stage exceeds the capability of the levees to hold back the water, then levee failure and flooding of Sacramento will occur. There are uncertainties about several parameters that determine the stage in the lower American River. These include amount of runoff, peak discharge from Folsom Dam, and stage of that discharge in the American River. The biggest unknown is the amount of runoff from a particular frequency event. These uncertainties are estimated, and this results in a range of river stages that may occur for any particular frequency flood event. All the different possible combinations for a particular frequency flood event are evaluated, and the percentages of those that result in flooding are calculated.

Release Capacity of Folsom Dam

Although the objective release of 115,000 cfs is a major release that can be sustained within the existing levees, Folsom Dam can only release the outlet capacity of 34,900 cfs until the lake's water surface is above the spillway crest. The lake must rise above elevation 418 feet, in order to make the flood releases through the spillway tainter gates of 115,000 cfs, the objective release in the floodway below Folsom. Thus, Folsom Dam does not have an opportunity to make releases to maintain much of its flood control space. This is an inherent inefficiency of the flood control operation of the dam. (See plate 4 for the location of the existing outlets, spillway crest, and tainter gates.)

Economic Damages

The existing average annual damages are $118 million. Upon completion of the Common Features Project, the average annual damages will be reduced to $104 million (including future growth).

CHAPTER III – PROJECT DESCRIPTION

PROJECT AUTHORIZATION AND GUIDANCE

Section 101(a) (6) of WRDA 99 (Public Law 106-53) provides authorization for the Folsom Dam Modification Project:

> AMERICAN AND SACRAMENTO RIVERS, CALIFORNIA. –
>
> *(A) IN GENERAL. - The Folsom Dam Modification portion of the Folsom Modification Plan described in the United States Army Corps of Engineers Supplemental Information Report for the American River Watershed Project, California, dated March 1996, as modified by the report entitled "Folsom Dam Modification Report, New Outlets Plan," dated March 1998, prepared by the Sacramento Area Flood Control Agency, at an estimated cost of $150,000,000, with an estimated Federal cost of $97,500,000 and an estimated non-Federal cost of $52,500,000. The Secretary shall coordinate with the Secretary of the Interior with respect to the design and construction of modifications at Folsom Dam authorized by this paragraph.*
>
> (B) REOPERATION MEASURES. - Upon completion of the improvements to Folsom Dam authorized by subparagraph (A), the variable space allocated to flood control within the Reservoir shall be reduced from the current operating range of 400,000-670,000 acre-feet to 400,000-600,000 acre-feet.
>
> (C) MAKEUP OF WATER SHORTAGES CAUSED BY FLOOD CONTROL OPERATION. - The Secretary of the Interior shall enter into, or modify, such agreements with the Sacramento Area Flood Control Agency regarding the operation of Folsom Dam and reservoir as may be necessary in order that, notwithstanding any prior agreement or provision of law, 100 percent of the water needed to makeup for any water shortage caused by variable flood control operation during any year at Folsom Dam and resulting in a significant impact on recreation at Folsom Reservoir shall be replaced, to the extent the water is available for purchase, by the Secretary of the Interior.
>
> (D) SIGNIFICANT IMPACT ON RECREATION. - For the purposes of this paragraph, a significant impact on recreation is defined as any impact that results in a lake elevation at Folsom Reservoir below 435 feet above sea level starting on May 15 and ending on September 15 of any given year.
>
> (E) UPDATED FLOOD MANAGEMENT PLAN. - The Secretary, in cooperation with the Secretary of the Interior, shall update the flood management plan for Folsom Dam authorized by section 9159(f)(2) of the Department of Defense Appropriations Act, 1993 (106 Stat.1946), to reflect the operational capabilities created by the modification authorized by subparagraph (A) and improved weather forecasts based on the Advanced Hydrologic Prediction System of the National Weather Service.

Corps Headquarters provided guidance on the intent of this authorization in a memo dated January 18, 2000. This memo directed that a decision document be prepared to support the authorized project. This document would not need to reformulate alternatives but would need to show that the proposed project is economically justified, technically sound, and environmentally acceptable. This LRR describes the Folsom Dam Modification Project identified in Section 101(a)(6)(A) of WRDA 99. In addition, this document will serve as the basis for entering into a Project Cooperation Agreement (PCA) on components that will be implemented.

Section 101 (a)(6)(B) directed the Corps and the USBR to modify the operation from 400,000-670,000 acre-feet (see plate 6) to 400,000-600,000 acre-feet (see plate 7),

upon completion of the Folsom Dam Modification Project authorized in Section 101(a)(6)(A). The outlets modification works and the additional surcharge storage will alter the flood control storage, so that the level of protection provided in the 400,000 - 670,000 acre-feet variable flood storage space would differ throughout the variable space. The modification from 400,000 - 670,000 acre-feet to 400,000 - 600,000 acre-feet would provide a "balanced" level of protection. Providing a "balanced" level of protection means that Sacramento would receive the same level of protection anywhere in the variable space ranging from 400,000 - 600,000 acre-feet depending upon space available in upstream reservoirs. Operating at this balanced level of protection would reduce effects to water supply, recreation, and environmental uses of the water at Folsom Reservoir without appreciably affecting flood control. In order to implement this component, the water control manual would need to be modified and a document to meet National Environmental Policy Act requirements would be prepared. Currently, the USBR is preparing an environmental impact statement (EIS) on extending the 400,000-670,000 acre-foot reoperation to a long-term basis. This EIS will define the baseline for the proposed change to 400,000-600,000 acre-feet. With outlet works modifications and increased surcharge in place, Folsom Dam may continue to operate using the 400,000-670,000 acre-foot flood space. Thus, these components are complete without adjustment to the variable space. The reduced reoperation plan to 400,000-600,000 acre-feet is scheduled to be implemented in 2006-2007.

Section 101(a)(6)(E) directed that the Corps and the USBR update the Flood Management Plan to reflect the operational capabilities created by the Folsom Dam Modification Project and improved weather forecasts based on the Advanced Hydrologic Prediction System of the National Weather Service. The Corps in coordination with the USBR has begun preliminary studies to update the Flood Management Plan. This work is expedited because it could affect the Long-Term Study without-project condition that is currently being developed.

Authorized Project

In 1996, the Corps, along with The Reclamation Board and SAFCA, prepared the SIR, which documented the comprehensive flood control analysis of the American River watershed. The Folsom Modification Plan was one of three candidate plans developed in the 1996 SIR. The components of the 1996 Folsom Modification Plan consist of the following fundamental features:

- Increasing the release capacity at Folsom Dam through modification of the spillway and river outlets to maintain releases at or below the objective release of 115,000 cfs for larger events, and

- Modifying the use of surcharge in Folsom Dam through both physical improvements and operational changes to increase the flood storage capacity in order to maintain the objective release of 115,000 cfs for larger events.

The construction of this plan as outlined in the 1996 SIR would require 6 years. During the construction period, there would be effects on operation, including the loss of outflow capacity. The lake would have to be lowered to accommodate the demolition of the spillway crest and the strengthening of the piers. In addition, there would be significant effects on traffic using the Folsom Dam Roadway. Construction would be scheduled and managed to minimize traffic interruptions.

While the SIR was being finalized in 1995, a spillway tainter gate at Folsom Dam failed. The USBR spent the next few years performing construction work on the dam to fix problems that resulted from the gate failure. Completion of the USBR's work was delayed by public concerns over closing the dam road during construction. In anticipation of similar concerns, SAFCA developed and evaluated two additional plans to increase the early release capacity at Folsom Dam while reducing the traffic and operational effects of lowering the spillway. These plans included enlarging existing outlets and/or constructing new outlets. The resulting report concluded that lowering the spillway would result in major effects on traffic from road closure and that the new plans would have fewer effects.

Congress authorized the Folsom Dam modification portion of the Folsom Modification Plan described in the SIR as modified by the SAFCA report. The primary difference between the SIR and the SAFCA report was that SAFCA proposed enlarging existing outlets and adding five new outlets in the emergency spillway and constructing a new emergency spillway stilling basin. This plan avoids lowering the main spillway that was part of the 1996 SIR Modifications Plan.

Implementation of the Authorized Project

The Folsom Dam Modification Project would be constructed in two phases: (1) outlet works modifications and (2) surcharge storage. The intent is to provide the most efficient sequence of events to enable Sacramento to improve its flood protection.

There are several reasons why two phases would be desirable. First, the major portion of flood control benefits is from the outlet works modifications, the design and construction of which would take approximately 6 years. There is a need to accomplish this work as soon as possible to improve the flood protection for Sacramento. The construction of the outlet works modifications could begin as early as spring 2002. Construction of new emergency gates needed for surcharge would create construction conflicts with outlet works modifications if work were done at the same time.

Second, the modification of the use of surcharge storage would provide additional flood control space in the reservoir. Many of the project features that would be needed to implement surcharge may also be needed to implement raising Folsom Dam, one of the alternatives being investigated in the Long-Term Study. However, some of these features would be different. If the modified use of surcharge is constructed now, Long-Term features such as the new emergency spillway tainter gates and dikes may have to be modified again. The phased construction will allow ample time for a decision to be made

on the Long-Term Study. A chief's report on the Long-Term Study will be available in spring 2002.

This LRR includes detailed analyses of the design, costs, benefits, accomplishments, and residual risk of both components. An environmental assessment/Initial Study (EA/IS) has been prepared that evaluates the effects of these two components on environmental resources in the area. During design phase, more detailed analysis will be conducted on the surcharge features.

REFINEMENT OF AUTHORIZED FEATURES

To reduce costs and ensure dam safety, the SIR and SAFCA plans have been analyzed and refined further. More detailed analyses on the design, costs, benefits, and effects were conducted to ensure a cost effective, technically sound, and environmentally acceptable project. The refinements and the fundamental reasons for these refinements are discussed below. Table 2 compares the authorized features and current project.

Increasing the Release Capacity

When the Folsom Modification Plan was developed in the SIR and then modified by SAFCA, the primary objective in relation to the release capacity was to modify the outlet capacity at Folsom Dam so that the objective release of 115,000 cfs could be reached before a water-surface elevation of 418 feet (the spillway crest).

Both the SIR and SAFCA's report included enlarging the existing river outlets to 6 feet wide by 12 feet high. This size was based on construction limitations and concerns about approaching the upper size limits of similar functioning gates in other projects. The possible enlargement of the existing river outlets was examined in greater detail in this report than in the earlier reports. It was determined that the gates could be manufactured in either two or three sections to reduce the size, brought into the chamber, and assembled in place. This would allow the size of the gates to be larger. Full-scale models of gate leafs were constructed and taken through the various adits and shafts in the dam to determine construction constraints.

The SAFCA report also identified the need to construct a new stilling basin downstream of the auxiliary spillway to handle the flows from the new outlets. Enlargement of the existing outlets was examined to determine if the number of new outlets could be reduced and if any new outlets could be moved so that they would discharge into the main spillway basin. This type of design would result in a significant cost savings because the need for a new stilling basin downstream of the auxiliary spillway would be eliminated.

A plan to reduce new outlets and enlarge existing outlets was developed. Two new outlets were evaluated; each outlet gate would be about 6 feet wide by 10 feet high. These outlets would be located in monoliths 12 and/or 17, which are located under the main spillway tainter gates. The new outlets would discharge into the existing main stilling basin, avoiding any major modifications to the emergency spillway stilling basin. The

TABLE 2. AUTHORIZED AND CURRENT PROJECT

Component	Features		Refinements and Justification
	Authorized Plan	**Current Project**	
Increase release capacity	Plan I - New Outlet Plan Construct 5 new outlets (two 7' x 14' slide gates per outlet) under the auxiliary spillway. Construct new stilling basin downstream of auxiliary spillway. Plan II - New and Enlarge Plan Construct 5 new outlets (two 7' x 14' slide gates per outlet) under the auxiliary spillway. Construct new stilling basin downstream of auxiliary spillway. Enlarge 8 existing river outlets to 6'x 12'.	Enlarge 8 existing river outlets to 9'-4" x 16'-3". Modify to allow 100% conjunctive use with spillway.	Further evaluation indicated that the outlets could be enlarged more than originally estimated and that this would meet the project's objective release. This would greatly reduce the cost.
Modify use of surcharge storage	Raise impervious core in Mormon Island Dam, Dike 5, and Dike 7. Modify surcharge operation to provide additional flood space. Construct parapet wall at Newcastle Powerhouse. Raise penstock gate hoists, and relocate hydraulic pumps. Replace 3 emergency spillway tainter gates with 42' x 59' tainter gates. Top-seal tainter gates.	No change. No change. No change. No Change. The tainter gates would include a strong enough foundation so that the gates could be expanded. Top seal would not be used.	Further evaluation indicated that top-seal tainter gates are not technically possible on the existing spillway tainter gates. The foundation support for the gates would be strong enough to allow the gates to be expanded if a future action such as the Folsom Enlargement Plan is implemented.
Revise Reoperation	Reduce the variable space allocated to flood control from 400,000-670,000 acre-feet to 400,000-600,000 acre-feet.	Currently no known changes from authorized plan. To be analyzed in a separate document.	N/A
Update Flood Management Plan	Plan revisions to reflect the operational capabilities created by outlets and surcharge modifications and improved weather forecasts.	New dam operation has not been developed. Update to be formulated and analyzed upon approval of this LRR.	N/A

eight existing river outlets would be enlarged. The enlarged outlet gates would be about 8.5 feet wide by 15 feet high. The enlarged outlets would be designed to allow for concurrent releases with flow over the spillway.

Further examination of this plan revealed significant problems with the gate chambers required for the new gates. There was not enough room to construct the

chambers without impacting some of the other facilities inside the dam. A significant amount of mechanical and electrical equipment would have to be relocated.

Further studies indicated that the eight existing river outlets could be enlarged sufficiently to provide the desired releases of 115,000 cfs at a water-surface elevation of 418 feet. Table 3 summarizes the range of total flows for all eight outlets determined at pool elevation 418 feet for various height and width outlet combinations. More detailed information concerning the refinements of the outlet works modifications can be found in the Engineering Appendix (Appendix 1B).

TABLE 3. DISCHARGE CAPACITY IN CFS OF VARIOUS OUTLET SIZES AT ELEVATION 418 FEET

Height (ft)	Width (ft)				
	8.5	**9**	**9.3**	**9.5**	**10**
14	92,740	98,290	-	103,830	109,370
15	99,830	105,790	-	111,760	117,730
16	106,660	113,040	-	119,410	125,790
16.4	-	-	116,000	-	-
17	113,510	120,300	-	127,080	133,870

Further studies addressed maintaining outlet release capacity during construction. Numerous methods of mitigating loss of release capability during construction were examined. It was determined that the reduced outlet capacity could be mitigated by sequential construction of the outlets. One upper tier outlet would be enlarged first. Most of the work would be accomplished during the non-flood season. If construction is such that the outlet is not operational during a flood season, then operation of the remaining seven outlets would be modified to make up for the one lost upper tier outlet. Currently, once the flows are being released from the spillway and outlets concurrently, the river outlet openings are reduced to 60 percent to reduce the potential for cavitation. The Corps and the USBR have agreed that the river outlets would be held at variable operation with concurrent spillway flows. The proposed variable operation allows reduction of the river outlet openings from 100 percent to 85 percent as the concurrent spillway releases increase to 115,000 cfs. This would make up for the loss of one upper tier outlet and reduce the risk of cavitation. If there is damage due to cavitation, it would be repaired as part of the project prior to the next flood season. Once the first upper tier outlet is enlarged, two can be enlarged concurrently. The new enlarged outlet capacity would be 13,000 cfs. Its capacity of 13,000 cfs plus about 17,000 cfs for the five remaining 5-foot-wide by 9-foot-long outlets (with two outlets being enlarged) and would be greater than the outlet capacity under existing conditions. Therefore there would not be a reduction in the level of flood protection for Sacramento.

As a result of being able to prevent operational effects during construction, the need for any new outlets was eliminated. Based on these analyses, enlarging the existing river outlets to 9 feet 4 inches wide by 16 feet 3 inches high would provide approximately

115,000 cfs (approximately 13,000 cfs for each of the upper tier outlets and 16,000 cfs for the lower tier outlets) at a reservoir water-surface elevation of 418 feet.

Surcharge Storage

Under a controlled release operation, the five existing main spillway tainter gates would be open while flood releases are made. The flood pool could surcharge to elevation 474 feet. There was a concern that if an existing main spillway tainter gate failed in the closed position, releases would be limited to elevation 465 feet. To address this issue, the use of top-seal, a feature that is added to the gates to allow water surface elevations to exceed the existing top of gate, was examined. However, it was determined that the existing gates are not structurally capable of handling the additional head with the top seal. Replacement of all five of the existing main spillway tainter gates was also explored, but this would result in significant costs and required road closures. Therefore, under the revised emergency release diagram, if one of the existing main spillway tainter gates does not open, the surcharge elevation would be limited to elevation 465 feet. This condition is similar to the existing conditions.

In addition, the foundation of the gates would be strong enough to allow the gates to be expanded if a decision was made to enlarge Folsom under the Long-Term Project.

CURRENT PROJECT

The Folsom Dam Modification Project consists of two fundamental components: (1) outlet works modifications and (2) surcharge storage (see Figure 1).

Outlet works modifications

This component primarily includes increasing the release capacity at Folsom so that 115,000 cfs could be released at a reservoir water-surface elevation of 418 feet. The fundamental features, accomplishments and residual risk, and operation and maintenance are described below.

Features

A detailed discussion of the refined features and their functions is included in the Engineering Appendix (Appendix 1B). The features are briefly described below.

Enlarge Eight Existing Outlets. The eight existing river outlets would each be enlarged from 5 feet wide by 9 feet high to 9 feet 4 inches wide by 16 feet 3 inches high. No new outlets would be constructed. Plates 4 and 8 through10 show the downstream elevation, spillway section, and the gate chamber section of the dam with the enlarged outlets.

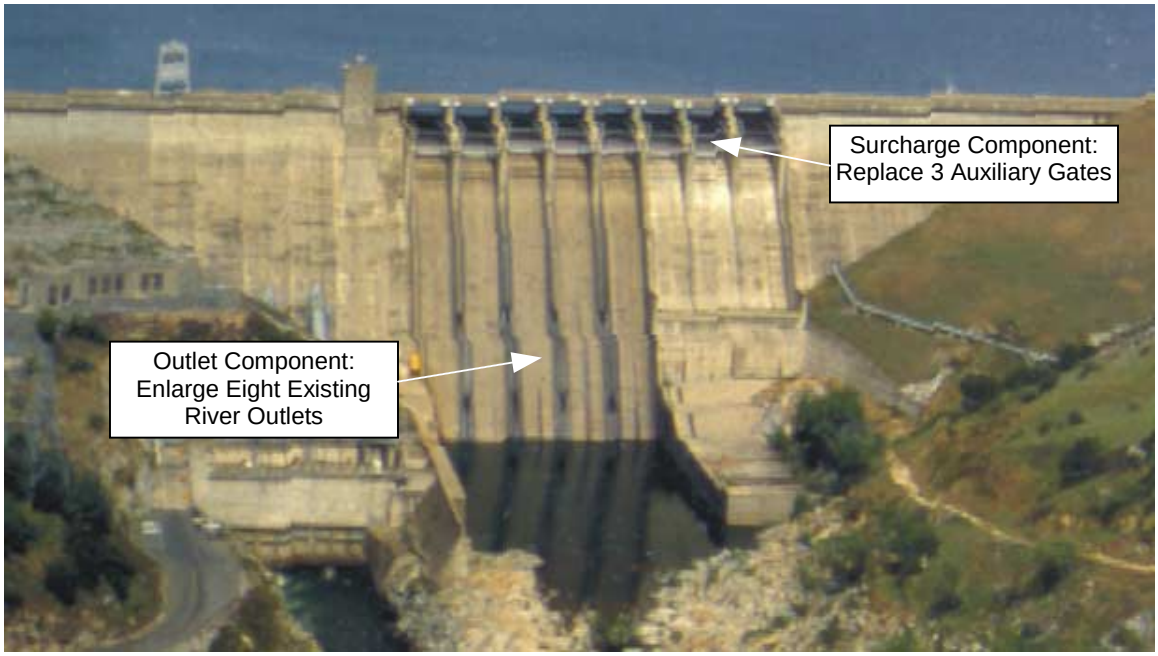

FIGURE 1. MAJOR MODIFICATIONS TO FOLSOM DAM IN THE OUTLET AND SURCHARGE COMPONENTS.

Modify to Allow 100 Percent Conjunctive Use with Spillway. Existing normal river regulation at Folsom Dam is maintained by two tiers of four outlets each, controlled by 5-foot-wide by 9-foot-high slide gates. The outlets consist of rectangular conduits through the dam, which exit on the spillway face and discharge into the spillway stilling pool. Spillway releases are made through five 42-foot-wide by 50-foot-high radial gates located near the crest of the dam. Three additional 42-foot-wide by 53-foot-high radial gates for extremely large flood releases are located to the left of the main spillway and release flow to a flip bucket on the emergency spillway on the downstream face of the dam.

The spillway face and downstream end of the outlets at Folsom Dam incurred considerable damage as a result of cavitation caused by simultaneous flood releases in major storms in the past through the outlets and over the spillway. To prevent damage, sufficient air intakes, entrance curves and bulkheads, and eyebrow deflectors would be included in the enlarged outlets to provide sufficient aeration to prevent cavitation problems. A physical model of the enlarged outlets is being conducted to determine if the aeration provisions are sufficient to allow full outlet operation simultaneous with spillway flows. If not, additional modifications will be investigated with the objective of achieving simultaneous operation.

Accomplishments and Residual Risk

The outlet works modification component would allow flood inflows to be passed through the reservoir more efficiently decreasing the reservoir level for4 a given inflow. As a result, the space allocated for flood storage is maintained until inflow to the reservoir exceeds the capacity of the flood control system below Folsom Dam. This improvement in operating efficiency would increase flood protection by reducing the probability of

flooding in Sacramento in any one year from 1 chance in 100 (upon completion of the Common Features Project) to 1 chance in 130. The component would provide nearly a 98 percent chance of protecting Sacramento during a 1 in 50 chance flood in any one year, a 77 percent chance during a 1 in 100 chance flood in any one year, a 34 percent chance during a 1 in 200 chance flood in any one year, and an 8 percent chance during a 1 in 400 chance flood in any one year. Plate 5 and Table 4 show the percent chance that the without-project conditions and the with-project conditions would contain different frequency floods.

TABLE 4. COMPARISON OF PERCENT CHANCE OF FLOODING DURING DIFFERENT FREQUENCY FLOODS

Feature	Annual Performance (Chance of Design Being Exceeded in any year)	Conditional Annual Percent Chance of Not Flooding / Flooding For Indicated Events			
		0.02 50-yr	0.01 100-yr	0.005 200-yr	0.0025 400-yr
Without Project (Common Features Completed)	1 in 100	93 / 7	59 / 41	17 / 83	2 / 98
Outlet Works Modifications	1 in 130	98 / 2	77 / 23	34 / 66	8 / 92
Outlet Works Modifications and Surcharge Component	1 in 140	98 / 2	79 / 21	38 / 62	9 / 91

As mentioned in Chapter II, Folsom Dam's existing spillway capacity is inadequate to protect the dam from an extreme flood event. Corps studies show that the dam is capable of passing a flood about 70 percent of the PMF. Upon completion of the outlet works modifications, the dam would be capable of passing 75 percent of the PMF.

Surcharge

Surcharge storage is the space above the normal gross pool of a reservoir that is designed to ensure that the dam can safely pass floodwaters without overtopping. Currently at Folsom Dam, the emergency spillway release diagram dictates how the surcharge space is operated to prevent the dam from being overtopped. Under existing conditions, the existing emergency release diagram and the physical features of the dam allow for surcharge storage to elevation 470 feet without overtopping the existing emergency spillway tainter gates while they are in closed position. Under existing conditions, when the reservoir elevation exceeds 470 feet, the emergency spillway tainter gates must be open, and the dam must release more than the objective releases, which raises the potential for levee failure downstream, to permit full use of surcharge space to elevation 475.4 feet. Plate 3 illustrates the existing emergency release diagram.

The proposed project would modify the emergency release diagram and some physical features of the dam to allow dam operators to maintain objective releases, or releases that would not exceed the downstream levee system's capacity, while surcharging to elevation 474 feet. Once the reservoir elevation reaches above 474 feet, the new emergency spillway tainter gates would need to be open, and the dam must release more than the objective releases, which raises the potential for levee failure downstream, to allow the remaining surcharge space from 474 to 475.4 to be used for dam safety. The difference between the existing conditions and the with-project conditions is that under the with-project conditions, the releases made from Folsom would be within the downstream levee system's capacity when the reservoir level is between 470 and 474.

The implementation of the surcharge component features would allow releases to be maintained below the probable non-failure point (PNP) of downstream levees for a longer period. The PNP is the highest water-surface elevation at which levee failure is highly unlikely. The maximum duration of a maximum release of 160,000 cfs would be 48 hours (maximum downstream levee system's capacity upon completion of the Common Features Project). The emergency release diagram would be modified to open the emergency spillway tainter gates if elevation 474 feet is exceeded. A water-surface elevation of 474 feet is the upper limit before major modifications to the dam are needed. Use of this surcharge operation allows an additional 48,000 acre-feet of space to be credited for flood control.

The support structure for the gates would be designed to allow for expansion of the gates to accommodate (at a minimum) a raise with a maximum pool elevation of 487 feet. In addition, the impervious core in Mormon Island Dam and dikes 5 and 7 may need to be raised to the crown crest, and Pacific Gas and Electric Company's Newcastle Powerhouse may need to be floodproofed. A preliminary duration-frequency analysis shows that the dikes and powerhouse are currently inundated at elevations from 470 to 475.4 feet under both the existing and the with-project conditions. The proposed improvements could decrease the frequency of flooding in that elevation range. Therefore, modifications to the dikes and Newcastle Powerhouse may not be needed. Additional analysis would be completed during the design phase to determine the necessity of modifying the dikes and powerhouse. The final design of the surcharge component would be compatible with a raise or dam safety project that may be constructed in the future. The major features and accomplishments, and residual risk are described below. Additional analysis would be completed during the design phase, and the features listed below would be refined.

Features

Replace Three Emergency Spillway tainter gates. Modifications are required to the three emergency spillway tainter gates and bays to allow the emergency spillway release diagram to be modified. The emergency spillway tainter gates would be replaced with 42-foot-wide by 59-foot-high tainter gates (top-of-new-gate elevation at 476 feet). This would allow 2 feet of freeboard on the emergency spillway tainter gates (in a closed position) while the reservoir is operated to maintain the objective release to reservoir elevation 474 feet. The support foundation for these gates would be designed to accommodate

modification and expansion of the gates. Plate 10 shows the existing and new emergency spillway tainter gates.

Stoplogs provided for emergency repairs would be placed sequentially in each of the emergency spillway tainter gate bays to permit gate removal and replacement without the reservoir having to be held lower than normal during each summer construction season.

Revise the Emergency Spillway Release Diagram to Modify Surcharge Operation. Currently, an emergency spillway release diagram dictates how the space is operated to balance dam safety while maximizing flood protection. Once the water surface reaches the existing surcharge space, the dam is operated with the objective of preventing the dam from being overtopped. Once the surcharge storage component is implemented, a new emergency release diagram would be implemented. To accomplish this, the emergency spillway release diagram would be revised to maintain a maximum release of 160,000 cfs (the amount the downstream levees can handle) up to reservoir elevation 474 feet. Plate 11 is a preliminary revised emergency release diagram.

Raise Impervious Core in Mormon Island Dam, Dike 5, and Dike 7. The existing impervious core in Mormon Island Dam and dikes 5 and 7 is at elevation 466 feet. For this surcharge component, the impervious core in these dikes and dam may be raised to the crown crest (see Figure 2). This would most likely be done by installing a slurry wall from the top of the crest (elevation 480.5 feet) down to elevation 466 feet. The work would be done during the non-flood season after the reservoir has been drawn down below elevation 461 feet. Therefore, there would be no adverse operational effects due to construction.

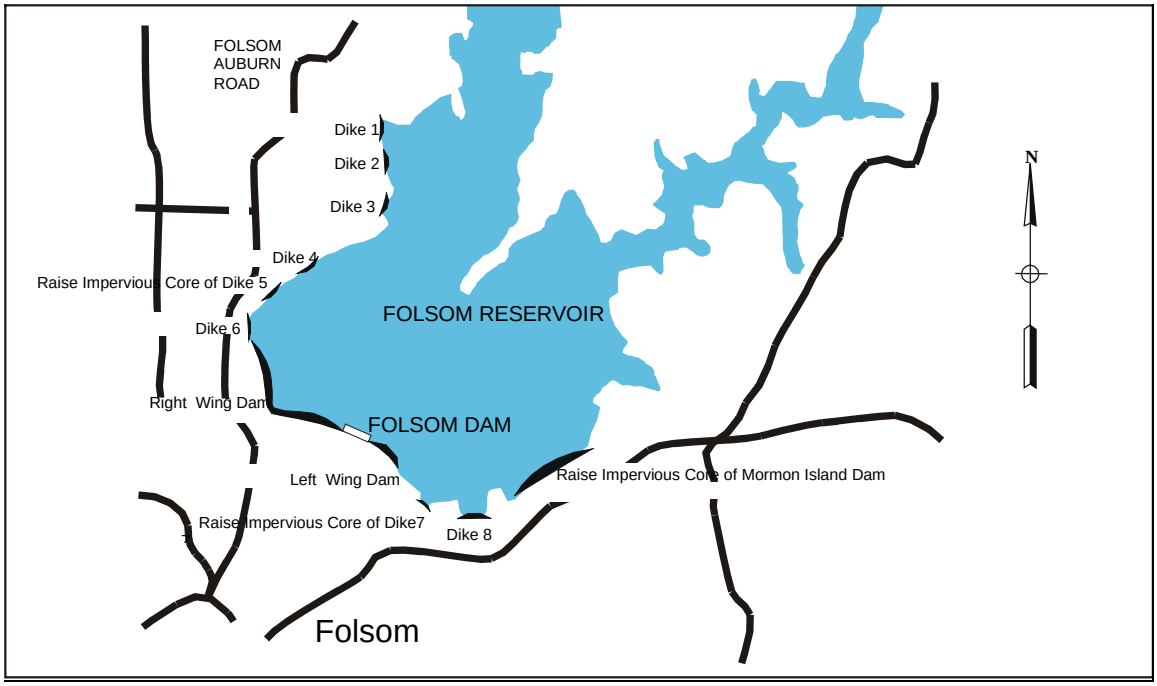

FIGURE 2. PLAN VIEW OF FOLSOM DAM AND RESERVOIR SHOWING LOCATION OF DIKE RAISING IN THE SURCHARGE COMPONENT.

Floodproof Newcastle Powerhouse. At elevation 474 feet, Newcastle Powerhouse (located on the northwest shoreline of the reservoir) would be inundated. To keep the power plant in service under this operation, modifications may be required. If required a parapet wall would be constructed around the powerhouse, and the access road would be raised.

Relocate Hydraulic Power Units for the Penstock Gate Hoists. Currently, the penstock gate hoists are located on the upstream face of the dam and are flooded once the reservoir levels exceed elevation 467 feet. The hydraulic power units for each gate would be relocated.

Accomplishments and Residual Risk

With construction of the surcharge component, the emergency spillway gates would be made taller. This would allow the water-surface elevation of Folsom Reservoir to "surcharge" to a lake level of 474 feet, or 4 feet higher than is currently allowed under controlled conditions. This additional 4 feet of storage adds approximately 45,000 acre-feet of flood control storage, and allows for controlled emergency releases of up to 160,000 cfs for a longer period of time. This component of the project would further increase flood protection to Sacramento by reducing the probability of flooding in any one year from 1 in 130 (upon completion of the outlet works modification increment) to 1 in 140 chance in any one year (combined outlet works modifications and surcharge component). It would provide nearly a 98 percent chance of protecting Sacramento during a 1 in 50 chance storm in any one year, a 79 percent chance during a 1 in 100 chance storm in any one year, a 38 percent chance during a 1 in 200 chance storm in any one year, and a 9 percent chance during a 1 in 400 chance storm in any one year. Plate 5 and table 4 show the percent chance that this project would contain different frequency floods.

Operation and Maintenance

When a project is completed, ownership is normally transferred to the non-Federal sponsor who is then responsible for the operation, maintenance, repair, replacement, and rehabilitation of the project. However, the Folsom Dam Modification Project would improve facilities owned by the Federal Government. Ownership would not be transferred because of the modifications, but SAFCA would be responsible for any increase in operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs of the modified structures due to the Folsom Dam Modification Project.

The operation of the Folsom Dam would be similar to the without-project condition. Once the construction of the features of the Folsom Dam Modification Project is complete, the Corps would revise the water control manual for Folsom Dam to reflect the new flood control diagram. The USBR, in coordination with the State Flood Operations Center, would continue to operate Folsom Dam in accordance with the revised water control manual.

Operation, maintenance, repair, replacement, and rehabilitation costs of improvement features such as the enlarged river outlets and surcharge component would normally be the responsibility of the non-Federal sponsor. However, since Folsom Dam is owned by the Federal Government, the OMRR&R would continue to be performed by the USBR, but a cost-sharing agreement would be negotiated between SAFCA and USBR to pay the portion of the OMRR&R costs related to the new flood control features. At Folsom Dam, the USBR would inspect completed works.

ENVIRONMENTAL COMPLIANCE

Public Review

The final EA/IS on the project has been prepared as a supplement to the 1996 Environmental Impact Statement/Environmental Impact Report (see Appendix 1A). The draft EA/IS was circulated for public review to resource agencies including the U.S. Fish and Wildlife Service (FWS), National Marine Fishery Service (NMFS), U.S. Environmental Protection Agency, California Department of Fish and Game, California State Historic Preservation Officer, California Department of Water Resources (DWR), and Regional Water Quality Control Board, as well as other concerned organizations and individuals. Following the 30-day public review of the EA/IS, the Corps reviewed the comments received and incorporated them into the final EA/IS, as appropriate. Preparation of the final EA/IS was a joint effort with the FWS, NMFS, SAFCA, and DWR.

Effects and Mitigation

More detailed information on the environmental effects and mitigation can be found in Appendix 1A. The following is a brief summary of the environmental resources evaluated, effects found, and mitigation, if appropriate.

Outlet works modification

Effects on several environmental resources were examined and found to be minor; therefore, they were eliminated from detailed analyses. These resources included:

Agriculture and Prime and Unique Farmlands. There are no agricultural operations or prime and unique farmlands in the project area; therefore, no effects would occur.

Noise. Most of the noise-producing construction (concrete demolition) would take place within the dam structure and in the river canyon. This would not add significantly to noise levels outside the project due to the noise muffling effects provided by the canyon.

Aesthetics. The project would not significantly change the visual appearance of the existing dam so there would be no esthetic effects.

Hazardous, Toxic, and Radiological Waste. There are no known hazardous, toxic, or radiological wastes in the project site. The existing 55-kilowatt emergency generators

located at the northeast corner of the pumping plant would be replaced with a new 500- to 725-kilowatt diesel generator. Any stained soil observed near the existing generator would be removed and disposed of at a permitted site. While minor amounts of hazardous waste would be produced during construction (used oil, paint residue, and similar materials), these would be managed in conformance with existing laws and regulations.

The following environmental resources were examined in more detail.

Fisheries. Construction activities to enlarge the existing river outlets would result in a temporary increase in the level of activity along the upstream face of Folsom Dam when the temporary bulkhead and permanent bulkhead guides are installed. These activities may displace fish that are commonly present in the general construction area. These effects would be short term and would not be significant.

Operation with the enlarged outlets would result in changes in the level of storage in Folsom Reservoir during storm events. In general, water levels in Folsom Reservoir would increase at a slower rate during storm events, peak at a lower level, and return to pre-storm levels more quickly than under the without-project condition because more water could be released through the enlarged river outlets. The ability to release water more efficiently with the enlarged outlets is not expected to affect the stratification of Folsom Reservoir or the volume of the coldwater pool. The rules governing reservoir level during the flood season (November through March) are not changed as a result of the project. However, the increased outlet capacity provided by the project would allow dam operators to more closely match reservoir releases to reservoir inflow, thereby reducing the fluctuation in reservoir levels that occurs during a flood event. In addition, changes relative to the rate of releases would only occur during significant flood events. Under the with-project condition, releases of more than 30,000 cfs would occur earlier than under the without-project condition. This is expected to occur only in the flood season during periods of substantial inflow, and not during the period when stratification occurs (typically April through November). Accordingly, no effects to the coldwater pool of Folsom Reservoir are expected.

Enlarging the eight existing outlets would allow Folsom Dam to operate more effectively and efficiently in compliance with the existing Folsom Dam Operation Diagram. Under the without-project condition, Folsom Dam is limited to 34,000 cfs until the reservoir level is above the spillway crest (elevation 418 feet). The primary change that the outlet component would make is to allow Folsom Dam to release up to 115,000 cfs when the reservoir levels are at or below the spillway crest. There was some concern that changes in the operational capability of Folsom Dam could result in more frequent releases above 34,900 cfs, which in turn would affect gravel transport in the Lower American River below Folsom Reservoir. To mitigate for potential effects to gravel transport, an operational rule restriction would be implemented to ensure that that releases from the modified dam occur only during the large floods when releases would have reached higher levels under the without-project condition. The operational rule would restrict the increase in outflows from Folsom Dam so that outflows from Folsom Dam above 25,000 cfs will be limited to 60% of the actual or forecast inflow. Once the actual or forecast inflow exceeds

150,000 cfs maximum flood releases will be made. Operations outside the range of these flows will be the same as without project condition. Therefore there would be no change in the gravel transport at the critical flow exceedance frequency of 1 in 2.5 chance in any one year to 1 in 10 chance in any one year.

Vegetation and Wildlife. Since the construction of the outlet works modification is generally confined to the interior of Folsom Dam, no effects to vegetation or wildlife are anticipated. During construction, existing access roads would be used, and no removal of vegetation would be necessary.

Vegetation along the lower American River consists primarily of riparian and grassland communities. These communities are adapted to periodic inundation that typically occurs during winter storms, and riparian communities are highly tolerant of the existing flow patterns along the lower American River. Flow changes that may occur with the enlarged outlets are within the normal range of flows experienced by these communities. Therefore, no adverse effects to vegetation and wildlife along the Lower American River are anticipated.

Cultural Resources. The Sacramento District has completed an analysis, which determined that Folsom Dam and Reservoir are not eligible for the National Register of Historic Places. This analysis was coordinated with the SHPO. The outlet component would not affect cultural resources sites along the Lower American River because flood releases are expected to remain within the range of flows that occur under current flood operations.

Traffic. During construction of the outlet component, Folsom Dam Roadway would need to be closed periodically to access the top of the dam. To avoid traffic effects, closure would be primarily limited to weekends and nights outside of primary recreation times. A traffic analysis was conducted which determined that there would be no significant effects as a result of this closure sequence. For further traffic closure clarification see our Environmental Assessment/Initial Study (Appendix 1A). While significant effects of closing Folsom Dam Road were not identified, the Corps and non-Federal sponsors have committed to participate in improving the USBR's communication program designed to inform motorists about road closures. In addition, a temporary traffic signal and other lane markings would be implemented to increase safety in the construction area.

Water Quality. Construction activities would generally be confined to the interior of the dam and would not affect water quality. Construction methods currently proposed include using a conveyor to remove concrete rubble from the interior of the dam. The proximity of construction activities downstream of the dam to the American River poses a potential source for dust and sediment to increase turbidity and suspended solids levels in the river. In addition, the operation, refueling, and maintenance of onsite machinery such as diesel compressors, haul trucks, and other equipment would be required, and these activities have the potential to release hazardous substances into the environment. For all construction activities, normal construction safety practices would be implemented to

ensure that the risk of hazardous materials spills is minimized, which would in turn would minimize the potential for water quality effects. To mitigate for potential effects to water quality, best management practices to control construction-related contamination and to reduce construction effects to less than significant would be implemented.

Sediment that has accumulated along the upstream face of the dam needs to be removed prior to enlargement of the outlets. The Corps estimates that a total of 30,000 cubic yards will need to be removed in the course of construction. The majority of the surface sediments sampled are in the silt and clay size fractions, which would be prone to re-suspension during construction. Sediments sampling revealed potential toxicity due to high nickel, chromium, and copper concentrations. The use of best management practices such as use of environmentally friendly clamshell dredge technology around the construction area during sediment removal would minimize the potential for re-suspended sediments to be transported to areas outside of the localized construction area or to be discharged into the river downstream of Folsom Dam. The Corps, the State, and SAFCA will consult with Reclamation, the San Juan Water District, and the cities of Folsom and Roseville to ensure that dredging activities on the upstream face of Folsom Dam occur during periods of low outflow (both through the river outlet and through the penstocks), and that penstock shutters are configured in a manner that minimized the entrainment of suspended sediment.

Implementation of the operational rule described under the "Fishery" section above, would ensure that releases from the outlet works modifications would only occur during large floods and therefore there would be no erosion related water quality effects along the Lower American River.

Air Quality. Significant air quality impacts have not been identified. However, since the project area is classified as non-attainment, best management practices would be used to control fugitive dust to help protect ambient air quality conditions. The best management practices would include monitoring dust conditions along access roads and within the construction area to ensure that the generation of fugitive dust is minimized.

Recreation. Outlet works modification would generally be confined to the interior of Folsom Dam. Construction of the outlet works modifications would be completed without lowering the reservoir. Therefore, there would be no construction effects to recreational opportunities at Folsom Reservoir.

With outlet works modifications in place, the risk of flooding of recreation facilities near Folsom Lake would be reduced. The flood risk for recreation development at 470 feet elevation, for example, would fall from about a 1 in 85 chance to a 1 in 130 chance. Thus, outlet works modifications would have a somewhat beneficial effect on recreational facilities.

Operation. During the first construction season, only one outlet would be enlarged. The dam would be operated so that the existing release capability of the dam is not reduced during construction. Once the first enlarged outlet capacity is in place, work could begin

on enlarging some of the other existing outlets without decreasing release capability during construction. As a result, there would be no operational effects during construction.

The operational rule restriction would be implemented to ensure that that releases from the modified dam occur only during the large floods when releases would have reached higher levels than under the without-project condition. The operational rule would restrict the increase in outflows from Folsom Dam so that outflows from Folsom Dam above 25,000 cfs will be limited to 60 percent of the actual or forecast inflow. Once the actual or forecast inflow exceeds 150,000 cfs maximum flood releases will be made. Operations outside the range of these flows will be the same as without project condition. More detailed information concerning the operational rule is in the Engineering Appendix.

Surcharge Storage

Effects on several environmental resources were examined and found to be minor; therefore, they were eliminated from detailed analyses. These resources include agriculture and prime and unique farmlands, noise, esthetics, cultural resources and hazardous, toxic, and radiological waste. The reasons why these resources were eliminated are summarized under *Outlet works modification* in ENVIRONMENTAL COMPLIANCE.

The following environmental resources were evaluated in more detail:

Fisheries. Construction activities would generally be occur on the emergency gates of the Folsom Dam and upstream at various dikes around Folsom Reservoir. These activities may temporarily displace fish that are commonly present in the general construction area. These effects would be short term and would not be significant.

Vegetation and Wildlife. As with the outlet works modifications, construction would primarily be confined to the face of the existing structure of Folsom Dam and upstream along dikes that are un-vegetated therefore, no effects to vegetation or wildlife are anticipated. During construction, existing access roads would be used, and no removal of vegetation would be necessary.

As mentioned in Chapter II, in accordance with the Emergency Diagram, Folsom Dam Reservoir could surcharge to 475.4 feet. The difference in the proposed project and the without-project conditions is the frequency of flooding and the duration at the elevation range from 470 to 475.4 feet. The proposed project could decrease the frequency of flooding at this elevation range. The proposed project would reduce the duration of flooding at the elevation range of 470 to 474 feet, and increase the duration of flooding for about 1 day at the elevation range from 474 to 475.4 feet. The tolerance limits of vegetation along the Folsom Reservoir are well above the expected duration of the proposed operational changes.

Effects on wildlife are expected to be minimal because most active animals would be able to move to adjacent upland areas during periods of elevated water levels.

Traffic. During construction of the surcharge component, Folsom Dam Roadway would need to be closed periodically to access the top of the dam. Since most of the traffic occurs during peak commute hours during the week days, road closures would be limited to weekends and non-commute hours (9:00 a.m. to 3:00 p.m.). The measures to reduce impacts to traffic described under the section on outlet modifications would continue through the construction of the surcharge features.

Water Quality. Construction would generally be confined to the surface of Folsom Dam and dikes on the periphery of Folsom Reservoir. As with the outlet component, the proximity of construction activities downstream of the dam to the American River poses a potential source for dust and sediment to increase turbidity and total dissolved solid levels in the river. In addition, the operation, refueling, and maintenance of onsite machinery such as diesel compressors, haul trucks, and other equipment would be required, and these activities have the potential to release hazardous substances into the environment. For all construction activities, normal construction safety practices would be implemented to ensure that the risk of hazardous materials spills is minimized, which would in turn would minimize the potential for water quality effects. To mitigate for potential effects to water quality, best management practices to control construction-related contamination and to reduce construction effects to less than significant would be implemented.

Recreation. Construction activities would primarily be limited to the interior of the dam and upstream at Folsom Reservoir. Construction activities of the surcharge component would not affect the significant recreation area (Granite Bay, Beal's Point, and Browns Ravine) during the recreation season (Memorial Day to Labor Day). Some small staging areas may be needed for potential slurry wall construction on dikes 5 and 7 and Mormon Island. This work would be done during the main construction season, but the staging would be confined to a small area.

During winter floods with a probability of 1 in 85 to 1 in 150 chance of flooding in any one year, operation of the surcharge component would result in Folsom Reservoir water-surface elevations of approximately 457 to 470 feet. These elevations are lower than the water-surface elevations under those same frequencies under the without-project conditions. Therefore, no effect to recreation is anticipated for the marina and boat ramps. During these flood events, the expected reservoir is higher than the functional elevation range for the swimming beaches at Granite Bay and Beal's Point. However, the use period of the beaches is not during the winter; therefore, no effect is expected.

During 1 in 150 to 1 in 165 chance of flooding in any one year, reservoir surface elevations would be 0.2 and 0.4 foot higher than under those same frequencies under without-project conditions. These high water-surface elevations would also occur for longer durations. These levels are also within the functional elevation range for the marina and boat ramps; therefore, no effect on those facilities would occur. These ranges are higher that the functional elevation ranges for swimming, but since these elevations occur during the winter, no effect on swimming is expected.

Air Quality. As with the outlet works modifications, significant air quality impacts have not been identified. However, since the project area is classified as non-attainment, best management practices would be used to control fugitive dust to help protect ambient air quality conditions. The best management practices would include monitoring dust conditions along access roads and within the construction area to ensure that the generation of fugitive dust is minimized.

REAL ESTATE

Since the modifications to Folsom Dam are occurring at the interior of the Dam and upstream at Folsom Reservoir, no new lands are required. The only lands, easements, rights-of-way, relocations, and disposal areas (LERRD's) required consist of providing a disposal site for the excess sediment dredged from the dam during the construction of the outlet works modification component. More information concerning real estate requirements is contained in the Real Estate Plan (see Appendix 1D).

COSTS AND BENEFITS

The total project including both components has a first cost of $147.4 million, with an annual cost of $12.0 million and annual benefits of $29.6 million. The overall benefit-to-cost ratio is 2.5 to 1. A breakdown of the cost and benefits for each component is described below and shown in Tables 5 and 6. Additional information on benefit analysis is included in Appendix 1C.

Outlet Works Modifications

The estimated total first cost would be $108.8 million for outlet works modification. The resulting average annual cost would be $9.2 million. The total average annual benefits for flood control are $24.7 million (including future growth in the flood plain over the project life). Estimated average net annual benefits for flood control are $15.5 million, and the benefit-to-cost ratio is 2.7 to 1. Since the benefits are greater than the costs, the project is economically feasible. The outlet works modification component reduces the average annual damages to $85.1 million.

Surcharge Storage

The estimated total first cost would be $38.6 million for the surcharge storage component. The resulting average annual cost would be $2.8 million. The total average annual benefits for flood control are $4.9 million (including future growth in the flood plain over the project life). The estimated net annual benefits for flood control are $2.1 million, and the benefit-to-cost ratio is 1.8 to 1. Since the benefits are greater than the costs, the component is economically feasible. The surcharge modification component reduces the average annual damages to $80.2 million.

TABLE 5. COMPONENT AND TOTAL COSTS FOR THE PROJECT[1]

MCACES Account	Item	Outlet Works Modifications ($ Million)		Modified Use of Surcharge Space ($ million)		Total	
		Fed	**Non-Fed**	**Fed**	**Non-Fed**	**Fed**	**Non-Fed**
	First Cost						
01	Lands and Damages	0	0	0	0	0	0
02	Relocations	0	0	0	0	0	0
04	Construction	86.6	0	30.7	0	117.3	0
06	Environmental Mitigation	0	0	0	0	0	0
30&31	Engineering, Design, Supervision, and Inspection	22.2	0	7.9	0	30.1	0
	Subtotal	**$108.8**	**0**	**$38.6**	**0**	**$147.4**	**0**
	5 percent cash	(5.4)	5.4	(1.9)	1.9	(7.3)	7.3
	Subtotal	**$103.4**	**$5.4**	**$36.7**	**$1.9**	**$140.1**	**$7.3**
	Adjustment to 65% Federal – 35% Non-Federal Cash Adjustment	(32.7)	32.7	(11.6)	11.6	(44.3)	44.3
	Subtotal	**$70.7**	**$38.1**	**$25.1**	**$13.5**	**$95.8**	**$51.6**
	Percentage	**65.0**	**35.0**	**65.0**	**35.0**	**65.0**	**35.0**

[1]October 2000 price levels, 50-year economic life, and 6-3/8 percent interest rate.
[2]There is a small cost for air quality credits for environmental mitigation, however the cost is small enough that it is rounded to 0. The cost is estimated to be under $50,000 for each component.

TABLE 6. ECONOMIC SUMMARY[1]

Item	Outlet Works Modifications ($ Million)	Modified Use of Surcharge Space ($ Million)	Total ($ Million)
Investment Cost			
Total First Cost	108.8	38.6	147.4
Interest During Construction	29.6	3.3	32.9
Total Investment Cost	**$138.4**	**$41.9**	**$180.3**
Annual Cost			
Interest	8.8	2.7	11.5
Amortization	0.4	0.1	0.5
O&M Cost[2]	0	0	0
Total Annual Cost	**$9.2**	**$2.8**	**$12.0**
Annual Flood Control Benefits	**$24.7**	**$4.9**	**$29.6**
Net Annual Flood Control Benefits	**$15.5**	**$2.1**	**$17.6**
Benefit-to-Cost Ratio	**2.7**	**1.8**	**2.5**

[1]October 2000 price levels, 50-year economic life, and 6-3/8 percent interest rate.

[2]This estimate was based on computed rather than actual OMRR&R costs. OMRR&R costs were estimated by applying OMRR&R cost factors to the capital costs of the gates. It assumes that the existing equipment will have higher average OMRR&R cost factors than the new equipment. It also assumes that with the remaining project life, there will be no replacement costs. Because the OMRR&R cost of using the older existing components (lower capital cost but higher OMRR&R factors) are estimated to approximate the cost of the new equipment (higher capital cost but lower OMRR&R factors), the cost difference between the current OMRR&R and future OMRR&R funding is estimated to be $0. At some point in the future negotiations between the local sponsor and the Bureau of Reclamation will be held. The actual cost of OMRR&R will be calculated for the difference between the old features (by audit) and the new features (by estimate) and an agreement between the parties for the OMRR&R costs will be made.

CHAPTER IV - PROJECT EVALUATION

The January 18, 2000, memo from Corps Headquarters directed that this LRR demonstrate that the authorized project is economically justified, technically sound, and environmentally acceptable. The four basic criteria are (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability.

COMPLETENESS

Completeness is the extent to which a project provides and accounts for all necessary investments or other actions to ensure realization of the planned effects. A complete project (1) meets the objectives, (2) needs no further actions for complete fulfillment of the project, (3) is consistent and reliable, (4) is capable of being physically implemented, and (5) mitigates unavoidable adverse effects, as appropriate.

The project meets the objectives in contributing to reduction in flood damage reduction and meets the operational objective of releasing 115,000 cfs at a water-surface elevation of 418 feet. The outlet works modification and surcharge components both can function independently and therefore need no further actions for complete fulfillment. Upon construction of the enlarged outlet capacity, the release capacity will be consistently and reliably increased. Constructability analysis indicates that both components can be physically implemented. Environmental compliance documentation has been completed for the outlet works modification and surcharge components, and appropriate mitigation has been provided.

EFFECTIVENESS

Effectiveness is the extent to which a project resolves the identified problems and achieves the specified objective(s). The effectiveness of this project was defined by the reduction of the flood damages and by meeting the operational objective of releasing 115,000 cfs at a pressure head created by a water-surface elevation of 418 feet.

The project reduces flood damages from $110 million to $80 million (including expected future growth) and reduces risk from about 1 in 100 chance to a 1 in 140 chance of flooding in any one year. In addition, the project meets the operational objective of releasing 115,000 cfs at a water-surface elevation of 418 feet.

EFFICIENCY

Efficiency is a measure of the extent to which a project is the most cost-effective means of alleviating the identified problems while realizing the specified objectives consistent with protecting the Nation’s environment. One measure of efficient is monetary costs versus benefits. Efficiency is shown as net economic benefits and is the extent to which the economic benefits exceed costs.

The total first cost for the outlet component is $108.8 million. The annual cost is $9.2 million, and the annual net benefits are $15.5 million. The benefit-to-cost ratio is 2.7 to 1. The total first cost for the surcharge component is $38.6 million; the annual cost is $2.8 million; and the net benefits are $2.1 million. The benefit-to-cost ratio is 1.8 to 1. Since the benefits are significantly greater than the cost, the project is economically feasible and highly efficient.

ACCEPTABILITY

Acceptability is the workability and viability of a project to other Federal agencies, affected State and local agencies, and public entities, given existing laws, regulations, and public policies. Two primary dimensions to acceptability are implementability and satisfaction. Implementability means that the alternative is feasible from technical, environmental, economic, financial, political, legal, institutional, and social perspectives. Support by a local sponsor, other agencies, and the public is of prime importance in this category. The satisfaction was based on input from the staff of The Reclamation Board, SAFCA, and USBR, and a public assessment vote that residents recently passed. This assessment involved an increase in their SAFCA assessments to pay for flood control and restoration projects, including the Folsom Dam Modification Project.

There are no known environmental effects that are extensive, controversial, or unlawful. All effects are mitigated as much as is practicable. The action complies with Federal and State endangered species acts.

CHAPTER V - COORDINATION

VIEWS OF THE LOCAL SPONSORS

Preparation of this report was accomplished in close coordination with The Reclamation Board and SAFCA. At this time, the local sponsors are willing to enter into the Project Cooperation Agreement (PCA) and begin construction of the project.

COORDINATION WITH OTHER AGENCIES

Preparation of this report was also closely coordinated with the USBR, FWS, and NMFS. The USBR, which owns and operates Folsom Dam, and the State Division of Safety of Dams have reviewed and commented on this document. In addition, some of the design work was completed by the USBR because of their knowledge of Folsom Dam.

COORDINATION WITH THE USBR

A detailed description of the Corps' coordination with the USBR is documented in the Plan for Coordination Document sent to the Corps' South Pacific Division in July 2000.

To ensure proper coordination with the USBR and other agencies, the following have been established: product development team, overview management group, and the executive committee. The project development team consists of all team members producing the decision document, engineering design, and environmental assessment. Since this is a large project and there are many people on the product development team, a coordinator has been identified for each discipline. The discipline coordinators meet monthly. The discipline coordinators then coordinate with other members of the product development team within their discipline. The overview management group consists of executive level members from each agency executive level members from each agency and is used to resolve issues and make decisions that cannot be resolved at the discipline coordinator level. The Reclamation Board, SAFCA, USBR, and the Corps have members that participate in each of these teams. During the construction phase, the Corps will manage the construction and will establish a construction field office at Folsom Dam. This office will allow the Corps to work closely with the contractor and the USBR personnel operating the dam.

CHAPTER VI - PROJECT IMPLEMENTATION

This chapter summarizes the procedures and cost-sharing requirements for implementing the project.

COST SHARING

The non-Federal sponsors are responsible for the LERRD's required for the project. In addition, the sponsors must provide a cash contribution equal to 5 percent of the construction first costs. This is the first adjustment shown in Table 5. The 5 percent cash contribution is required irrespective of the total cost of the LERRD's provided by the sponsors. In accordance with cost-sharing requirements, the sponsors must provide a minimum of 35 percent of the total construction costs. The project costs would be apportioned 65 percent Federal and 35 percent non-Federal in accordance with cost-sharing requirements for flood control projects set forth in Section 202 of WRDA 96. Given the estimated construction cost of $147.4 million (October 2000 price levels), the Federal contribution would be $95.8 million, and the non-Federal contribution would be $51.6 million.

Costs presented so far are first costs at October 2000 price levels. This estimate has been adjusted to represent the fully funded amount. The fully funded estimate accounts for future inflation and is based on the current first cost and the schedule at which contracts will be awarded. The estimate better represents the actual costs that Congress will need to appropriate and the local sponsors will provide in the future to construct the project. The fully funded cost estimate for this project is $174.5 million: $113.4 million is the Federal contribution, and $61.1 million is the non-Federal contribution.

FINANCIAL ANALYSIS

The total estimated fully funded project cost is $174.5 million, and the non-Federal share is $61.1 million.

The Reclamation Board has received authorization for this project through the State legislative process. SAFCA has recently completed a public assessment vote. During this assessment, the residents of Sacramento who are currently in FEMA's probability of 1 in 100 chance in any one year flood plain voted on an increase in taxes to pay for several civil works projects including the Common Features Project and the Folsom Dam Modification Project. This assessment was approved, and SAFCA would obtain funding through this tax to fund their cost share of the Folsom outlet works modification component.

FEDERAL AND NON-FEDERAL RESPONSIBILITIES

Federal and non-Federal obligations and requirements would be further defined in the PCA signed prior to initiation of construction. The non-Federal funds would not have to be provided until after the PCA is signed.

Federal Responsibilities

The Corps will accomplish pre-construction engineering and design studies. Once the PCA is signed and a cash contribution, LERRD's, and assurances are provided by the non-Federal sponsors, the Federal Government will construct the project.

Non-Federal Responsibilities

The State of California Reclamation Board will be responsible to:

- Provide a minimum of 35 percent, but not to exceed 50 percent, of total project costs as further specified below: (1) provide, during construction, funds needed to cover the non-Federal share of design costs; (2) provide, during construction, a cash contribution equal to 5 percent of total project costs; (3) provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project; (4) provide or pay the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and (5) provide, during construction, any additional costs as necessary to make its total contribution equal to at least 35 percent of total project costs.

- Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24 in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

- Provide 35 percent of that portion of total cultural resource preservation mitigation and data recovery costs attributable to structural flood control that are in excess of 1 percent of the total amount authorized to be appropriated for structural flood control.

- Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as would properly reflect total project costs.

- Publicize flood plain information in the area concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in

adopting such regulations as may be necessary to ensure compatibility between future development and protection levels provided by the project.

- Participate in and comply with applicable Federal flood plain management and flood insurance programs.

- Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

- Perform, or cause to be performed, 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), 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsors shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

- Inform affected interests, at least annually, regarding the limitations of the protection afforded by the project.

- 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 have prepared within one year after the date of signing the PCA, a floodplain management plan. The plan shall be designed to reduce the impacts of future flood events in the project area, including but not limited to, addressing those measures to be undertaken by Non-Federal interest to preserve the level of flood protection provided by this Project. As required by Section 402, as amended, the Non-Federal sponsor shall implement such plan not later than one year after completion of construction of the Project. The Non-Federal Sponsor shall provide an information copy of the plan to the Government upon its preparation.

SAFCA will be responsible to:

- Assume the responsibility for paying for the OMRR&R of flood control modifications made to Folsom Dam as a result of the completed project. USBR manages, operates and maintains Folsom Dam and will continue to so in the future. SAFCA will enter into an agreement with USBR to pay for any additional OMRR&R costs associated with the flood control modifications made to Folsom Dam as a result of this project. The agreement between USBR and SAFCA must be executed prior to execution of the project PCA.

- Assume complete financial responsibility for necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under

lands, easements, or rights-of-way that the Government determines the non-Federal sponsor must provide for the construction, operation, or maintenance of the project.

Both Non-Federal Sponsors will be responsible to:

- Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the WRDA 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof until the non-Federal sponsors have entered into a written agreement to furnish their required cooperation for the project or separable element.

- Hold and save the Government free from all damages arising for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

- Comply with all applicable Federal and State laws and regulations including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as 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 Section 402 of the WRDA 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of flood plain management plans.

PROJECT COOPERATION AGREEMENT

Prior to initiation of plans and specifications, the Federal Government and local sponsors will execute a PCA. This agreement will define responsibilities of the local sponsors for plans and specifications, project construction, and project operation and maintenance.

PROJECT SCHEDULE

The current schedule is an expedited schedule. The schedule envisions a strong project delivery team and a robust independent technical review throughout the design process to maintain high quality standards while meeting aggressive milestones. The overall schedule goal and team intent is to provide the project flood protection benefits to the community of Sacramento with an expedited approach.

Complete Public review of draft EA/IS	April 2001
Final Decision Document to SPD/HQUSACE	August 2001

HQ/ASA concurrence	September 2001
PCA executed (outlets and surcharge)	January 2002
Advertise first construction contract	February 2001
Advertise main outlets contract	July 2002[1]
Complete outlets construction	2009
Implement surcharge component	2007-2009

The schedule of related activities is:

• Update Flood Management Plan	2002
• Make decision on long-term flood control	2002
• Revise variable space reoperation	2008-2009
• Implement new Water Control Manual	2009

[1] Current gate size reevaluation may impact schedule date.

CHAPTER VI - CONCLUSIONS AND RECOMMENDATION

CONCLUSIONS

Listed below are the conclusions of the LRR:

- Increasing low-level outlet capacity would enable Folsom Dam to release the objective release of 115,000 cfs much earlier in a flood event. This would more efficiently use Folsom Dam's flood control space and reduce the risk of flooding in Sacramento to a 1 in 130 chance in any given year.

- Outlet works modifications are economically feasible. The first cost is $108.8 million. The average annual costs and flood control benefits amount to $9.2 million and $24.7 million, respectively.

- Modifying the use of surcharge storage space to delay opening the emergency spillway tainter gates until the reservoir water-surface elevation reached 474 feet elevation would increase the Folsom Dam storage space credited to flood control by 48,000 acre-feet. The surcharge storage raise would be accomplished by increasing the height of the emergency spillway tainter gates, retrofitting (without raising) the wing dams, dikes, and Mormon Island Dam, and other appurtenant facilities. Dam operations would be revised to maintain releases below the PNP of downstream levees for a longer period. Combining the outlet works modification and the increased surcharge would reduce the risk of flooding to a 1 in 140 chance in any given year.

- Surcharge storage is an economically justified increment. The first cost is estimated to be $38.6 million; the annual cost is $2.8 million; and the economic benefits are $4.9 million.

- Outlet works modifications combined with raising surcharge storage is economically justified. The first costs are $147.4 million, and the annual costs are $11.5 million. The project annual benefits are $29.6 million. The benefit-to-cost ratio is 2.5.

- Mitigation measures will be implemented to ensure that outlet works modifications and surcharge operations would have no significant adverse environmental effects. The project would have no effect on water supply, hydropower, or recreation. The project would not require any lands in addition to existing project lands.

- Outlets and surcharge work would be done in phases. Because the outlet works modification provides most of the flood control benefit, construction of this component would be initiated as a first phase. The design and construction of the outlet works modification component would take about 6 years. Surcharge work is also delayed because of the possibility that the American River Watershed Long-

Term Study could result in raising Folsom Dam for flood control, in which case the surcharge work would be incorporated into dam raise construction to avoid duplication of work. Thus, design and construction of surcharge facilities would take place after a decision is made on the Long-Term Study. Construction of these surcharge facilities would take approximately one year to complete.

- This purpose of this project is to reduce flood damages. This project does not address the existing dam-safety deficiency of inadequate spillway capacity. The existing capability of the spillway to pass the PMF is 70 percent and after completion of this project, the dam will be able to pass 75 percent of the PMF.

- Analyses conducted during preparation of this LRR indicate that the project is locally supported, environmentally and institutionally acceptable, technically complete, and economically feasible.

- The Reclamation Board and SAFCA, the local sponsors, have set a flood control goal to achieve a minimum of 1 in 200 chance of flooding in any given year for the Sacramento area. The project is strongly supported by the sponsors as a major step towards achieving their goal. Formulation of this project has been closely coordinated with the local sponsors and the USBR.

- Of the total first cost of $147.4 million, the Federal share is $95.8 million, and the local share is $51.6 million. The local sponsors, The Reclamation Board and SAFCA, are willing and financially capable of signing a PCA, contributing their share of the cost of the project, and meeting other sponsor requirements.

RECOMMENDATION

Based on the findings presented, I recommend that the current project described in this report be implemented as a Federal project, subject to cost sharing, financing, and other requirements of WRDA 1999, and that this report be approved as the basis for executing the PCA.

However, these understandings and recommendations reflect the information available at this time and current Department of the Army policies governing this project. They do not reflect program and budgeting priorities inherent in the national civil works construction program or the perspective of higher review levels within the Executive Branch. Consequently, these recommendations may be modified before they are incorporated into the PCA.

Michael J. Conrad
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District Engineer