

EXECUTIVE SUMMARY

ES.1 PURPOSE AND SCOPE OF REPORT

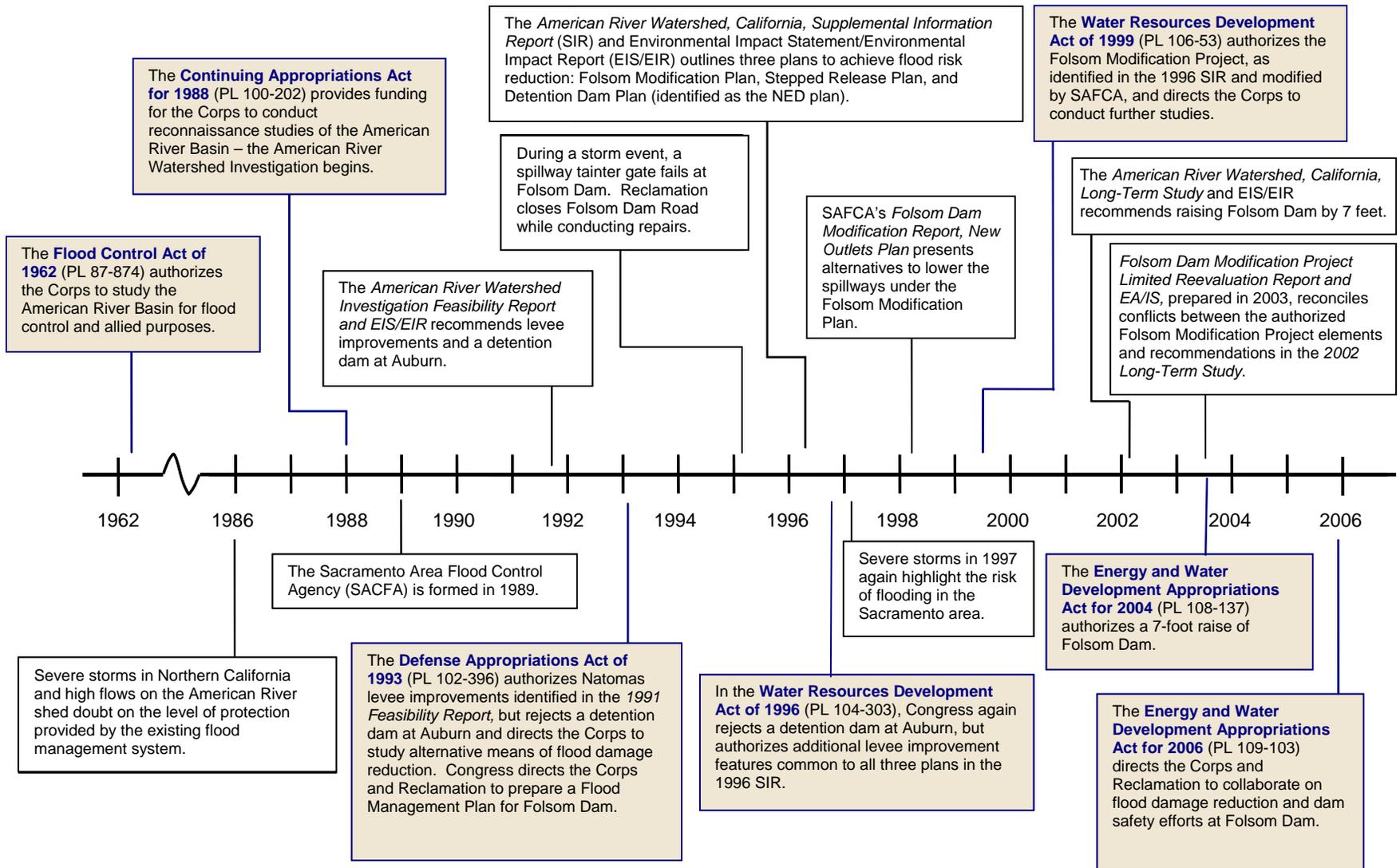
The purpose of this *Post Authorization Change (PAC) Report* is to document changes to two authorized projects: the Folsom Modification Project and Folsom Dam Raise Project. Both projects share an objective of improving flood management on the lower American River, primarily through structural modifications to the existing Folsom Dam and appurtenant facilities. This *PAC Report* describes recommended changes to these authorized projects. It is anticipated that these changes will reduce flood risk to areas along the American River, California, generally equivalent to the flood risk reduction intended to be provided by the Folsom Modification Project and Folsom Dam Raise Project. Similar to the Folsom Dam Raise Project, changes will include provisions to meet the United States Department of the Interior, Bureau of Reclamation's (Reclamation), objective of passing the Probable Maximum Flood (PMF) at Folsom Dam. The PMF is the flood discharge that would result from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably considered possible in a region. The updated information in this *PAC Report* is to be part of a single, joint project that addresses in a more efficient and effective manner the objectives of the United States Army Corps of Engineers (Corps) previously authorized flood damage reduction projects and Reclamation's dam safety concerns.

This *PAC Report* is intended to accomplish the following:

- Demonstrate consistency of a refined project with existing congressional project authorizations.
- Report on changes to project accomplishments and benefits, and Federal interest in a refined project.
- Serve as a basis for new Project Cooperation Agreements (PCA), as needed, between the Federal Government and local sponsors.
- Seek revision for authorized project cost for the Folsom Modification Project from Congress, as appropriate.

ES.2 BACKGROUND

In February 1986, major storms in Northern California caused record flood flows in the American River basin. Record high outflows from Folsom Dam and Reservoir, together with high flows in the Sacramento River, resulted in water levels rising above the design freeboard of levees protecting the Sacramento area. It was clear after the 1986 storm event that Sacramento was a city at significant risk of flooding, and major efforts would be needed to reduce the potential of catastrophic flooding and damages. These concerns led to a series of investigations and subsequent authorizations of projects to help reduce the level of flood risk to the Sacramento area and address safety issues at Folsom Dam. A time line of pertinent studies, authorizations, and appropriations is included in **Figure ES-1**.



**FIGURE ES-1
TIME LINE OF PERTINENT STUDIES, AUTHORIZATIONS, AND APPROPRIATIONS**

Studies have shown that serious flood risks exist in the Sacramento area downstream along the American River to its confluence with the Sacramento River. Within the Sacramento area, a major flood could affect more than 400,000 people by causing flood inundation damages to over 110,000 structures. This would amount to about \$20 billion in damages. The estimated average annual equivalent flood damages in the Sacramento area would be about \$200 million.

The two projects of paramount interest in this *PAC Report* are the Folsom Modification Project and Folsom Dam Raise Project. Both projects have changed from their initial formulation and authorization. The Folsom Modification Project primarily includes features to improve the efficiency and effectiveness of the existing flood control outlet works at Folsom Dam and flood control storage in Folsom Reservoir. The Folsom Dam Raise Project was intended to be constructed following implementation of the Folsom Modification Project. The Folsom Dam Raise Project primarily includes enlarging the flood control storage space in Folsom Reservoir, features to meet Reclamation's objective of passing the PMF, and features to help restore the ecosystem downstream from Folsom Dam. The Folsom Modification and Folsom Dam Raise projects, in combination with other authorized elements downstream from the dam (Common Features), were expected to reduce the risk to Sacramento of flooding to an annual exceedence probability (AEP) of 0.0057 (a 1 in 175 chance in any 1 year). Because of escalating costs and technical problems, the Folsom Modification Project has been delayed. Because of this delay, associated impacts to the Folsom Dam Raise Project, and Reclamation's effort to address dam safety issues at Folsom, there is now an emphasis on reconsidering the individual projects on a more integrated basis. The Energy and Water Development Appropriations Act of 2006 (see **ES.3 Authorities**, below) directed the Corps and Reclamation to collaborate on flood damage reduction and dam safety at Folsom Dam. This *PAC Report* was prepared in part to respond to Congress's request.

As a companion to the *PAC Report*, Reclamation and the Corps cooperated in preparation of the Reclamation *2007 Final Folsom Dam Safety/Flood Damage Reduction Environmental Impact Statement/Environmental Impact Report (EIS/EIR)*. Reclamation is the lead Federal agency, with participation by the Corps as a cooperating agency. The document discloses potential environmental impacts of action alternatives meeting Corps flood damage reduction and Reclamation dam safety objectives. The *EIS/EIR* includes information being developed by Reclamation as part of ongoing designs and construction of dam safety improvements at Folsom Dam under the Reclamation Safety of Dams Program. The Reclamation *2006 Draft Folsom Dam Safety/Flood Damage Reduction Draft EIS/EIR* was circulated for public review, in conjunction with the Corps *Draft PAC Report*, from 1 December 2006 until 26 January 2007. Public meetings were held on 9 and 10 January 2007 to allow the public and interested agencies the opportunity to provide oral and written comments. The Corps intends to adopt the *2007 Final Folsom Dam Safety/Flood Damage Reduction EIS/EIR* to satisfy requirements of the National Environmental Policy Act for changes to the originally authorized Folsom Modification and Folsom Dam Raise projects, as appropriate.

ES.3 AUTHORITIES

The basic authorities addressed in this *PAC Report* are as follows:

- **Folsom Modification Project** – Section 101(a) (6) of the Water Resources Development Act (WRDA) of 1999, Public Law (PL) 106-53, provides authorization for the Folsom Modification Project. It directed the Corps to implement a project to modify Folsom Dam and Reservoir generally as described in a March 1996 *American River Watershed, California, Supplemental Information Report* by the Corps, and as modified by a March 1998 *Folsom Dam Modification Report, New Outlets Plan*, by the Sacramento Area Flood Control Agency (SAFCA). The total authorized cost was \$150 million.
- **Folsom Dam Raise Project** – Section 128 of the Energy and Water Development Appropriations Act of 2004 (PL 108-137) directed the Secretary of the Army to carry out a project for flood damage reduction and ecosystem restoration, as described in a Corps *Chief of Engineers Report*, dated November 2002, at a total cost of \$257.3 million. Included in the Folsom Dam Raise Project authority are provisions for the expedited design and construction of a new bridge at Folsom and ecosystem restoration.
- **Project Collaboration and Auxiliary Spillway** – Section 128 of the Energy and Water Development Appropriations Act of 2006 (PL 109-103) directed the Secretary of the Army and the Secretary of the Interior to collaborate on authorized activities to maximize flood damage reduction improvements and address dam safety needs at Folsom Dam. Pursuant to this legislation, the Secretaries are to consider reasonable modifications to existing authorized activities, including an auxiliary spillway.

ES.4 AUTHORIZED PROJECTS

Major features of the Folsom Modification Project and Folsom Dam Raise Project are summarized below:

- **Folsom Modification Project** – The Folsom Modification Project is described in the Corps November 2003 *American River Watershed, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study*. This project primarily consists of two major features: (1) outlet works modifications and (2) emergency spillway gate replacement for surcharge storage. Under the outlet works feature, eight existing outlet works would be enlarged and two new outlets would be added. The surcharge storage component would include replacing three emergency spillway tainter gates, revising the emergency spillway release diagram, and raising the impervious core in Mormon Island Auxiliary Dam and in several dikes around the lake. The project would be operated to achieve the objective release of 115,000 cubic feet per second (cfs) earlier in a flood event, and enhance the use of surcharge storage space in the reservoir through modifications to the emergency spillway and related operational changes. The non-Federal project sponsor for the Folsom Modification Project is the State of California through the Department of Water Resources (DWR). SAFCA is a co-

sponsor with DWR, and agreed to enter into a cost-sharing agreement with Reclamation to pay for any portion of the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs related to the new flood damage reduction features.

- **Folsom Dam Raise Project** – The Folsom Dam Raise Project is described in the Corps November 2002 *American River Watershed, California, Long-Term Study, Final Supplemental Plan Formulation Report/Environmental Impact Statement/Environmental Impact Report*. This project consists of raising the main dam and associated wing dams, dikes, and other appurtenances by 7 feet. The Folsom Dam Raise Project would provide flood benefits while also resolving certain dam safety issues associated with passing the PMF. This project would eliminate the need for replacing the three emergency spillway tainter gates considered in the Folsom Modification Project. The State of California, through DWR, is also the non-Federal project sponsor for the Folsom Dam Raise Project. SAFCA is a co-sponsor and would be responsible for OMRR&R costs. In addition, SAFCA is the non-Federal sponsor for the ecosystem restoration component of the project and the City of Folsom is the sponsor for the Folsom Dam Bridge.

ES.5 REFINED AUTHORIZED PROJECTS

The process for identifying refinements to the authorized projects included evaluating and selecting a plan to jointly address the Corps' authorized flood damage reduction projects and Reclamation's dam safety issues. This was accomplished in the following steps: (1) identifying specific project objectives and constraints, (2) identifying alternative components and combinations of components to meet these objectives, (3) evaluating and comparing these alternatives, and (4) selecting refined authorized projects for implementation.

ES.5.1 Project Objectives and Constraints

The specific objectives for a plan to address both the authorized flood management projects and dam safety issues at Folsom Dam are as follows:

- Primarily from the results of approved studies and authorized projects to date, develop a modification of Folsom Dam and Reservoir capable of reducing flood damages to areas along the American River, California, generally functionally equivalent to the flood risk reduction intended to be provided by the authorized Folsom Modification and Folsom Dam Raise projects.
- Ensure that a refined project provides for the following:
 - Includes features to pass the PMF.
 - Allows and accounts for early implementation of the Folsom Dam Bridge.
 - Retains the capability to implement ecosystem restoration features, as authorized for the Folsom Dam Raise Project.
- Meet the minimum community goal, as articulated by SAFCA, of having a project capable of safely passing the 200-year computed design flood event.

Three major constraints related to project authorization, project area, and applicable laws, regulations, and policies were identified. In addition, a series of supporting constraints was also identified to help identify potential refinements to the authorized projects.

ES.5.2 Alternative Plan Consideration

The No-Action Plan and four action alternative plans were identified to address the project objectives consistent with the identified constraints. These plans include various combinations of features (identified in prior and recent engineering studies) and provide varying levels of flood risk reduction, as described below.

- **No-Action Plan** – Under this plan, the Federal Government would take no further action to reduce flood damages in the Sacramento area, other than those actions currently underway. This primarily includes (1) continuation of the 400,000 to 670,000 acre-foot variable space flood pool interim operation agreement at Folsom Reservoir, (2) completion of the Common Features (primarily levee improvements) project along the American River, (3) completion of seismic retrofit work at Folsom facilities, (4) construction of a new bridge just west of Folsom Dam, and (5) modification of the L.L. Anderson Dam spillway by Placer County Water Agency (PCWA). This alternative would also include Reclamation constructing an emergency fuseplug spillway project near Folsom Dam for hydrologic dam safety purposes. It also includes modification of the Folsom Dam Flood Control Diagram adopted by Reclamation and SAFCA in 2004. Under this plan, Folsom Dam and Reservoir, along with downstream levee improvements, would provide Sacramento with protection against the 100-year computed design flood event.
- **Alternative A – Eight Main Dam Outlets and Fuseplug Spillway** – This alternative consists of three major features: (1) enlarging six of the eight existing outlets (two lower tier outlets and all four upper level outlets), (2) constructing two new outlets along the upper outlet tier, and (3) constructing an emergency fuseplug spillway. The fuseplug spillway would be completed to address passage of the PMF. This alternative also includes modification of the flood control storage space in Folsom Reservoir to a variable space ranging from 400,000 to 600,000 acre-feet.
- **Alternative B – Six Submerged Tainter Gate Auxiliary Spillway** – This alternative includes constructing a new gated auxiliary spillway southwest of Folsom Dam. The auxiliary spillway would be at the same location as the emergency fuseplug spillway described in Alternative A, but in addition to passing the PMF, it would also significantly contribute to reducing flood damages along the American River. Major features include (1) a 1,100-foot-long approach channel beginning in Folsom Lake, (2) a control structure, including six submerged tainter flood gates 33 feet high by 23 feet wide at a sill elevation of 368 feet above mean sea level (msl), (3) a 3,000-foot-long spillway chute with a bottom width of about 169 feet, and (4) a stilling basin in the American River. It also includes modification of the flood control storage space in Folsom Reservoir to a variable space ranging from 400,000 to 600,000 acre-feet.
- **Alternative C – Six Submerged Tainter Gate Auxiliary Spillway, 3.5-Foot Dam Raise, and Three Emergency Spillway Gate Replacements** – This alternative includes

constructing a new gated auxiliary spillway southwest of Folsom Dam (similar to Alternative B), raising Folsom Dam and Reservoir by 3.5 feet, and replacing the three emergency spillway tainter gates at Folsom Dam. It also includes modifying the flood control storage space in Folsom Reservoir to a variable space ranging from 400,000 to 600,000 acre-feet.

- Alternative D – Six Submerged Tainter Gate Auxiliary Spillway, 7-Foot Dam Raise, and Eight Emergency and Main Dam Spillway Gate Replacements** – This alternative is similar to Alternative C except that it includes raising Folsom Dam by 7 feet (comparable to the authorized Folsom Dam Raise Project). The raise would be a combination of raising the concrete monolith and embankments and adding a parapet wall. In addition, it includes (1) replacing five main dam spillway gates and three emergency spillway gates, (2) modifying the spillway and bridge piers, (3) replacing the spillway bridge, and (4) modifying the elevator tower. It also includes modifying the flood control storage space in Folsom Reservoir to a variable space ranging from 400,000 to 600,000 acre-feet. The estimated performance, first and annual costs, annual flood damage reduction benefits, and net benefits of this and the other action alternative plans are summarized in **Table ES-1**.

TABLE ES-1
SUMMARY OF ACTION ALTERNATIVE PLANS CONSIDERED

Item	Alternative			
	A	B	C	D
Major Features				
Outlet Conduits (new and enlarged)	8 outlets	NA	NA	NA
Emergency and Main Spillway Gate Replacement	NA	NA	3 gates	8 gates
No. of Submerged Tainter Gates ¹ or Fuseplug	Fuseplug	6 gates	6 gates	6 gates
Folsom Dam Raise (feet)	NA	NA	3.5	7
Performance				
Passes PMF	Yes	Yes	Yes	Yes
Probability of Flooding				
Annual Exceedence Probability	0.0068	0.0064	0.0054	0.0047
1 in X Chance in Any Year	1 in 147	1 in 156	1 in 185	1 in 213
Design Flood Event (frequency in years) ²	180	200	240	275
First Cost (\$ millions)³	630	876	988	1,439
Annual Cost (\$ millions)⁴				
Total	33.0	45.3	50.1	83.9
Flood Damage Reduction (less dam safety)	33.0	35.2	40.0	73.8
Annual Flood Damage Reduction Benefits (\$ millions)	84.7	89.9	107.1	118.9
Net Annual Flood Damage Reduction Benefits (\$ millions)	51.7	54.7	67.1	45.1
Residual Damages (\$ millions)	113.5	108.3	91.1	79.3
Percent Damage Reduction	43	45	54	60
Key: NA = not applicable No. = number PMF = Probable Maximum Flood				

Notes:

- Auxiliary spillway submerged tainter gates are 33 feet high by 23 feet wide.
- Design flood event given as the frequency of the maximum computed event that can be passed.
- October 2006 price levels.
- 50-year period of analysis and 4-7/8 percent discount rate. Does not include ongoing costs to replace water supplies foregone due to continued interim operation. They are to be reevaluated in future studies.

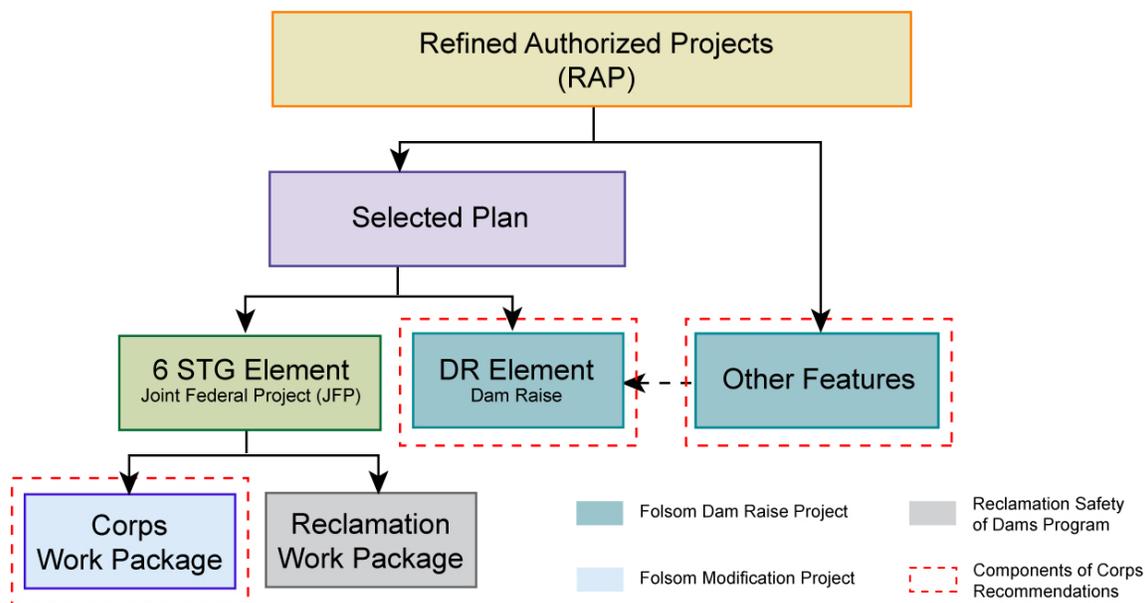
ES.5.3 Alternative Plan Evaluation and Selection

To assist in identifying a Selected Plan, the above action alternative plans were compared using the four general criteria contained in the Federal Water Resources Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (or P&G) (1983). Completeness is a determination of whether a plan includes all elements necessary to realize planned effects. Effectiveness is the extent to which an alternative can alleviate problems and achieve the project objectives. Efficiency is the extent to which an alternative is the most cost-effective means for realizing project objectives consistent with protecting the Nation's environment. Acceptability is the workability and viability of a plan with respect to its potential acceptance by other Federal agencies, State and local governments, public interest groups, and individuals.

On the basis of this comparison of the alternatives, Alternative C was identified as the Selected Plan. This is primarily because Alternative C would closely meet the objectives and accomplishments of the Folsom Modification and Folsom Dam Raise projects, is functionally equivalent to those projects, incorporates dam safety risk reduction, would provide the greatest net benefits of all the alternatives considered, and is highly supported by the non-Federal sponsors.

ES.5.4 Selected Plan and Refined Authorized Projects Description

The Selected Plan (Alternative C above) includes constructing a six submerged tainter gate auxiliary spillway, raising Folsom Dam 3.5 feet, replacing three emergency spillway gates, and modifying the flood control storage space. The Refined Authorized Projects (RAP) include the Selected Plan along with two Other Features: ecosystem restoration (part of the authorized Folsom Dam Raise Project), and a permanent bridge replacement increment. **Figure ES-2** shows the major components of the RAP. Through the combination of the elements shown in the figure, the RAP addresses the specific objectives outlined above to achieve flood damage reduction and improve dam safety. The non-Federal project sponsor for the flood damage reduction portion of the RAP is the State of California through DWR. SAFCA is a co-sponsor with DWR and will enter into a cost-sharing agreement with Reclamation to pay for any portion of the OMRR&R costs related to the new flood damage reduction features.



**FIGURE ES-2
COMPONENTS AND RESPONSIBILITIES OF THE REFINED AUTHORIZED PROJECTS**

In the RAP, Other Features are companion to the DR Element of the Selected Plan. Corps and Reclamation Work Packages make up the 6 STG Element.

ES.5.5 Accomplishments

The primary accomplishments of the RAP are as follows:

- Flood Damage Reduction** – With the RAP, the existing level of flood risk to much of Sacramento (expressed as AEP) would be reduced from 0.0124 to 0.0054 (from a 1 in 81 chance in any year to a 1 in 185 chance). The RAP would provide the capability for Folsom Dam and Reservoir to pass, with outflows of 160,000 cfs for a sustained time (currently being evaluated), the 240-year design flood event. This exceeds the minimum requirement of SAFCA and The Reclamation Board of the State of California (The Reclamation Board). The RAP would control a flood with a 3-day inflow volume to Folsom Reservoir of about 50 percent larger than the floods of record (1986 and 1997) in the American River basin.

It is important to understand that the RAP is the next critical step for reducing the threat of flooding in Sacramento. With the RAP in place, a significant flood risk would still remain for the community. It is estimated that the RAP could reduce existing flood damages by about 54 percent.

- Probable Maximum Flood** – With the RAP in place, the PMF in the upper American River watershed could be passed through Folsom Dam and Reservoir without danger of a major structural failure. Ability to pass the PMF would not reduce the frequency of

major flooding along the American River; however, it would reduce the potential of catastrophic overtopping and potential failure of Folsom Dam and appurtenant structures.

- **Other Features** – The RAP would also preserve the potential to implement ecosystem restoration features authorized by the Folsom Dam Raise Project along the lower American River. In addition, the RAP would be constructed consistent with the expedited implementation of a permanent bridge just downstream from Folsom Dam. The bridge will allow safe and efficient transportation from east Folsom to areas north of the American River near Folsom Reservoir.

ES.5.6 Major Features

As can be seen in **Figure ES-2**, the major feature of the RAP consists of the Selected Plan. The Selected Plan includes (1) an auxiliary spillway with six submerged tainter gates (6 STG Element) and (2) Folsom Dam raise (DR Element).

E.5.6.1 6 STG Element

The 6 STG Element consists of the auxiliary spillway with six submerged tainter gates and variable flood space operation.

- **Auxiliary Spillway with Six Submerged Tainter Gates** – A new auxiliary spillway with six submerged tainter gates would be located southwest of Folsom Dam. Features of the auxiliary spillway include (1) a 1,100-foot-long approach channel beginning in Folsom Lake, (2) a control structure, including six submerged tainter flood gates, (3) a 3,000-foot-long spillway chute with a bottom width of about 169 feet, and (4) a stilling basin in the American River. The control structure would be operated collectively with spillway gates on Folsom Dam to manage flood flows from Folsom Reservoir. These components of the Selected Plan are referred to in supporting documentation as the Joint Federal Project, or JFP. **Figure ES-3** shows a conceptual rendering of the auxiliary spillway and appurtenances in relation to the existing Folsom Dam.

Both Reclamation and the Corps are to participate in the construction of the JFP. The relative amount of participation is based upon the relative cost of a single purpose dam safety project (a fuseplug spillway) and a single purpose flood damage reduction project (the same as the 6 STG Element). The value of participation is about 20 percent Reclamation (dam safety) and 80 percent Corps (flood damage reduction). The individual work items to construct the spillway were distributed into two work packages – one to be constructed by Reclamation to address dam safety (Reclamation Work Package), and one to be constructed by the Corps to address flood damage reduction (Corps Work Package). The work packages are based on the cost distribution and on increased engineering and construction efficiencies.

As shown in **Figure ES-2**, each agency is to treat its work package as its project to construct. Although the project contains joint flood damage reduction and dam safety features and costs, the Corps Work Package will be the flood damage reduction cost and the Reclamation Work Package will be the dam safety cost. The cost of the Corps Work

Package is reported below. The cost of the Reclamation Work Package is under development.

- **Flood Space Operations** – The RAP also includes changing the flood control storage space in Folsom Reservoir from a variable space ranging from 400,000 acre-feet to 670,000 acre-feet, to 400,000 acre-feet to 600,000 acre-feet.



**FIGURE ES-3
CONCEPTUAL RENDERING OF THE AUXILIARY SPILLWAY, SUBMERGED
TAINTER GATE STRUCTURE, AND APPURTENANT FACILITIES**

E.5.6.2 DR Element

As highlighted below, the DR Element for the Selected Plan primarily includes replacement of the emergency spillway gates and a 3.5-foot Folsom Dam raise. Further, the Other Features component of the DR Element includes ecosystem restoration and a bridge increment.

- **Spillway Gate Replacement** – Replacement of the three existing emergency spillway gates at Folsom Dam with 42-foot-wide by 59-foot-high tainter gates. This would allow 2 feet of freeboard for the emergency spillway tainter gates (in a closed position) when the reservoir is operated to maintain controlled releases of up to 160,000 cfs (emergency objective release).

- **Folsom Dam Raise** – Raising Folsom Dam and appurtenant facilities by 3.5 feet would result in an increase in flood storage capacity in Folsom Reservoir for flood damage reduction uses by approximately 46,200 acre-feet. This would be above (to elevation 474 feet above msl) the current authorized flood pool storage of 1.02 million acre-feet associated with a pool elevation of 470 feet above msl. This increase would be within the existing project boundary for Folsom Reservoir. Primary features of the raise would include raising the Mormon Island Auxiliary Dam and auxiliary dikes around Folsom Reservoir by 3.5 feet.

The 6 STG Element provides all of the performance and functionality that would have been achieved by the outlet works modifications of the authorized Folsom Modification Project. Additionally, the DR Element provides much of the performance and functionality that would have been provided by the authorized Folsom Dam Raise Project. It is important to note that under the authorized projects, the dam safety component rested with the Folsom Dam Raise Project. However, the 6 STG Element not only provides a significant increase in the reduction of flood risk along the lower American River, but it also resolves the PMF issues at Folsom by augmenting the existing spillway release capacity. Accordingly, the dam safety component of the authorized projects is included in the 6 STG Element and will be implemented by Reclamation as part of the Reclamation Work Package (see **Figure ES-2**).

ES.5.7 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Physical operation of the enlarged Folsom Dam and Reservoir and emergency gates would be as under existing conditions. Timing and duration would be modified based on an updated Water Control Manual. The auxiliary spillway and gating system would require additional OMRR&R support. The non-Federal sponsor would enter into an agreement with Reclamation, as necessary, to facilitate the non-Federal sponsor's OMRR&R activities.

ES.5.8 Economics

Table ES-2 summarizes the total costs and benefits associated with the Selected Plan and RAP. As shown, the estimated first cost for the RAP is \$973.7 million, excluding the cost of the Reclamation Work Package. The portion of this cost for flood damage reduction (Selected Plan) is \$848.2 million. The estimated average annual cost of the Selected Plan is \$43.5 million. Excluding potential benefits for the Folsom Dam Bridge and ecosystem restoration, the total estimated average annual benefits for the RAP associated with flood damage reduction are \$107.1 million. The resulting net average annual flood damage reduction benefits for the RAP are \$63.8 million.

As can be seen in **Table ES-2**, costs for the Selected Plan are different than the cost of Alternative C in **Table ES-1**. This is primarily because the costs for the Selected Plan and RAP were developed to a greater level of detail than the costs used to compare alternatives.

TABLE ES-2
SUMMARY OF COSTS AND BENEFITS FOR CORPS PORTION OF SELECTED
PLAN AND REFINED AUTHORIZED PROJECTS (\$ MILLIONS) ¹

Item	Refined Authorized Projects		
	6 STG Element (Corps Work Package Only)	DR Element + Other Features	Total
First Cost			
Land	0.0	0.2	0.2
Roads and Relocations	0.0	0.0	0.0
Construction	538.6	73.6	612.2
Environmental Mitigation	0.4 ²	3.0	3.4
Cultural Resources	0.0	0.8	0.8
EDS&A	144.0	37.7	181.7
Subtotal – Selected Plan (less Reclamation Work Package)	683.0	115.3	798.3
Temporary Bridge Increment	0.0	49.9	49.9
Total - Selected Plan (less Reclamation Work Package)	683.0	165.2	848.2
Other Features			
Ecosystem Restoration	0.0	59.8	59.8
Permanent Bridge Increment	0.0	65.7	65.7
Total - RAP (less Reclamation Work Package)	683.0	290.7	973.7
Investment Cost			
First Cost (Selected Plan) ³	683.0	115.3	798.3
Less Cultural Resources	0.0	-0.8	-0.8
Less Sunk Costs	-55.9	-22.1	-78.0
IDC	75.1	8.9	84.0
Total	702.2	101.3	803.5
Annual Cost (Selected Plan) ^{3,4}			
Interest and Amortization	37.7	5.5	43.2
Operation and Maintenance	0.2	0.1	0.3
Subtotal	37.9	5.6	43.5
Annual Flood Damage Reduction Benefits	89.9	17.2	107.1
Net Annual Flood Damage Reduction Benefits	52.0	11.6	63.6
Benefit-to-Cost Ratio for Flood Damage Reduction	2.4	3.1	2.5
Key: DR = dam raise EDS&A = engineering, design, supervision, and administration IDC = interest during construction		MCACES = microcomputer-aided cost engineering system RAP = Refined Authorized Projects STG = submerged tainter gate	

Notes:

1. MCACES October 2006 price levels.
2. Environmental mitigation for previous work and treated as a portion of sunk costs.
3. First and annual cost for the Selected Plan portion of RAP only - less Reclamation Work Package and Other Features costs.
4. 50-year period of analysis, and 4-7/8 percent interest rate.

Table ES-2 also shows costs for a temporary bridge and a permanent bridge. The bridge costs are separated in this way to identify which portion of the new bridge cost at Folsom would be allocated to the Folsom Dam Raise Project cost, and which would be a local transportation betterment. The Folsom Dam Raise Project includes a temporary bridge to support the dam raise during its construction. All costs in excess of the temporary bridge cost that are needed to build a permanent bridge are treated as a separate increment in the Other Features portion of the DR Element (permanent bridge increment). The bridge is under construction and therefore the costs are sunk costs and are not part of the Folsom Dam Raise Project economic cost. The cost structure and cost-sharing of the bridge are discussed in detail in the Corps *2006 Folsom Dam Raise, Folsom Bridge Post Authorization Decision Document*. The bridge is scheduled to be completed in January 2009.

Figure ES-4 shows a breakdown of the first costs of the RAP according to the two major elements of the Selected Plan. The figure also shows how those costs are further allocated and apportioned between flood damage reduction and dam safety, and between Federal and non-Federal responsibilities.

ES.5.9 Implementation

Table ES-3 contains an implementation schedule for the Selected Plan portion of the RAP. A number of approvals/reviews are required to implement the Selected Plan portion of the RAP. Approvals allowing initiation of construction are expected to be obtained by June 2007.

The 6 STG Element (or JFP) would be implemented through the Corps Work Package, focusing on flood damage reduction features, and the Reclamation Work Package, focusing on dam safety features. Efforts related to ecosystem restoration features are being continued, as authorized, as part of the Folsom Dam Raise Project. The bridge is currently being constructed at Folsom Dam, also as part of the Folsom Dam Raise Project.

As indicated in **Table ES-3**, Reclamation may begin construction of its Work Package before all Corps flood damage reduction approvals are in place; construction could begin in September 2007. Initiation of the Corps Work Package is not expected until spring 2010. Almost 7 years would be required for construction of the 6 STG Element. Construction of the DR Element would be phased to begin well after the beginning of construction of the 6 STG Element. Construction of all project phases resulting in project accomplishments for flood damage reduction is not scheduled until 2016.

Project implementation depends in part on execution of several PCAs. Likely PCA requirements are described below in **Section ES.7**.

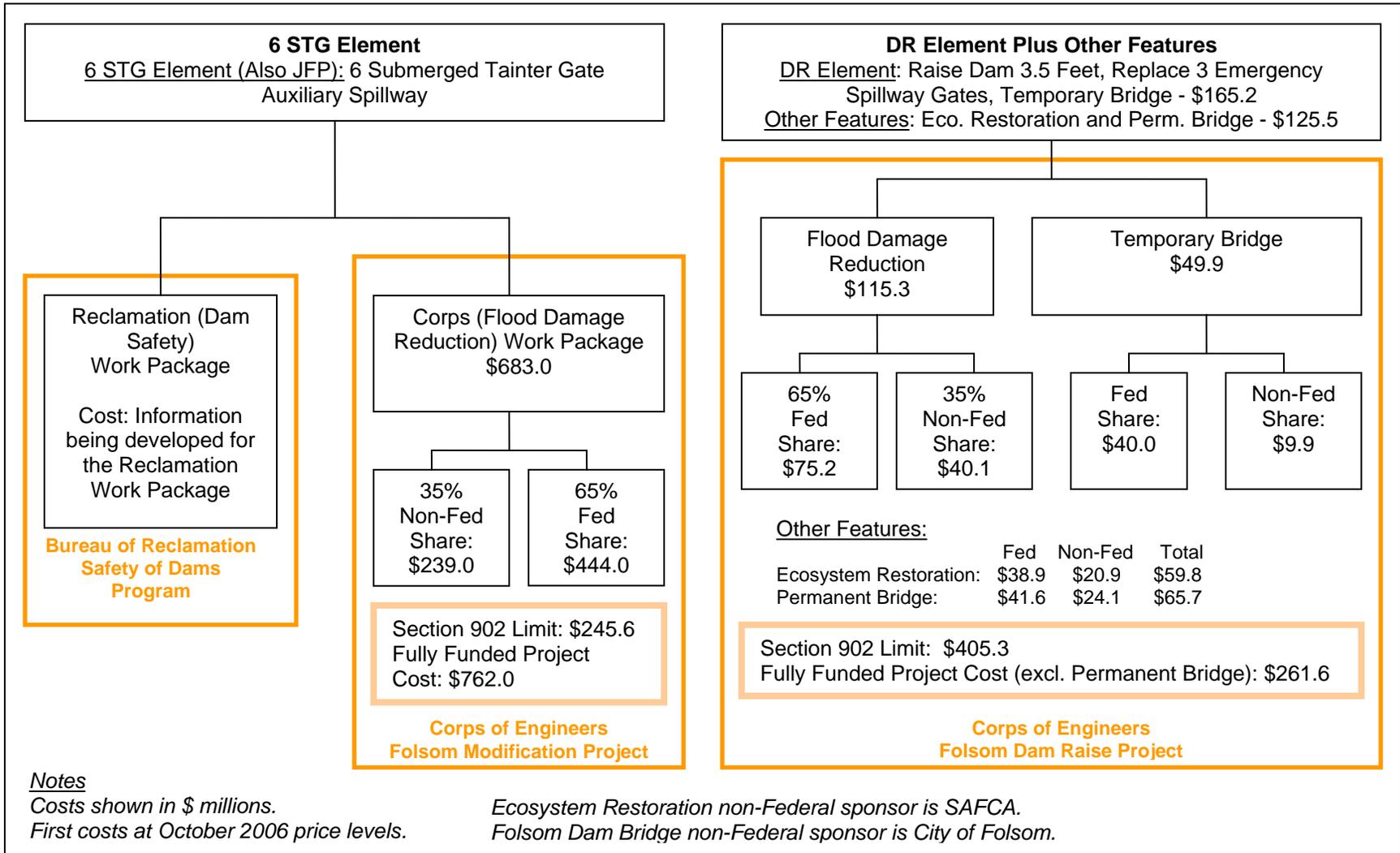


FIGURE ES-4
SUMMARY OF COSTS FOR THE REFINED AUTHORIZED PROJECTS ACCORDING TO ELEMENT

**TABLE ES-3
IMPLEMENTATION SCHEDULE OF 6 STG ELEMENT AND DR ELEMENT**

Task Name	Start Date	Finish Date
Project Approval Activities PAC & EIS/EIR Final Reports	In progress	June 2007
Folsom Modification & Related Activities¹ 6 STG Element Construction -Reclamation Work Package -Corps Work Package Folsom Dam Reoperation & Forecast-Based Release -Decision Document & EIS/EIR	September 2007 2010 January 2007	2010 2014 June 2008
Folsom Dam Raise² Folsom Bridge Construction Folsom Dam Raise Construction Ecosystem Restoration Construction	February 2007 2014 2016	January 2009 2016 2019
Key: DR = dam raise EIS/EIR = Environmental Impact Statement/Environmental Impact Report	PAC = Post Authorization Change STG = submerged tainter gate	

Notes:

1. A more detailed schedule for activities related to the 6 STG Element is included in **Appendix C – Joint Federal Project Engineering Design Report**.
2. A more detailed schedule for activities related to the Folsom Dam Raise Project is included in **Appendix B – Folsom Dam Raise Project Engineering Design Report**.

ES.6 CHANGES FROM AUTHORIZED PROJECTS

Changes from the existing authorized projects are summarized below:

- **Changes in Scope** – The functionality of the 6 STG and DR elements of the RAP is considered equivalent to that of the authorized Folsom Modification Project and Folsom Dam Raise Project. It should be noted that there is a recommended deletion of (1) the surcharge storage component of the Folsom Modification Project, and (2) the L.L. Anderson Dam component of the Folsom Dam Raise Project. Surcharge storage components would no longer be needed for flood damage reduction with the 3.5-foot dam raise and gate modification. L.L. Anderson Dam modifications are being accomplished independently by PCWA.
- **Changes in Location** – There has been no fundamental change in the location of the authorized projects. Whereas construction for the Folsom Modification Project focused on the main dam itself, the gated auxiliary spillway component of the RAP would occur adjacent to the dam.
- **Changes in Purpose** – The purpose of the RAP remains focused on flood damage reduction, an authorized project purpose. The RAP also includes a goal to resolve hydrologic dam safety issues at Folsom, similar to the Folsom Dam Raise Project. Ecosystem restoration and the Folsom Bridge, included in the authorized Folsom Dam Raise Project, continue to be implemented and are included in the RAP.
- **Changes in Designs** – The primary reasons for design changes between the authorized projects and RAP are recent findings that the auxiliary gated spillway would be a more effective and efficient method of evacuating the flood space in Folsom Reservoir earlier

in a storm event, while also resolving hydrologic dam safety issues at Folsom Dam. **Table ES-4** summarizes design changes between the authorized projects and the RAP. All other features would remain unchanged.

TABLE ES-4
SUMMARY OF PROJECT COMPONENTS¹

Item	Folsom Modification Project (2003 LRR) ²	Folsom Dam Raise Project (2004 E&WDAA)	Refined Authorized Projects (RAP)	
			6 STG Element	DR Element ³ and Other Features
FOLSOM DAM				
Main Dam				
Main Concrete Dam	–	Raise dam crest 7.0 feet	–	–
Wing Dams	–	Raise wing dams 7.0 feet	–	Raise wing dams 3.5 feet
Spillway & Stilling Basin	Construct additional anchorage for spillway stilling basin	Enlarge spillway stilling basin	–	–
Outlets	<ul style="list-style-type: none"> Enlarge 8 existing outlets (9'4" by 14' upper tier & 9'4" by 12' lower tier) Construct 2 new upper tier outlets Construct eyebrow deflectors on all outlets 	–	–	–
Emergency Gates	Replace 3 emergency spillway tainter gates with 42' by 59' tainter gates (new top of gate elevation of 476.0 feet above msl)	Replace 3 emergency spillway tainter gates with 66' high tainter gates (new top of gate elevation of 484.0 feet above msl)	–	Replace 3 emergency spillway tainter gates with 42' by 59' tainter gates (new top of gate elevation of 476.5 feet above msl)
Main Spillway Gates	–	Replace spillway gates	–	–
Dikes				
Mormon Island Auxiliary Dam	–	Raise dike 7.0 feet	–	Raise dike 3.5 feet
Dike 5	–	Raise dike 7.0 feet	–	Raise dike 3.5 feet
Dike 7	–	Raise dike 7.0 feet	–	Raise dike 3.5 feet
Other Dikes	–	Raise dikes 7.0 feet	–	Raise dikes 3.5 feet
Auxiliary Spillway	–	–	Auxiliary spillway with 6 STGs (33' high by 23' wide) at gate sill elevation 368 feet above msl	–
OTHER FEATURES				
Folsom Bridge	–	Construct a temporary and permanent bridge downstream from Folsom Dam	–	Advanced implementation of Folsom Dam Bridge
L.L. Anderson Dam Spillway Modification	–	Modify L.L. Anderson Dam spillway at French Meadows Reservoir	–	L.L. Anderson Dam spillway modification will be implemented by Placer County Water Agency separately from the DR Element
Ecosystem Restoration	–	Implement ecosystem restoration features to benefit the lower American River	–	Ecosystem restoration efforts continue as authorized
Key: – = does not apply DR = dam raise E&WDAA = Energy and Water Development Appropriations Act LRR = Limited Reevaluation Report msl = mean sea level STG = submerged tainter gate				

Notes:

- Assumes objective release of 160,000 cfs for a sustained time (currently being evaluated) as part of flood operations for without-project conditions.
- Plan described in the Corps November 2003 American River Watershed, California, Final Limited Reevaluation Report and Environmental Assessment/Initial Study (2003 LRR).
- Dam Raise Element includes a 3.5-foot raise of the wing dams and dikes; the main dam crest will not be raised.

- Changes in Total Project First Costs** – Changes in total project first costs are shown in **Table ES-5**. The authorized first cost for the Folsom Modification Project in Section 101(a) of WRDA 1999 is \$150 million. That cost was updated in the Corps 2003 *Folsom Dam Modification Project, Final Limited Reevaluation Report* to \$214.1 million (\$183.8 million for the outlet works modification and \$30.3 million for surcharge storage). After updating to October 2006 price levels, the cost is \$242.5 million. The authorized first cost for the Folsom Dam Raise Project in Section 128 of the Energy and Water Development Appropriations Act of 2004 is \$257.3 million. The Corps 2002 *Chief of Engineers Report* on the Folsom Dam Raise Project presented an updated first cost of \$248.6 million (\$297.7 million updated to October 2006 price levels).

TABLE ES-5
SUMMARY COMPARISON OF COSTS AND BENEFITS (\$ MILLIONS)

Item	Authorized Projects					Refined Authorized Projects (2006 Price Levels)		
	Folsom Modification		Folsom Dam Raise		Combined Projects	6 STG Element (Corps Work Package)	DR Element and Other Features	Total
	2003 LRR ¹		2002 Chief of Engineers Report ²					
	2003 Price Levels	2006 Price Levels	2001 Price Levels	2006 Price Levels	2006 Price Levels			
First Cost								
Flood Damage Reduction	214.1	242.5	128.2	153.5	396.0	683.0	165.2	848.2
Other Features	0	0	120.4 ³	144.2 ³	144.2 ³	⁵	125.5 ⁶	125.5 ⁶
Total	214.1	242.5⁴	248.6	297.7⁴	540.2⁴	683.0	290.7	973.7
Annual Cost (Flood Damage Reduction)	15.6	17.7	10.2	12.2	29.9	37.9 ⁷	5.6 ⁷	43.5 ⁷
Annual Benefits (Flood Damage Reduction)	31.2	35.3	19.2	23.0	58.3	89.9	17.2	107.1
Net Benefits	15.6	17.6	9.0	10.8	28.4	52.0	11.6	63.6
Benefit-to-Cost Ratio	2.0	2.0	1.9	1.9	1.9	2.4	3.1	2.5
Key:	DR = dam raise LRR = Limited Reevaluation Report				STG = submerged tainter gate			

Notes:

- Corps 2003 *American River Watershed, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study*, November.
- Corps 2002 *Chief of Engineers Report, American River Watershed, California, Long-Term Study*, 5 November.
- Includes ecosystem restoration and dam safety at \$27.4 million and \$93 million, respectively, at 2001 price levels, and \$32.8 million and \$111.4 million, respectively, at 2006 price levels.
- Total cost of the authorized projects repriced to current price levels would be significantly greater at about \$1,390 million (\$655 million for Folsom Modification Project and \$737 million for Folsom Dam Raise Project).
- Plan elements to be accomplished under Reclamation Safety of Dams Program.
- Includes ecosystem restoration (continued increment) at \$59.8 million and permanent bridge increment at \$65.7 million.
- Annual costs from **Table ES-2**.

The combined first cost of the authorized projects at prices updated to 2006 price levels is \$540.2 million. In comparison, the total first cost for the RAP is \$957.7 million (less costs for dam safety) and the total cost for the Selected Plan portion of the RAP is \$842.4 million. The changes in total and project-related costs are due to changes in features attributed to each project and updating of costs to current price levels.

- **Change in Cost Allocation** – Table ES-6 shows a comparison of first costs between both project purposes for the authorized projects (at base condition price levels) and the RAP at October 2006 price levels.

TABLE ES-6
SUMMARY COMPARISON OF COST ALLOCATION BY PROJECT PURPOSE
INCLUDING DAM SAFETY FUNCTION (\$ MILLIONS)

Item	Authorized Projects ¹						Refined Authorized Projects (2006 Price Levels)					
	Folsom Modification (2003 prices)		Folsom Dam Raise (2001 prices)		Combined (at indicated prices)		6 STG Element (Corps Work Package)		DR Element and Other Features		Total	
	First Cost	% of Total	First Cost	% of Total	First Cost	% of Total	First Cost	% of Total	First Cost	% of Total	First Cost	% of Total
Flood Damage Reduction	214.1	100	128.2	52	342.3	74	683.0	100	165.2 ²	57	848.2	87
Ecosystem Restoration ³	0	0	27.4	11	27.4	6	0	0	59.8	20	59.8	6
Dam Safety	0	0	93.0	37	93.0	20	⁴	0	0	0	⁴	0
Permanent Bridge ⁵	–	–	–	–	–	–	0	0	65.7	23	65.7	7
Total	214.1	100	248.6	100	462.7	100	683.0	100	290.7	100	973.7	100
Key:	– = does not apply						STG = submerged tainter gate					
	DR = dam raise											

Notes:

1. Combination of costs at the time of authorization and/or last updated (Corps 2003 American River Watershed, California, Folsom Dam Modification Project Final Limited Reevaluation Report and Environmental Assessment/Initial Study – Outlet Works Modification only). Total combined first cost updated to October 2006 price levels would be \$540.2 million.
2. Includes features cost-shared at 65 percent Federal and 35 percent non-Federal, as well as temporary bridge cost, which includes a Corps-budgeted dam safety cost that is subject to Reclamation determination of which part, if any, may be subject to reimbursement by the Central Valley Project.
3. Continued increment in Refined Authorized Projects (RAP). Not a part of Selected Plan.
4. Reclamation Dam Safety Work Package to be accomplished under the Reclamation Safety of Dams Program.
5. Advanced construction increment and temporary bridge increment as part of RAP. Not a part of Selected Plan.

- **Changes in Cost Apportionment** – Table ES-7 compares the apportionment of first costs to Federal, non-Federal, and dam safety categories. All costs are shown at October 2006 price levels. The total costs portion of the Selected Plan for dam safety would be the responsibility of Reclamation under that agency's Safety of Dams Program. The apportionment of costs changed primarily because the 6 STG Element resolves hydrologic dam safety issues at Folsom; dam safety was originally addressed under the Folsom Dam Raise Project authority.

**TABLE ES-7
SUMMARY COMPARISON OF COST APPORTIONMENT BY PROJECT PURPOSE
INCLUDING DAM SAFETY**

Item	Authorized Projects ¹ (2006 price levels)					Refined Authorized Projects (RAP) (2006 price levels)				
	Federal ²	Non-Federal	Subtotal	Dam Safety ³	Total	Federal ²	Non-Federal	Subtotal	Dam Safety ³	Total
	Folsom Modification Project					6 STG Element (Corps Work Package)				
First Cost										
Flood Damage Reduction	157.6	84.9	242.5	–	242.5	444.0	239.0	683.0	–	683.0
Dam Safety	–	–	–	–	0	–	–	–	⁴	⁴
Total	157.6	84.9	242.5	–	242.5	–	239.0	683.0	–	683.0
Percent – Flood Damage Reduction	65	35	100	–	100	65	35	100	–	100
Percent – Total Cost	65	35	100	–	100	65	35	100	–	100
	Folsom Dam Raise Project					DR Element				
First Cost										
Flood Damage Reduction	100.4	53.1	153.5	–	153.5	115.2 ⁵	50.0 ⁵	165.2	–	165.2
Dam Safety	–	–	–	111.4	111.4	–	–	–	–	–
Ecosystem Restoration	21.3	11.5	32.8	–	32.8	38.9	20.9	59.8	–	59.8
Permanent Bridge	–	–	–	–	–	41.6	24.1	65.7	–	65.7
Total	121.7	64.6	186.3	111.4	297.7	195.7	95.0	290.7	–	290.7
Percent – Flood Damage Reduction	65	35	100	–	100	70 ⁵	30 ⁵	100	–	100
Percent – Total Cost	41	22	63	37	100	67	33	100	–	100
	Combined Projects					Total RAP				
First Cost										
Flood Damage Reduction	258.0	138.0	396.0	–	396.0	559.2	289.0	848.2	–	848.2
Dam Safety	–	–	–	111.4	111.4	–	–	–	⁴	⁴
Ecosystem Restoration	21.3	11.5	32.8	–	32.8	38.9	20.9	59.8	–	59.8
Permanent Bridge	–	–	–	–	–	41.6	24.1	65.7	–	65.7
Total	279.3	149.5	428.8	111.4	540.2	639.7	334.0	973.7	⁴	973.7
Percent – Flood Damage Reduction	65	35	100	–	100	66	34	100	–	100
Percent – Total Cost	52	28	79	21	100	66	34	100	–	100
Key:	– = does not apply DR = dam raise					STG = submerged tainter gate				

Notes:

1. The cost of the authorized projects repriced to current price levels would be significantly greater than shown in this table, at about \$1,390 million (\$655 million for the Folsom Modification Project and \$737 million for Folsom Dam Raise Project).
2. Corps of Engineers' budgetary responsibility.
3. Reclamation Safety of Dams Program item.
4. Plan elements to be accomplished under the Reclamation Safety of Dams Program.
5. Includes features cost-shared at 65 percent Federal and 35 percent non-Federal, as well as temporary bridge cost of \$21.5 million that is subject to Reclamation determination of which part, if any, may be subject to reimbursement by Central Valley Project water or power contractors.

- **Changes in Local Cooperation Requirements** – After the *PAC Report* is approved, and pending funding, design would proceed at Federal expense. This effort will be based on the PCAs between the Department of the Army and the non-Federal sponsors. The Department of the Army will enter into a PCA with the State of California and possibly SAFCA for the Folsom Modification Project, and with the State of California and SAFCA for the Folsom Dam Raise Project, at which time, the non-Federal share of design phase would be recouped. The Department of the Army and the City of Folsom have signed a separate PCA for Folsom Bridge.
- **Environmental Commitments** – The Reclamation *2007 Final Folsom Dam Safety and Flood Damage Reduction EIS/EIR* analyzed alternatives that address Reclamation dam safety objectives, as well as addressing Corps flood damage reduction objectives, as discussed in this *PAC Report*. In addition, an *EIS/EIR* for the Corps *2002 American River Watershed, California, Long-Term Study* fully evaluated potential impacts associated with a Folsom Dam raise of 3.5 feet. There has been no fundamental change in the types of impacts and required mitigation between the authorized projects and the RAP. Potentially significant adverse effects have been identified for geology and soils, traffic, water quality, fisheries, cultural resources, recreation, and noise. Implementation of proposed mitigation measures, as described in the *2007 EIS/EIR*, would reduce these impacts to less than significant levels. An environmental commitment of mitigation, to be implemented prior to, or concurrent with, construction activities, would be required to reduce potentially significant impacts for vegetation and wildlife, and special-status species.

ES.7 12 ACTIONS FOR CHANGE

The “12 Actions for Change” are a set of actions that the Corps will focus on to transform its priorities, processes, and planning. These actions were identified by the Corps and other investigative teams analyzing the performance of the Greater New Orleans Hurricane Protection System. They point to the need to transform the way the Corps serves the Nation and its Armed Forces. These 12 Actions were developed from that analysis and from other internal and external examinations of the Corps in the recent past. The Corps will use the 12 Actions to guide ongoing and future work, and to ensure the Corps is an organization that is adaptable, flexible, and responsive to the needs of the Nation. The 12 Actions for Change fall within three overarching themes: effective implementation of a comprehensive systems approach; communication; and reliable public service professionalism. The Folsom Modification Project and Folsom Dam Raise Project account for and contribute to the 12 Actions.

ES.8 CONCLUSIONS AND RECOMMENDATIONS

This evaluation provides pertinent conclusions and a list of Federal and non-Federal responsibilities for implementation of the Selected Plan, as included in the RAP. In addition, based on the findings presented in this report and supporting documents, the following recommendations are presented:

- Approval of the RAP as the plan that responds to the relevant authorities.
- Approval of dividing the 6 STG Element of the Selected Plan into two work packages that will be constructed by the Corps and Reclamation separately.
- Approval and forwarding to Congress a request for an increased new authorized cost for the Folsom Modification Project.
- Use of this document to support the PCAs for implementing those project features identified to be implemented by the Corps.
- Implement, as planned, separable ecosystem restoration project features.
- Continued implementation of the permanent Folsom Bridge Project.
- A further investigation of project features to address the significant residual flood risk to the greater Sacramento metropolitan area.

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ACRONYMS AND ABBREVIATIONS

	12 Actions	United States Army Corps of Engineers 12 Actions for Change
A	AEP	annual exceedence probability
	ARWI	American River Watershed Investigation
B	BMP	best management practice
C	CEQA	California Environmental Quality Act
	CERCLA	Comprehensive Environmental Response, Compensations, and Liability Act
	CFR	Code of Federal Regulations
	cfs	cubic feet per second
	CNP	conditional nonexceedence probability
	Corps	United States Army Corps of Engineers
	CVP	Central Valley Project
D	DR	dam raise
	DWR	California Department of Water Resources
E	EA	Environmental Assessment
	EDS&A	engineering, design, supervision, and administration
	EIR	Environmental Impact Report
	EIS	Environmental Impact Statement
	elevation xxx	elevation in feet above mean sea level
	EQ	environmental quality
	ESRD	Emergency Spillway Release Diagram
F	FEMA	Federal Emergency Management Agency
	FERC	Federal Energy Regulatory Commission
	FONSI	Finding of No Significant Impact
	FY	fiscal year
H	HEP	Habitat Evaluation Procedure
I	IS	Initial Study
J	JFP	Joint Federal Plan
	kW	kilowatt
L	LERRD	lands, easements, rights-of-way, relocations, and disposal areas

	LOP	level of protection
	LRR	Limited Reevaluation Report
M	M&I	municipal and industrial
	MCACES	microcomputer-aided cost engineering system
	MIAD	Mormon Island Auxiliary Dam
	MND	Mitigated Negative Declaration
	MOA	memorandum of agreement
	msl	mean sea level
N	NED	national economic development
	NEMDC	Natomas East Main Drainage Canal
	NEPA	National Environmental Policy Act
	NO _x	nitrogen oxides
O	OMRR&R	operate, maintenance, repair, replacement, and rehabilitation
	OSE	other social effects
P	P&G	Federal Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies
	PAC	Post Authorization Change
	PADD	Post Authorization Decision Document
	PASS	Project Alternative Solutions Study
	PCA	Project Cooperation Agreement
	PCWA	Placer County Water Agency
	PED	preconstruction, engineering, and design
	PL	Public Law
	PMF	Probable Maximum Flood
	PMS	Probable Maximum Storm
R	RAP	Refined Authorized Projects
	Reclamation	United States Department of the Interior, Bureau of Reclamation
	RED	regional economic development
S	SAFCA	Sacramento Area Flood Control Agency
	SIR	Supplemental Information Report
	SMAQMD	Sacramento Municipal Air Quality Management District
	STG	submerged tainter gate

	SWP	State Water Project
T	The Reclamation Board	The Reclamation Board of the State of California
U	USFWS	United States Fish and Wildlife Service
W	WRDA	Water Resources Development Act

CHAPTER 1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF REPORT

The purpose of this *Post Authorization Change (PAC) Report* is to document changes to two authorized projects: the Folsom Modification Project and the Folsom Dam Raise Project. Both projects share an objective of improving flood management on the lower American River, primarily through structural modifications to the existing Folsom Dam and appurtenant facilities. This *PAC Report* describes recommended changes to these authorized projects. It is anticipated that these changes will include reducing flood risk to areas along the American River, California, generally equivalent to the flood protection intended to be provided by combining the existing authorized Folsom Modification Project with the Folsom Dam Raise Project. It is also anticipated that the recommended changes will include provisions to meet the United States Department of the Interior, Bureau of Reclamation's (Reclamation), objective of passing the Probable Maximum Flood (PMF) at Folsom Dam. The updated information is to be presented as part of a single, joint project that addresses the objectives of the United States Army Corps of Engineers' (Corps) previously authorized flood damage reduction projects and Reclamation's dam safety concerns in a more efficient and effective manner.

This *PAC Report* is intended to accomplish the following:

- Demonstrate consistency of a refined project with existing congressional project authorizations
- Report on changes to project accomplishments and benefits, and Federal interest in a refined project
- Serve as a basis for new Project Cooperation Agreements (PCA), as needed, between the Federal Government and local sponsors
- Seek revision for authorized project cost for the Folsom Modification Project from Congress, as appropriate

As a companion to the *PAC Report*, Reclamation is preparing information to support designs and construction of dam safety improvements at Folsom Dam as part of Reclamation's Safety of Dams program. Some of the actions described in the Folsom Modification and Folsom Dam Raise projects are independent of, or in addition to, elements incorporated into the Refined Authorized Projects (RAP) described in **Chapter 4**; these include static and seismic modifications, which are being implemented solely by Reclamation and are considered part of the without-project condition for this PAC (see **Chapter 3**).

Reclamation, as the lead Federal agency, with participation by the Corps as a cooperating agency, has prepared the *2007 Final Folsom Dam Safety and Flood Damage Reduction Environmental Impact Statement/Environmental Impact Report (EIS/EIR)*, which discloses potential environmental impacts of action alternatives meeting Reclamation dam safety and Corps flood damage reduction objectives. The action alternatives include features that would

address Reclamation's dam safety objectives and the Corps' flood damage reduction objectives jointly, as well as features that would exclusively address dam safety, security, or flood damage reduction objectives. Project features are expected to be constructed jointly by Reclamation and the Corps. The increments or features that exclusively address dam safety or flood damage reduction would be constructed by the appropriate agencies. Since the *EIS/EIR* alternatives include additional features not addressed in the *PAC Report*, the *EIS/EIR* perspective contrasts with the *PAC Report*, resulting in a different without-project condition.

The Reclamation *Draft Folsom Dam Safety and Flood Damage Reduction EIS/EIR* (2006c) was circulated for public review, in conjunction with the draft Corps *PAC Report* (2006d), from 1 December 2006 until 26 January 2007. Public meetings were held on 9 and 10 January 2007 to allow the public and interested agencies the opportunity to provide oral and written comments. The Corps intends to adopt the *2007 Final Folsom Dam Safety and Flood Damage Reduction EIS/EIR* (Reclamation) to satisfy the requirements of the National Environmental Policy Act (NEPA) for changes to the originally authorized Folsom Modification and Folsom Dam Raise projects, as appropriate.

1.2 FOLSOM DAM AND RESERVOIR

Folsom Dam and Reservoir are located downstream from the confluence of the north and south forks of the American River, near the City of Folsom. Folsom Dam is located approximately 20 miles northeast of Sacramento. Folsom Reservoir has a capacity of 977,000 acre-feet with a surface area of 11,450 acres.

Originally authorized in 1944 as a 355,000-acre-foot flood control unit, Folsom Dam was reauthorized in 1949 as a larger, multiple-purpose facility. The Corps constructed Folsom Dam and transferred it to Reclamation for coordinated operation as an integral part of the Central Valley Project (CVP). Construction of the dam began in October 1948 and was completed in May 1956. Water was first stored in February 1955.

Folsom Dam is a concrete gravity dam 340 feet high and 1,400 feet long. The main section is flanked by two earthfill wing dams. The right wing dam is 6,700 feet long and 145 feet high, and the left wing dam is 2,100 feet long and also 144 feet high. In addition to the main section and wing dams are one auxiliary dam and eight smaller earthfill dikes. All retention structures have a crest elevation of 480.5 feet (National Geodetic Vertical Datum of 1929) above mean sea level (msl). The concrete dam has a solid parapet wall with a top elevation of 484 feet. (For the remainder of the report, all elevations given are in feet above or below msl, unless otherwise stated.) Folsom Reservoir's normal operating pool is 977,000 acre-feet with a reservoir water surface at elevation 466 feet. The design surcharge pool is 1,084,780 acre-feet at reservoir water surface elevation 475.4 feet, with 5.1 feet of existing freeboard.

1.3 BACKGROUND

In February 1986, major storms in Northern California caused record flood flows in the American River basin. Record high outflows from Folsom Dam and Reservoir, together with high flows in the Sacramento River, resulted in water levels rising above the design freeboard of

levees protecting the Sacramento area. It was clear after the 1986 storm event that Sacramento was a city at significant risk of flooding, and major efforts would be needed to reduce the potential of catastrophic flooding and damages. Soon after the 1986 flood, feasibility-scope investigations were initiated by the Corps with support from The Reclamation Board of the State of California (The Reclamation Board) and local cities and counties (and later, from the Sacramento Area Flood Control Agency, or SAFCA). An initial *American River Watershed Investigation (ARWI) Feasibility Report and EIS/EIR* was completed by the Corps in December 1991. This report confirmed the flood threat, identified potential alternatives to help address flooding problems, and surfaced possible dam safety issues at Folsom Dam. As described below, this report resulted in congressional authorization in 1993 for improvements to levees in the Natomas area of Sacramento and guidance on further studies. Later supplements to the *1991 ARWI Feasibility Report* have resulted in further recommendations for improvements to local levees, the operation of Folsom Dam and Reservoir, and flood warning and evacuation planning. However, a residual need remains to provide higher levels of flood protection to the Sacramento area.

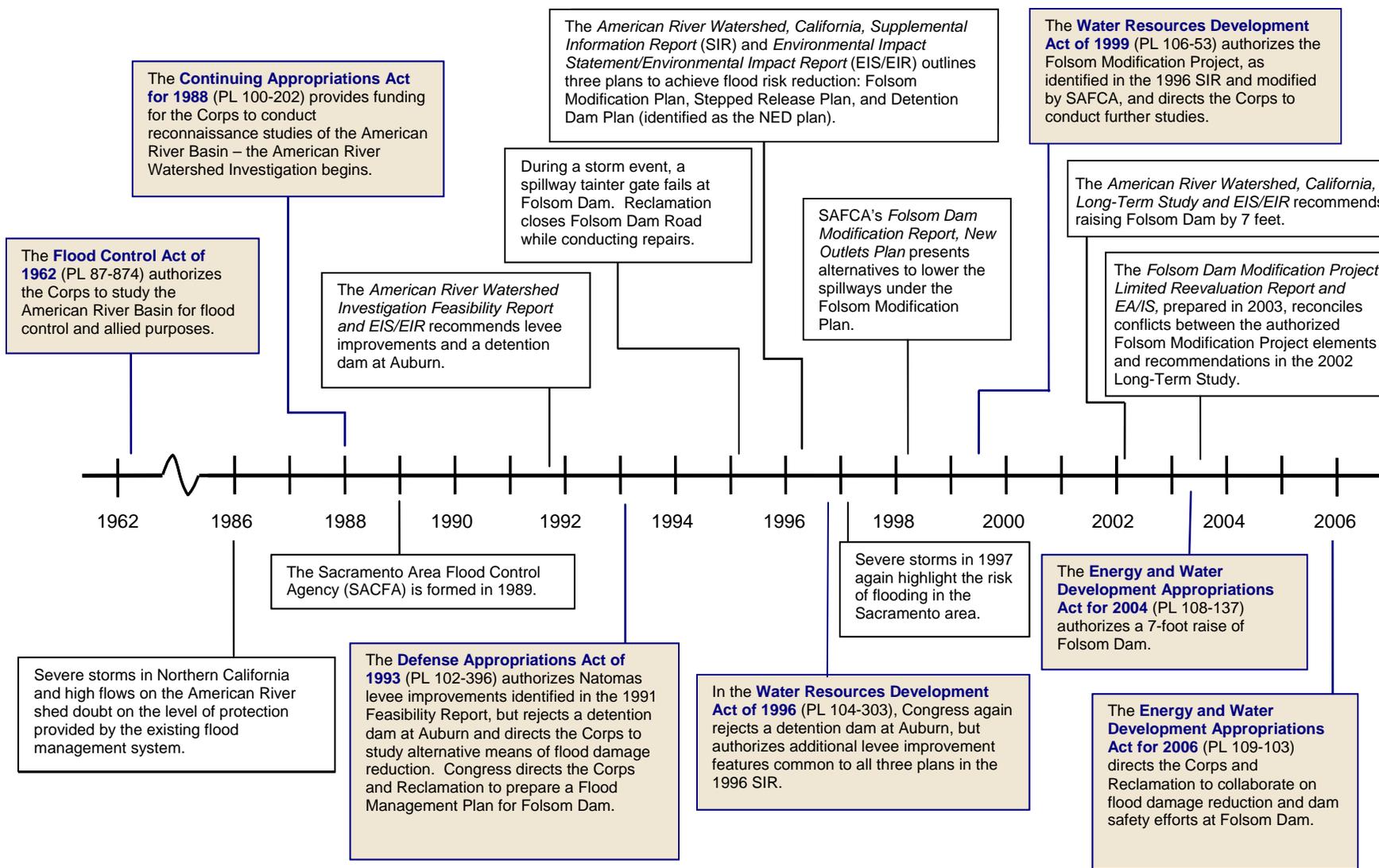
The Water Resources Development Act (WRDA) of 1999, along with supplemental documentation, identified potential modifications to Folsom Dam that would allow operators to achieve the objective release of 115,000 cubic feet per second (cfs) earlier in a flood event, and enhance the use of surcharge storage space in the reservoir through modifications to the emergency spillway and related operational changes; the project was termed the Folsom Modification Project. In the Energy and Water Development Appropriations Act of 2004, Congress authorized a plan to raise Folsom Dam; the Folsom Dam Raise Project would provide flood benefits while also resolving certain dam safety issues associated with passing the PMF. Because of delays and technical problems associated with implementing the Folsom Modification Project authorized in WRDA 1999, compatibility with the potential to raise Folsom Dam, and ongoing dam safety issues at Folsom, an emphasis now exists on considering these individual projects together.

1.4 HISTORY

This section summarizes the history of flood management, studies, and actions in the American River basin leading to preparation of this *PAC Report*. Discussion begins with major flood damage reduction actions following the floods of February 1986.

1.4.1 1986 Through 1993 Defense Appropriations Act

It is estimated that major sections of levees along the American and Sacramento rivers would likely have failed if the storms of February 1986 had lasted longer. These failures would potentially have resulted in significant loss of life, immediate loss of billions of dollars in property damages, and additional billions of lost dollars in regional impacts and restoration costs. The 1986 storms raised concerns over the adequacy of the existing flood damage reduction system protecting Sacramento. These concerns led to a series of investigations and subsequent authorizations of projects, beginning with the ARWI, to help increase the level of flood protection to the Sacramento area and address safety issues at Folsom Dam. A time line of pertinent studies, authorizations, and appropriations is included in **Figure 1-1**.



**FIGURE 1-1
TIME LINE OF PERTINENT STUDIES, AUTHORIZATIONS, AND APPROPRIATIONS**

The first major document addressing flood management on the American River was the *ARWI Feasibility Report*, dated December 1991 (Corps). This report included a decision document, *EIS*, and *EIR*. The *EIS/EIR* was completed to satisfy both the requirements of NEPA and the California Environmental Quality Act (CEQA).

Major conclusions of the *1991 ARWI Feasibility Report* were that (1) a serious flood threat existed for the Sacramento area from the American and Sacramento rivers, (2) a series of alternative plans was capable of helping to reduce the threat of flooding that included improvements to the levee system, modification of Folsom Dam and Reservoir, and new upstream storage, and (3) strong non-Federal support existed for implementing these improvements. The plan recommended in the *1991 ARWI Feasibility Report* was a flood detention dam on the North Fork American River and levee improvements in the Natomas area of Sacramento sufficient to control runoff from storms occurring, on average, about once every 200 years. This level of protection (LOP) was chosen by The Reclamation Board and SAFCA as a minimum of flood protection that they would support.

Project Performance Statistics

Performance of flood projects can be characterized in different ways. Flood project performance was historically characterized by the Corps using a “level of protection” concept. Level of protection (LOP) expresses the average return period, in years, of the largest storm event that can be safely accommodated by a project. A 100-year LOP means that on average, over a very long period of time, flooding would happen about once every 100 years.

More recently, the Corps has adopted risk-based analysis to more accurately describe flood performance and risk. The following terms are typical outputs of risk-based analysis:

- **Annual exceedence probability (AEP)** – AEP expresses the probability that a project will perform satisfactorily given any storm that may occur. It is the statistical probability that a specific capacity or target stage will be reached or exceeded in any given year, expressed as a chance or percent probability.
- **Conditional non-exceedence probability (CNP)** – CNP expresses estimated project reliability given the occurrence of a storm of a specific frequency - for example, the probability that a project will safely contain a storm event with a 2 percent chance of occurring in any given year. For levees, CNP includes both the chance of capacity exceedence and the chance of failure at a lesser stage.

Many studies and reports prepared for the American River Watershed Investigation prior to the mid-1990s estimated project performance in terms of a single event or LOP. For this reason, LOP is often used in the description of previously authorized projects discussed in this *PAC Report*. However, current risk-based techniques are used in describing and comparing current alternatives or proposed changes to the authorized projects. While LOP and risk-based measures such as AEP and CNP seem similar, they cannot be directly compared.

This PAC Report

Characterizing flood threat, or project performance, for analytical purposes as a single event is not allowed under current Corps risk-based guidance. For example, the 100-year event (single design event LOP) is distinct from the 1 in 81 chance in any given year (risk-based analysis project performance under Corps criteria). However, the non-Federal sponsors for the authorized projects have found that describing flood conditions in Sacramento in terms of a single event is a convenient way of imparting information about project performance. The non-Federal sponsors have established safely passing the 200-year computed design event as a minimum objective of any potential project change considered. Accordingly, efforts are made in this *PAC Report* to characterize the ability of alternatives considered for achieving the non-Federal objective as well as defining performance in terms consistent with Corps guidance.

After completion and processing of the *1991 ARWI Feasibility Report*, Congress provided guidance relating to the American River study in Section 9159 of the 1993 Defense Appropriations Act (see Existing Project Authorizations section below). As shown in **Figure 1-1**, this Act authorized construction of the Natomas features described in the *1991 ARWI Feasibility Report*. In addition, the Act directed that additional studies and consulting activities be undertaken to further develop a flood protection plan for Sacramento.

1.4.2 1991 American River Watershed Investigation Feasibility Report Through Water Resources Development Act of 1996

Following completion of the *1991 ARWI Feasibility Report*, and resulting Congressional guidance in the 1993 Defense Appropriations Act, additional studies were undertaken to further review the flood problems and develop additional solutions. This second major study effort was documented by the Corps, The Reclamation Board, and SAFCA in the March *1996 American River Watershed Project, California, Supplemental Information Report* (1996 SIR). This report included a decision document and *EIS/EIR*.

Major conclusions of the *1996 SIR* were similar to the *1991 ARWI Feasibility Report*: (1) a serious flood threat existed for the Sacramento area, (2) a series of alternative plans existed that were capable of helping reduce the threat of flooding, and (3) strong non-Federal support existed for implementing these improvements. In addition, it was described in the *1996 SIR* that Folsom Dam could only pass between about 70 to 75 percent of the PMF. Even though flooding would be severe if Folsom Dam could pass the PMF, it would be increasingly catastrophic if the dam were overtopped during such an event. Following is a summary of the three basic alternatives described in the *1996 SIR*:

- **Folsom Modification Plan** – This plan was formulated to achieve the greatest benefits to flood damage reduction while minimizing impacts to existing systems and environmental resources. Its primary features included (1) a minor increase in variable flood control space in Folsom Reservoir, (2) modifications to the main spillway, spillway gates, and outlets at Folsom Dam, (3) modifications to use of surcharge storage in Folsom Reservoir, (4) construction of a slurry wall in about 24 miles of existing levees along the lower American River to increase the reliability of the 115,000 cfs objective release, and (5) strengthening of about 12 miles of levees along the Sacramento River to help protect the Natomas area. At that time, it was estimated that this plan would provide about a 1 in 180 annual exceedence probability.
- **Folsom Stepped Release Plan** – This plan was formulated to provide at least a 200-year LOP goal, identified by The Reclamation Board and SAFCA, but without new upstream storage or any additional increase in seasonal flood space in Folsom Reservoir. Its primary features included (1) modifying the main spillway, spillway gates, and outlets at Folsom Dam, (2) modifying use of surcharge storage in Folsom Reservoir, (3) increasing the objective release from Folsom Dam to 145,000 cfs and 180,000 cfs, depending on reservoir inflows, (4) constructing levee, channel, and other improvements, including a slurry wall in existing levees along the lower American River to handle the increased objective release, (5) modifying the Sacramento Weir and Bypass and Yolo Bypass to accommodate the increased objective release, (6) strengthening about 12 miles of levees

along the Sacramento River to help protect the Natomas area, and (7) constructing recreation and environmental restoration facilities along the American River Parkway. At that time, it was estimated that this plan would provide about a 1 in 235 annual exceedence probability.

- **Flood Detention Dam Plan** – This plan was formulated to provide a very high level of flood protection to Sacramento. Its primary features included (1) constructing a flood detention dam on the North Fork American River, (2) constructing a slurry wall in about 24 miles of existing levees along the lower American River to increase the reliability of the 115,000 cfs objective release, (3) strengthening about 12 miles of levees along the Sacramento River to help protect the Natomas area, and (4) reducing the flood control storage space in Folsom Reservoir to pre-1995 conditions (returning the flood space to 400,000 acre-feet). At that time, it was estimated that this plan would provide about a 500-year LOP.

The plan recommended in the *1996 SIR* was the Flood Detention Dam Plan. It was also noted in the *1996 SIR* that a decision on how to best resolve the PMF issue at Folsom would be deferred until an independent decision was made on a long-term flood protection project for Sacramento. This is because it was determined that the scope of a resolution of the PMF issue would greatly depend on the long-term project selected for implementation.

After completion and processing of the *1996 SIR*, Congress authorized only a portion of the recommended plan. The authorized elements became known as the “Common Features” because they consisted of levee and other flood system improvements common to all three of the alternatives put forth in the *1996 SIR*. Authorization for the Common Features was contained in Section 101 of WRDA 1996 (see Existing Project Authorizations section below). The Common Features include constructing (1) 24 miles of slurry wall in the levees along the lower American River, (2) approximately 12 miles of levee modifications to help protect the Natomas area, (3) three telemetered stream flow gages upstream from Folsom Reservoir, and (4) modifications to the flood warning system along the lower American River.

1.4.3 Water Resources Development Act of 1996 Through 2002 Long-Term Study

While efforts moved forward to further develop and implement the Common Features, discussions continued on ways to achieve higher levels of flood protection for Sacramento. These discussions and related activities culminated in Congressional action as part of WRDA 1999 (see Existing Project Authorizations section below). WRDA 1999 included two applicable authorizations (1) Folsom Dam Modifications and (2) American River and Sacramento River levee improvements.

- **Folsom Dam Modifications** – This is the fundamental authorization for the Folsom Modification Project. Section 101(a) of WRDA 1999 included five major actions. The first was (1) modification of Folsom Dam and appurtenant facilities generally, as described for the Folsom Modification Plan in the *1996 SIR* (see above), but as further modified by a subsequent report by SAFCA titled *Folsom Dam Modification Report, New Outlets Plan*, dated March 1998. The authorization also included (2) reducing the variable flood space in Folsom reservoir, (3) delegating responsibility to the Secretary of

the Interior to make up any lost water due to a variable flood control space interim operation, (4) defining what significant impacts to recreation due to flood operations means at Folsom, and (5) updating a flood management plan authorized in the 1993 Defense Appropriations Act to consider forecast-based operations at Folsom.

- **American and Sacramento River Levee Improvements** – Section 366 of WRDA 1999 further modifies the WRDA 1996 authorization with specific direction related to levee modifications. As shown in the authorization language (see Project Authorizations section below), this authorization identified levee improvements at various locations along the American River, Natomas Cross Canal, and Sacramento River. Work directed in this section of WRDA is important to the current effort because it would allow for Folsom Dam to increase outflows to 160,000 cfs for a sustained time (currently being evaluated) without a high probability of levee failure along the lower American River.

The Corps undertook detailed studies to refine project features of the Folsom Modification Project authorized in WRDA 1999. The Corps updated features of the Folsom Modification Project to provide the maximum flood risk reduction in a manner consistent with the Folsom Dam Raise Project, as described in the Corps *2002 American River Watershed, California, Long-Term Study* (2002 Long-Term Study). Specifically, refinements were needed to resolve conflicts between project features relating to gate modifications. The results of these efforts were published in the Corps *2003 Folsom Dam Modification Project Final Limited Reevaluation Report and Environmental Assessment/Initial Study* (2003 LRR).

While detailed efforts continued to develop a functional plan to modify Folsom Dam under Section 101 of WRDA 1999, and to implement actions defined in Section 366 of WRDA 1999, the Corps, The Reclamation Board, and SAFCA continued to formulate plans for higher levels of flood protection in Sacramento. These efforts culminated in the *2002 Long-Term Study*, dated February 2002. This is an integrated *Feasibility Report* (combined decision document and *EIS/EIR*). Major conclusions of this report were that (1) a serious residual flood threat remains to the Sacramento area, (2) there continues to be a series of alternative plans capable of further reducing the threat of flooding, (3) net benefits for an upstream detention dam would likely continue to exceed those of other alternatives, and (4) strong non-Federal support continues to exist for implementing improvements in flood damage reduction. The *2002 Long-Term Study* did not include a specific recommendation. However, on 5 November 2002, based on findings in the *2002 Long-Term Study Feasibility Report*, a *Chief of Engineers Report* was signed that recommended a 7-foot raise in the height of Folsom Dam. This dam raise, which included provisions for making advanced releases from Folsom Reservoir to create additional flood space, would, in addition to reducing the chance of flooding to about 1 in 213 in any year, also resolve hydrologic dam safety issues at Folsom. Without the advanced release provision, the project would reduce the risk of flooding to about 1 in 164 in any year. The project would also include enlarging the spillway at L.L. Anderson Dam, implementing ecosystem restoration and habitat improvement along the American River, and building a temporary bridge just downstream from Folsom Dam.

A project to implement the above *2002 Long-Term Study*, as defined in the *2002 Chief of Engineers Report*, was authorized by Congress under Section 128 of the Energy and Water

Development Appropriations Act of 2004 (see Existing Project Authorizations section below). This is also the fundamental authorization for the Folsom Dam Raise Project.

1.4.4 Subsequent Guidance

As part of the Energy and Water Development Appropriations Act of 2006 (Public Law (PL) 109-103), Congress provided further guidance on implementation of the Folsom Dam permanent bridge. Also as part of the 2006 Act, Congress directed that the Secretary of the Army and Secretary of the Interior collaborate on authorized activities to maximize flood damage reduction improvements and dam safety needs at Folsom Dam. This authorization has been instrumental for both the Corps and Reclamation to work together in developing a single project that addresses both flood damage reduction and dam safety in an effective and efficient manner. Specifically, PL 109-103 directed the Secretaries to consider reasonable modifications to the existing authorized activities, including an auxiliary spillway.

1.5 EXISTING PROJECT AUTHORIZATIONS

This section summarizes relevant congressional authorizations, appropriations, and guidance related to flood damage reduction and dam safety projects at Folsom Dam.

1.5.1 Flood Control Act of 1944

The Flood Control Act of 1944 (PL 78-534) authorized construction of Folsom Dam, as proposed by the State of California Water Plan. Under this authorization, Folsom Dam was to be constructed as a 335,000-acre-foot reservoir for the purpose of flood control, with outlet facilities for future power generation. This authorization was expanded in 1949 under the American River Basin Development Act. The 1944 Act states the following:

The Folsom Reservoir on the American River, California, is hereby authorized substantially in accordance with the plans contained in House Document Numbered 649, Seventy-eighth Congress, Second Session, with such modifications thereof as in the discretion of the Secretary of War and the Chief of Engineers may be advisable, at an estimated cost or \$18,474,000.

1.5.2 American River Basin Development, California Act of 1949

The American River Basin Development, California Act of 1949 (PL 81-356) provided final authorization for Folsom Dam and Reservoir as a 1,000,000-acre-foot facility. The Act states the following:

The Central Valley project, California, authorized by section 2 of the Act of Congress of August 26, 1937 (50 Stat. 850), is hereby reauthorized to include the American River development as hereinafter described, which development is declared to be for the same purposes as described and set forth in the Act of congress of August 26, 1937 (50 Stat. 850).

Sec. 2. The American River development shall consist of: Folsom Dam and Reservoir having a storage capacity of approximately one million acre-feet, to be constructed by the Corps of Engineers at such point below the confluence of the North Fork and the South Fork of the American River near the city of Folsom, California, as the Secretary of the Army and the Chief of Engineers after consultation with the Bureau of Reclamation and other appropriate State, Federal, and local agencies may find most advisable; and the following features for the development and use of water, to be constructed, operated, and maintained by the Secretary of the Interior through the Commissioner of Reclamation: A hydroelectric power plant with a generating capacity of approximately one hundred and twenty thousand kilowatts, and necessary hydroelectric afterbay power plants and necessary electric transmission lines to the nearest practical interconnection with the Central Valley project transmission system; a storage dam with a capacity of approximately forty thousand acre-feet to be located on Sly Park Creek, a tributary of the North Fork of Consumnas River, with necessary appurtenant works, including a diversion dam on Camp Creek, tunnel, conduit, and canals for the delivery of water to lands in El Dorado County, and incidental works appurtenant thereto. The Secretary of the Interior, through the Bureau of Reclamation, is hereby further authorized and directed to conduct the necessary investigations, surveys, and studies for the purpose of developing plans for disposing of the water and electric power which would be made available by the project, including studies of such supplemental works and equipment as may be required to maintain a firm supply of electric energy, and render reports thereon which would set forth the works required for such disposition, together with findings as to their engineering and financial feasibility, including a study of the water resources and requirements of the entire American River watershed and the areas serviceable therefrom, and particularly of a diversion canal at the highest feasible level extending southerly from Folsom Reservoir as will permit the maximum beneficial use of the water for irrigation of the lands lying under said canal in El Dorado and Sacramento Counties; a diversion canal at the highest feasible level for the purpose of securing the maximum beneficial use of the water in Placer County extending northerly from such reservoir to a point on the Bear River in the vicinity of Sheridan, California, and a conduit or conduits with necessary pumping plants and supplemental works extending from the most feasible diversion point on the Central Valley project, California, to serve lands and municipalities in Contra Costa, Alameda, Santa Clara, San Joaquin, and San Benito Counties.

Nothing in this Act shall be construed by implication or otherwise as an allocation of water and in the studies for the purposes of developing plans for disposal of water as herein authorized the Secretary of the Interior shall make recommendations for the use of water in accord with State water laws, including but not limited to such laws giving priority to the counties and areas of origin for present and future needs.

Said studies and the reports thereon shall be submitted to the proper State authorities under the procedure provided for in the Flood Control Act of 1944 (Public Law 534, Seventy-eighth Congress, second session).

Folsom Dam and Reservoir, upon completion of construction by the Corps of Engineers, to the extent where water from said reservoir is ready to be turned either into the power plant or conduits, shall be transferred to the Bureau of Reclamation for operation and maintenance under the supervision of the Secretary of the Interior together with the other features of the American River development herein authorized for construction by the Bureau of Reclamation, all in accordance with the Federal reclamation laws (Act of June 17, 1902, 32 Stat. 388, and Acts amendatory thereof or supplementary thereto). After the transfer as provided herein, the dam shall be operated for flood control in accordance with criteria established by the Secretary of the Army as provided for in section 7 of the Flood Control Act of 1944 (Public Law 534, Seventy-eighth Congress, second session).

Sec. 3. In locating and designing the works authorized for construction by section 2 of this Act the Secretary of the Army and the Chief of Engineers, the Secretary of the Interior and the Commission of Reclamation shall give due consideration to the report set forth in Bulletin Numbered 26 of the Division of Water Resources of the Department of Public Works of the State of California, and shall consult the local interests to be affected by the construction and operation of said works, through public hearings or in such other manner as in their discretion may be found best suited to a maximum expression of the views of such local interests.

Sec. 4. The Secretary of the Interior is directed to cause the operation of said works to be coordinated and integrated with the operation of existing and future features of the Central Valley project in such manner as will effectuate the fullest and most economic utilization of the land and water resources of the Central Valley project of California for the widest possible public benefit.

Sec. 5. There are hereby authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, such sums as are necessary to carry out the purposes of this Act.

1.5.3 Flood Control Act of 1962

The basic authority for the ARWI is in the Flood Control Act of 1962, PL 87-874. As a result of this study, the Common Features, Folsom Modification, and Folsom Dam Raise projects were developed and authorized. The 1962 authorization states the following:

The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the following named localities.....Sacramento River Basin and streams in northern California

draining into the Pacific Ocean for the purposes of developing, where feasible, multipurpose water resource projects, particularly those which would be eligible under the provisions of title III of Public Law 85-500.

1.5.4 Reclamation Safety of Dams Act of 1978 and 1984 Amendment

Reclamation's Safety of Dams Program was officially implemented by PL 95-578 (1978), as amended by PL 98-404 (1984). Sections 1 through 4, which deal with the general provisions of the Act, are included below:

To authorize the Secretary of the Interior to construct, restore, operate, and maintain new or modified features at existing Federal reclamation dams for safety of dams purposes.

Be it enacted by the Senate and the House of Representatives of the United States of America in Congress assembled, That this Act shall be cited as the "Reclamation Safety of Dams Act of 1978."

Sec. 2. In order to preserve the structural safety of Bureau of Reclamation dams and related facilities, the Secretary of the Interior is authorized to perform such modifications as he determines to be reasonably required. Said performance of work shall be in accordance with the Federal reclamation laws (Act of June 17, 1902, 32 Stat. 388, and Acts amendatory or supplementary thereto).

Sec. 3. Construction authorized by this Act shall be for purposes of dam safety and not for the specific purposes of providing additional conservation storage capacity or of developing benefits over and above those provided by the original dams and reservoirs. Nothing in this Act shall be construed to reduce the amount of project costs allocated to reimbursable purposes heretofore authorized.

Sec. 4. (a) Costs heretofore or hereafter incurred in the modification of structures under this Act, the cause of which results from age and normal deterioration of the structure or from nonperformance of reasonable and normal maintenance of the structure by the operating entity shall be considered as project costs and will be allocated to the purposes for which the structure was authorized initially to be constructed and will be reimbursable as provided by existing law.

With respect to the \$100,000,000 authorized to be appropriated the Reclamation Safety of Dams Act of 1978, costs heretofore, or hereafter incurred in the modification of structures under this Act, the cause of which results from new hydrologic or seismic data or changes in the state-of-the-art criteria deemed necessary for safety purposes shall be non-reimbursable and non-returnable under the Federal Reclamation law.

With respect to the additional \$650,000,000 authorized to be appropriated in The Reclamation Safety of Dams Act Amendments of 1984, costs incurred in the modification of structures under this Act, the cause of which results from new

hydrologic or seismic data or changes in state-of-the-art criteria deemed necessary for safety purposes, shall be reimbursed to the extent provided in this subsection.

(1) Fifteen percent of such costs shall be allocated to the authorized purposes of the structure, except that in the case of Jackson Lake Dam, Minidoka Project, Idaho-Wyoming, such costs shall be allocated in accordance with the allocation of operation and maintenance charges.

(2) Costs allocated to irrigation water service and capable of being repaid by the irrigation water users shall be reimbursed within 50 years of the year in which the work undertaken pursuant to this Act is substantially complete. Costs allocated to irrigation water service which are beyond the water users' ability to pay shall be reimbursed in accordance with existing law.

(3) Costs allocated to recreation or fish and wildlife enhancement be reimbursed in accordance with the Federal Water Project Recreation Act (79 Stat. 213), as amended.

(4) Costs allocated to the purpose of municipal, industrial, and miscellaneous water service, commercial power, and the portion of recreation and fish and wildlife enhancement costs reimbursable under the Federal Water Project Recreation Act, shall be repaid within 50 years with interest. The interest rate used shall be determined by the Secretary of the Treasury, taking into consideration average market yields on outstanding marketable obligations of the United States with remaining periods to maturity comparable to the applicable reimbursement period during the month preceding the fiscal year in which the costs are incurred. To the extent that more than one interest rate is determined pursuant to the preceding sentence, the Secretary of the Treasury shall establish an interest rate at the weighted average of the rates so determined.

(d) The Secretary is authorized to negotiate appropriate contracts with project beneficiaries providing for the return of reimbursable under this Act: Provided, however, That no contract entered into pursuant to this Act shall be deemed to be a new or amended contract for the purposes of section 203(a) of Public Law 97-293.

1.5.5 Continuing Appropriations Act for 1988

Direction for the Corps reconnaissance study was included in the 1987 Appropriations Act (PL 99-591). Direction for additional study, which became the ARWI, was included in committee language accompanying the fiscal year (FY) 1988 Continuing Appropriation Act (PL 100-202, dated, 22 December 1987):

...The conferees are aware that recent information presented by the Corps and the Bureau in a series of three fact-finding hearing in Sacramento reveals that the region may be under a greater threat from serious flooding than was previously believed. It is also clear that any improvement which may be made to increase the

level of flood control on the American River may not by itself alleviate the flood danger to the northern part of Sacramento County east and west of the Natomas East Main Drainage Canal, which includes the Natomas area and the Dry Creek watershed. The conferees therefore urge the Corps of Engineers to examine potential flood control improvement to the Natomas and the Dry Creek watershed concurrent to the Corps' evaluation of improving protection on the American River. The conferees further recognized that there may be additional flood protection afforded by a primarily peak-flow flood control facility (the so-called "dry dam") on the North Fork of the American River above Folsom. The conferees therefore direct the Corps of Engineers to include further assessments of the relationship between such a peak-flow flood control facility and the operation of Folsom Dam as they may pertain to incidental water, power and recreational benefits. Within this assessment, the Corps should include its analysis of the current and projected water supply demands in the American River basin.

1.5.6 Defense Appropriations Act of 1993

Authorization for the American River Watershed Project was provided in 1992 in Section 9159 of the Defense Appropriations Act for FY 1993 (PL 102-396), as follows:

SEC. 9159. SACRAMENTO AND AMERICAN RIVERS FLOOD CONTROL PROJECT, CALIFORNIA: PRECONSTRUCTION ENGINEERING AND DESIGN; NATOMAS LEVEE CONSTRUCTION.

(a) CONTINUATION OF ENGINEERING AND DESIGN. – The Secretary of the Army is directed to reevaluate the project for flood control and recreation, Sacramento and American Rivers, California, as described in the feasibility report of the Chief of Engineers, entitled the "American River Watershed Investigation," dated July 1, 1992, subject to the provisions of this section.

(b) NATOMAS LEVEE FEATURES. –

(1) CONSTRUCTION. – The Secretary of the Army is authorized and directed to construct the Natomas levee features of the project as described in the feasibility report referred to in subsection (a), subject to entering into appropriate local cost-sharing agreements from the non-Federal sponsors of the project, provided that such construction does not encourage the development of deep flood plains.

(2) CREDIT FOR CERTAIN NON-FEDERAL WORK. – The Secretary of the Army shall credit against the non-Federal share of the cost of construction under paragraph (1), or reimburse the non-Federal sponsors, for any planning and construction work performed by the non-Federal sponsors to protect the Natomas area which is commenced prior to the Army Corps of Engineers' receiving appropriations to initiate such construction and which is consistent with the feasibility report referred to in subsection (a).

(c) GATING AND EXPANDABILITY REPORT. – In carrying out the reevaluation described in subsection (a) and in consultation with the State of California, the local non-Federal sponsors, and other interested groups, the Secretary of the Army is directed within one year after the date of the enactment of this Act, to submit to the Committee on Public Works and Transportation of the House of Representatives and the Committee on Environment and Public Works of the Senate a report which:

(1) analyzes the outlet design of the flood control dam proposed as a feature of the project referred to in subsection (a), including an analysis of various configurations and capacities of gates (including a completely ungated configuration, a partly ungated configuration, emergency gates, operational gates, or a combination thereof) to ensure the safety of the flood control dam itself, to provide for system safety, to minimize small event flooding of the Auburn Canyon, and to minimize damages to the vegetation, soils, and habitat in the canyon; and

(2) includes further analysis as to whether any feature or characteristic of the flood control dam would preclude its efficient expansion for water, power, or other purposes, and whether the design would create any greater difficulty for an expanded dam to meet seismic requirements than a multipurpose dam would otherwise encounter, and further assessment of the extra costs attributable to installation into an expanded dam such penstocks, operational gates and other features of a multipurpose dam which would not be included in an expandable dam lacking advanced features.

(d) REPAYMENT OF DESIGN WORK. – The non-Federal share of the costs of the design and reevaluations described in subsection (a) shall not be required to be repaid until after the execution of the agreement required by section 103(j) of the Water Resources Development Act of 1986 and immediately prior to the initiation of construction of the project or the appropriate separable element.

(e) SPECIAL EVALUATION REPORTS. –

(1) In carrying out the reevaluation described in subsection (a) and in consultation with the State of California, the local non-Federal sponsors, and other interested groups, the Secretary of the Army shall perform further evaluation of, and, within twelve months after the date of the enactment of this Act, submit to the Committee on Public Works and Transportation of the House of Representatives and the Committee on Environment and Public Works of the Senate a report on, other features and operational procedures that should be implemented in a coordinated plan to provide flood protection sufficiently high for a major urban area subject to risk of frequent floods causing great economic, environment, and social damage. The report shall specifically address, at minimum, the following:

(i) The reliability, costs, environmental impacts, and public safety risks associated with increasing objective flows in the Lower American River

above the 115,000 cubic feet per second design capacity, as well as the costs and impacts of permanent reoperation of Folsom Reservoir at different levels of increased flood storage, including the appropriate alternatives for sharing costs associated with Folsom Dam.

(ii) The costs and benefits of lowering the spillway at Folsom Dam in order to improve the dam's ability to pass a maximum probable flood and improve its operational flexibility for flood control.

(iii) The costs and benefits of transferring flood control obligations from the Folsom Reservoir to a new flood control facility at Auburn, increasing the Folsom Reservoir's capability for water supply.

(iv) The costs and benefits of utilizing existing and increased flood space in the upstream reservoirs to enhance the flood control capability at Folsom Dam and of establishing offstream storage in Deer Creek, alone or in combination with the alternatives referenced in paragraphs (i) and (ii) of this subsection.

(2) The Secretary of the Army shall further consult with, and solicit the views of, the National Academy of Engineering on the contingency assumptions, hydrological methodologies used in the preparation of the American River Project, and other engineering assumptions and methodologies influencing the scope and formulation of the American River flood control alternatives. Such consultation shall also solicit the views of the National Academy of Engineering on the merits of normalized use of reservoir surcharge space in a flood control regime for Sacramento. Any opinions with respect to these and other issues rendered by the National Academy of Engineering shall be made available to the public and included in the reports transmitted to Congress pursuant to this section.

(f) FOLSOM DAM. –

(1) IN GENERAL. – Congress recognizes the urgency of ensuring that Folsom Dam is operated correctly, safely, efficiently and prudently for flood control purposes. The Secretary of the Interior (in consultation with the Sacramento Flood Control Agency and the Secretary of the Army) shall operate Folsom Dam to provide the maximum level of flood protection.

(2) FLOOD MANAGEMENT PLAN. – (A) Not later than one year after the date of enactment of this ACT, and consistent with existing law, the Secretaries of the Army River and Folsom Dam that ensures prompt, reliable, and full utilization of the flood control capability at Folsom Dam and other existing water resources development projects located in the American River watershed, California. Consistent with existing law, the plan should maximize the flood control capability within Folsom Dam's flood space reservation. The plan shall also identify opportunities and make recommendations to improve the stream gauge network and flood forecast system for the upper American River watershed.

The plan should also recognize that reservoir releases need to be made as quickly as possible in anticipation of incoming flow and in accordance with existing documents: “1959 Reservoir Regulations, Appendix II, the Corps Master Manual, Sacramento River Basin Reservoir Regulation Manual, Folsom Dam/Reservoir, American River: October 1, 1956,” revised March 1959.

(B) The components of the inflow forecasting system and revised flood release rules and practices, and hydrographic and flood frequency models shall give due deference to the National Academy of Engineering findings developed pursuant to subsection (e)(2) of this section.

1.5.7 Water Resources Development Act of 1996

Corps authorization for the American River Watershed Common Features project is provided by Section 101 of WRDA 1996 (PL 104-303). Pertinent sections of this authorization are provided below. Additional guidance is contained in WRDA 1999.

SEC. 101. Project Authorizations

(a) PROJECTS WITH CHIEF’S REPORTS. Except as provided in this subsection, the following projects for water resources development and conservation and other purposes are authorized to be carried out by the Secretary substantially in accordance with the plans, and subject to the conditions, described in the respective reports designated in this subsection:

(1) American River Watershed, California.

(A) IN GENERAL. The project for flood damage reduction, American and Sacramento Rivers, California: Report of the Chief of Engineers, dated June 27, 1996, at a total cost of \$56,900,000, with an estimated Federal cost of \$42,675,000 and an estimated non-Federal cost of \$14,225,000, consisting of

(i) approximately 24 miles of slurry wall in the levees along the lower American River;

(ii) approximately 12 miles of levee modifications along the east bank of the Sacramento River downstream from the Natomas Cross Canal;

(iii) 3 telemeter stream flow gauges upstream from the Folsom Reservoir;
and

(iv) modifications to the flood warning system along the Lower American River.

(B) CREDIT TOWARD NON-FEDERAL SHARE. The non-Federal interest shall receive credit toward the non-Federal share of project costs for expenses that the non-Federal interest incurs for design or construction of any of the features authorized under this paragraph before the date on which Federal funds are made

available for construction of the project. The amount of the credit shall be determined by the Secretary.

(C) INTERIM OPERATION. Until such time as a comprehensive flood damage reduction plan for the American River watershed has been implemented, the Secretary of the Interior shall continue to operate the Folsom Dam and Reservoir to the variable 400,000/670,000 acre-feet of flood control storage capacity and shall extend the agreement between the Bureau of Reclamation and Sacramento Area Flood Control Agency with respect to the watershed.

(D) OTHER COSTS. The non-Federal interest shall be responsible for

(i) all operation, maintenance, repair, replacement, and rehabilitation costs associated with the improvements carried out under this paragraph; and

(ii) 25 percent of the costs incurred for the variable flood control operation of the Folsom Dam and Reservoir during the 4-year period beginning on the date of the enactment of this Act and 100 percent of such costs thereafter.

1.5.8 Water Resources Development Act of 1999

WRDA 1999 (PL 106-53) includes further guidance on the American River Common Features and Folsom Modification projects. Following is information on each.

Common Features

Section 366 of WRDA 1999 includes further direction for Common Features:

b. Section 366 - American and Sacramento Rivers, California.

(a) IN GENERAL. The project for flood damage reduction, American and Sacramento Rivers, California, authorized by section 101(a)(1) of the Water Resources Development Act of 1996 (110 Stat. 3662-3663), is modified to direct the Secretary to include the following improvements as part of the overall project:

(1) Raising the left bank of the non-Federal levee upstream of the Mayhew Drain for a distance of 4,500 feet by an average of 2.5 feet.

(2) Raising the right bank of the American River levee from 1,500 feet upstream to 4,000 feet downstream of the Howe Avenue Bridge by an average of 1 foot.

(3) Modifying the south levee of the Natomas Cross Canal for a distance of 5 miles to ensure that the south levee is consistent with the level of protection provided by the authorized levee along the east bank of the Sacramento River.

(4) *Modifying the north levee of the Natomas Cross Canal for a distance of 5 miles to ensure that the height of the levee is equivalent to the height of the south levee as authorized by paragraph (3).*

(5) *Installing gates to the existing Mayhew Drain culvert and pumps to prevent backup of floodwater on the Folsom Boulevard side of the gates.*

(6) *Installing a slurry wall in the north levee of the American River from the east levee of the Natomas east Main Drain upstream for a distance of approximately 1.2 miles.*

(7) *Installing a slurry wall in the north levee of the American River from 300 feet west of Jacob Lane north for a distance of approximately 1 mile to the end of the existing levee.*

(b) COST LIMITATIONS. Section 101(a)(1)(A) of the Water Resources Development Act of 1996 (110 Stat. 3662) is amended by striking “at a total cost of” and all that follows through “\$14,225,000,” and inserting the following: “at a total cost of \$91,900,000, with an estimated Federal cost of \$68,925,000 and an estimated non-Federal cost of \$22,975,000,”

(c) COST SHARING. For the purposes of Section 103 of the Water Resources Development Act of 1986 (33 U.S.C. 2213), the modifications authorized by this section shall be subject to the same cost sharing in effect for the project for flood damage reduction, American and Sacramento Rivers, California, authorized by Section 101(a)(1) of the Water Resources Development Act of 1996 (110 Stat. 3662).

Folsom Modification

Section 101(a) (6) of WRDA 1999 (PL 106-53) provides authorization for the Folsom Modification Project, as follows:

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 effect 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.

1.5.9 Energy and Water Development Appropriations Act of 2002

Section 209 of the Energy and Water Development Appropriations Act of 2002 (PL 107-66) amended WRDA 1999 related to the replacement of water supply losses caused by interim operation of Folsom Dam and Reservoir for increased flood damage reduction. Pertinent sections are presented below:

SEC. 209. (a) Section 101(a)(6)(C) of the Water Resources Development Act of 1999, Public Law 106-53, is amended to read as follows:

(C) MAKEUP OF WATER SHORTAGES CAUSED BY FLOOD CONTROL OPERATION. —

(i) IN GENERAL. — 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 make up 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.

(ii) *COST SHARING.* — Seventy-five percent of the costs of the replacement water provided under clause (i) shall be paid for on a non-reimbursable basis by the Secretary of the Interior at Federal expense. The remaining 25 percent of such costs shall be provided by the Sacramento Area Flood Control Agency.

(iii) *LIMITATION.* — To the extent that any funds in excess of the non-Federal share are provided by the Sacramento Are Flood Control Agency, the Secretary shall reimburse such non-Federal interests for such excess funds. Costs for replacement water may not exceed 125 percent of the current average market price for raw water, as determined by the Secretary of the Interior.

1.5.10 Energy and Water Development Appropriations Act of 2004

The Energy and Water Development Appropriations Act for 2004 (PL 108-137) provided the following in pertinent part:

Section 128. AMERICAN RIVER WATERSHED, CALIFORNIA.

(a) *IN GENERAL*—The Secretary of the Army is authorized to carry out the project for flood damage reduction and environmental restoration, American River Watershed, California, substantially in accordance with the plans, and subject to the conditions, described in the Report of the Chief of Engineers dated November 5, 2002, at a total cost of \$257,300,000, with an estimated Federal Cost of \$201,200,000 and an estimated non-Federal cost of \$56,100,000; except that the Secretary is authorized to accept funds from State and local governments and other Federal agencies for the purpose of constructing a permanent bridge instead of the temporary bridge described in the recommended plan and may construct such permanent bridge if all additional cost for such bridge, above the \$36,000,000 provided for in the recommended plan for bridge construction, are provided by such governments or agencies.

(b) *EXPEDITING BRIDGE DESIGN AND CONSTRUCTION*—The Secretary, in cooperation with appropriate non-Federal interests, shall immediately commence appropriate studies for, and the design of, a permanent bridge (including an evaluation of potential impacts of bridge construction on traffic patterns and identification of alternatives for mitigating such impacts) and, upon execution of a cost-sharing agreement with such non-Federal interest, shall proceed to construction of the bridge as soon as practicable; except that such studies, design and construction shall not adversely affect the schedule of design or construction of authorized project for flood damage reduction.

Section 134. BRIDGE AUTHORIZATION. There is authorized to be appropriated \$30,000,000 for the construction of the permanent bridge in section 128(a).

1.5.11 Energy and Water Development Appropriations Act of 2006

PL 109-103, the Energy and Water Development Appropriations Act for 2006, provided further direction regarding actions at Folsom Dam. Pertinent sections of the act relating to the Folsom Modification and Folsom Dam Raise projects are included below:

SEC. 128. American River Watershed, California (Folsom Dam and Permanent Bridge) -

(a) COORDINATION OF FLOOD DAMAGE REDUCTION AND DAM SAFETY—The Secretary of the Army and the Secretary of the Interior are directed to collaborate on authorized activities to maximize flood damage reduction improvements and address dam safety needs at Folsom Dam and Reservoir, California. The Secretaries shall expedite technical reviews for flood damage reduction and dam safety improvements. In developing improvements under this section, the Secretaries shall consider reasonable modifications to existing authorized activities, including a potential auxiliary spillway. In conducting such activities, the Secretaries are authorized to expend funds for coordinated technical reviews and joint planning, and preliminary design activities.

(b) SECRETARY'S ROLE.—Section 134 of Public Law 108–137 (117 Stat. 1842) is modified to read as follows:

“SEC. 134. BRIDGE AUTHORIZATION.

“There is authorized to be appropriated to the Secretary of the Army \$30,000,000 for the construction of the permanent bridge described in section 128(a), above the \$36,000,000 provided for in the recommended plan for bridge construction. The \$30,000,000 shall not be subject to cost sharing requirements with non-Federal interests.”

(c) CONFORMING CHANGE.—Section 128(a) of Public Law 108–137 (117 Stat. 1838) is modified by deleting “above the \$36,000,000 provided for in the recommended plan for bridge construction,” and inserting in lieu thereof the following: “above the sum of the \$36,000,000 provided for in the recommended plan for bridge construction and the amount authorized to be appropriated by section 134, as amended.”

(d) MAXIMUM COST OF PROJECT.—The costs cited in subsections (b) and (c) shall be adjusted to allow for increases pursuant to section 902 of Public Law 99–662 (100 Stat. 4183). For purposes of making adjustments pursuant to this subsection, the date of authorization of the bridge project shall be December 1, 2003.

(e) EXPEDITED CONSTRUCTION.—The Secretary, in coordination with the Secretary of the Interior and affected non-Federal officials (including the City of Folsom, California), shall expedite construction of a new bridge and associated

roadway authorized in Public Law 108–137. The Secretary, to the extent practicable, may construct such work in a manner that is compatible with the design and construction of authorized projects for flood damage reduction and dam safety. The Secretary and the Secretary of the Interior shall expedite actions under their respective jurisdictions to facilitate timely completion of construction.

(f) *REPORT TO CONGRESS.*—The Secretary of the Army, in consultation with the Secretary of the Interior and non-Federal interests, shall report to Congress within ninety days of the date of enactment of this Act, and at four-month intervals thereafter, on the status and schedule of planning, design and construction activity.

1.6 PROJECT SPONSORS

Non-Federal sponsors for flood damage reduction elements of the RAP are expected to be The Reclamation Board and SAFCA. Reclamation would likely continue to perform operations, maintenance, repair, replacement, and rehabilitation activities related to Folsom Dam and appurtenant facilities, with cost sharing by SAFCA. The City of Folsom is the non-Federal sponsor for the permanent bridge, and is responsible for the associated cost; however, a Federal contribution is authorized. The State of California and SAFCA, as flood damage reduction sponsors, will contribute funds for the bridge through the City of Folsom.

1.7 FUNDING HISTORY

1.7.1 Folsom Modification Project

The funding history for the Folsom Modification Project is shown in **Table 1-1**.

TABLE 1-1
FEDERAL FUNDING HISTORY OF FOLSOM MODIFICATION PROJECT
(\$ MILLIONS)

Federal Funding Category	Fiscal Year	Allocations	Expenditures
Preconstruction, Engineering, and Design Construction ¹	All	6.7	6.7
	2001	4.7	4.5
	2002	5.9	5.2
	2003	6.5	7.0
	2004	-1.2	-1.2
	2005	7.5	7.7
	2006	6.2	3.9
Total Construction ¹		29.6	27.1
Total		36.3	33.8

Note:

1. Funding designations reflect congressional budgetary nomenclature, and not necessarily actual construction costs.

1.7.2 Folsom Dam Raise Project

The funding history for the Folsom Dam Raise Project is shown in **Table 1-2**.

**TABLE 1-2
FEDERAL FUNDING HISTORY OF FOLSOM DAM RAISE PROJECT (\$ MILLIONS)**

Federal Funding Category	Fiscal Year	Allocations	Expenditures
Preconstruction, Engineering, and Design	All	16.1	16.1
Construction			
	2004	3.3	3.0
	2005	7.9	6.9
	2006	11.1	9.3
Total Construction ¹		22.4	19.3
Total		38.5	35.4

Note:

1. Funding designations reflect Congressional budgetary nomenclature, and not necessarily actual construction costs.

1.8 REPORT ORGANIZATION

This *PAC Report* is organized into nine chapters, as follows:

- **Chapter 1, Introduction** – Describes the purpose and scope of this *PAC Report*, background and history, and fundamental authorizations relevant to the authorized Folsom Modification and Folsom Dam Raise projects.
- **Chapter 2, Project Area Description** – Describes the project area location and existing flood damage reduction system, focusing on Folsom Dam and Reservoir, residual flood problems, dam safety issues, and pertinent without-project conditions.
- **Chapter 3, Description of Authorized and Related Projects** – Summarizes the authorized Folsom Modification Project, Folsom Dam Raise Project, dam safety issues at Folsom Dam, and other pertinent ongoing projects and programs.
- **Chapter 4, Authorized Project Refinement** – Describes project objectives, major alternatives considered, the rationale for selection of a plan, and identification of a refined project for continued implementation of the authorized projects.
- **Chapter 5, Changes from Authorized Project Plans** – Compares the authorized Folsom Modification Project and the Folsom Dam Raise Project to the refined project.
- **Chapter 6, Joint Federal Participation** – Provides the cost distribution for the Joint Federal Project (JFP) and summarizes components of Corps and Reclamation work packages.
- **Chapter 7, Implementation** – Describes the cost distribution, cost appropriation and other implementation considerations for the Selected Plan and the RAP.

- **Chapter 8, Conclusions and Recommendations** – Summarizes key findings and recommendations.
- **Chapter 9, References** – Contains sources used in preparing this *PAC Report*.

This report also contains a set of supporting appendices. The appendices include Engineering Design Reports for the Folsom Modification Project, Folsom Dam Raise Project, and the selected project to address both flood damage reduction and dam safety at Folsom Dam. Additional appendices include the following:

- Real Estate
- Economics
- Cost Distribution
- Pertinent Correspondence
- United States Army Corps of Engineers 12 Actions for Change

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CHAPTER 2.0 PROJECT AREA DESCRIPTION

2.1 LOCATION

The project area includes Folsom Dam and Reservoir; inflowing rivers and streams, including the North, South, and Middle forks of the American River; the American River downstream to its confluence with the Sacramento River in the City of Sacramento; and other affected flood facilities, including the Sacramento River, Yolo Bypass, and Sacramento Weir. The American River Watershed covers about 2,100 square miles northeast of the City of Sacramento and includes portions of Placer, El Dorado, and Sacramento counties. **Plate 1** illustrates the project area within the Sacramento River Watershed, and **Plate 2** shows the Folsom Dam and Reservoir area.

2.2 EXISTING FLOOD DAMAGE REDUCTION SYSTEM

The existing flood damage reduction system for the American River and the Sacramento area includes Folsom Dam and Reservoir, and the levees along the lower American River. As mentioned, improvements underway as a part of the Common Features Project along the lower American River, as authorized by the Water Resources Development Act (WRDA) of 1999, will meet the intent of the authorization to safely pass the emergency flood release of 160,000 cubic feet per second (cfs) from Folsom Dam.

2.2.1 Folsom Dam and Reservoir

Folsom Dam, as described in **Chapter 6**, is a multipurpose project operated by the United States Department of the Interior, Bureau of Reclamation (Reclamation), as a part of the Central Valley Project (CVP). The dam regulates runoff from about 1,860 square miles of drainage area and has a storage capacity of 977,000 acre-feet at its gross pool at reservoir water surface elevation 466 feet. The top of the main dam is at elevation 480.5 feet, and the crest of the 392-foot-long spillway is at elevation 418 feet. The current maximum reservoir elevation, with induced surcharge, is 475.4 feet. The Folsom Dam spillway design flood, 1946 Probable Maximum Flood (PMF), set the above maximum reservoir elevation. Folsom Dam can not contain the current (2001) PMF within the designated surcharge flood space. The objective release for flood damage reduction from the dam to the lower American River is 115,000 cfs, with an emergency release of 160,000 cfs for a sustained time (currently being evaluated) without a high probability of levee failure along the lower American River.

Normal operation releases flow through three penstocks, located on the right side of the main Folsom Dam, that provide power generation and downstream water supply deliveries. The combined capacity of the three penstocks is 8,000 cfs but this capacity is not relied on for flood damage reduction operations. Flood damage reduction releases are made from eight gated low-level outlets, five gated principal spillway bays, and three gated emergency spillway bays (see **Plates 3** and **4**). During flood events, initial releases from the reservoir are made through the penstocks and the gated outlets up to spillway crest elevation 418.0 feet. The outlets can pass

24,800 cfs at pool elevation 418.0 feet. An existing operational restriction limits opening of the existing outlet gates to 60 percent when the existing spillway service tainter gates are making releases.

2.2.2 American and Sacramento River Systems

2.2.2.1 Nimbus Dam

Nimbus Dam and its reservoir, Lake Natoma, are about 6 miles downstream from Folsom Dam. Lake Natoma (8,760 acre-feet) acts as a power afterbay to Folsom and is a diversion dam for the Folsom South Canal. Nimbus Dam, because of its small capacity, has essentially no regulatory effect on flood flows in the American River. Nimbus Dam has a release capacity of 300,000 cfs, sufficient to pass the maximum objective release from Folsom Dam under normal operations (115,000 cfs), but insufficient to pass the maximum design discharge capacity from Folsom Dam (567,000 cfs).

2.2.2.2 Levees

Project levees downstream from Folsom Dam are shown in **Plate 5** (from the Corps March 1996 *Supplemental Information Report* (1996 SIR)) and are listed below:

- **American River Levees** – Federal project levees extend from the mouth of the American River upstream to the Mayhew Drain on the south bank, and to the Carmichael Bluffs on the north bank. On the south bank, non-Federal levees, constructed by local developers, extend upstream from the Mayhew Drain to Sunrise Boulevard.
- **Natomas East Main Drainage Canal (NEMDC) Levees** – The west levee, extending upstream about 13 miles from the American River, protects Natomas from high water surface elevations in the NEMDC. The east levee extends upstream about 4 miles and protects Rio Linda.
- **Arcade Creek and Dry Creek Levees** – Levees extend along both sides of Arcade Creek from the NEMDC to high ground about 2 miles upstream, and along lower Dry Creek.
- **Sacramento River Levees** – The levees along the Sacramento River were designed to carry 107,000 cfs from the Fremont Weir to the American River and 110,000 cfs downstream from the American River.

2.2.2.3 Sacramento Weir

In 1918, the United States Army Corps of Engineers (Corps) built the Sacramento Weir upstream from the Sacramento River and American River confluence, immediately west of Sacramento. This weir has 48 removable gates and a net crest length of 1,830 feet. The weir diverts high flows from the Sacramento River into the Yolo Bypass via the Sacramento Bypass. When flows from the American River are high enough, some of the American River water flows upstream through the Sacramento River channel to the weir. The California Department of Water Resources (DWR) maintains and operates the weir.

This is the only weir in the Sacramento River system with gates that allow it to be operated during flood events. The weir is operated to limit flood stages in the Sacramento River to project design levels, to reduce sediment in the Sacramento River channel downstream from the weir, and to make maximum use of the flood-carrying capacity of the Sacramento River channel downstream from the weir.

2.2.2.4 Yolo Bypass

The Yolo Bypass is a leveed floodway through the natural overflow Yolo Basin on the west side of the Sacramento River between Verona and Rio Vista near Suisun Bay, and immediately west of the metropolitan area of Sacramento. The bypass runs generally north to south and extends from the Fremont Weir downstream to Liberty Island, a distance of nearly 70 miles. The bypass is a feature of the Sacramento River Flood Control Project, which began operation in the 1930s.

During high flows in the Sacramento River, floodwater enters the Yolo Bypass over the Fremont Weir and over the Sacramento Weir and Bypass and is conveyed south around the metropolitan area of Sacramento. Floodwaters reenter the Sacramento River upstream from Rio Vista.

2.3 FLOOD PROBLEMS

Current estimates are that below Folsom Dam, with the existing levee system, there is about a 1 in 81 chance in any given year that levee failure and flooding will occur in Sacramento from the American River based on annual exceedence probability (AEP). Serious flood risks exist in the Sacramento area downstream along the American River to its confluence with the Sacramento River, as described below. Within the Sacramento area, a major flood would affect more than 400,000 people and in excess of 110,000 structures, with over \$40 billion in damageable property. Should this occur, estimated damages would be about \$20 billion. The average annual equivalent damages in the Sacramento area is about \$200 million.

2.3.1 Folsom Dam Release Capacity

The existing Folsom Dam has limited capability to make objective flood releases until the reservoir is significantly encroached. To make flood releases of 115,000 cfs, the reservoir must rise above the spillway crest elevation of 418 feet. A maximum of 24,800 cfs can be released through the low-level outlets when the reservoir level is at the spillway crest elevation. Operational considerations generally preclude spillway discharges until the reservoir level reaches elevation 423.6 feet, at which time the main spillway service gates are opened. The objective release capacity of 115,000 cfs is reached when the reservoir level reaches about elevation 447 feet. This flow is a combination of flows through the outlets (at 60 percent open) and the five primary spillway gates. Due to potential cavitation problems, the outlet gate openings are reduced to 60 percent when the spillway gates are opened.

If the reservoir water surface continues to rise, releases would increase flow up to the emergency release flow of 160,000 cfs. If the reservoir continues to rise and surpasses the

470-foot elevation, the current Emergency Spillway Release Diagram (ESRD) dictates that the release would increase above 160,000 cfs.

2.3.2 Folsom Dam Emergency Spillway Release Conditions

There is an existing emergency spillway release capacity deficiency due to dam safety concerns; this deficiency has resulted in restricted operation of the three gated emergency spillway bays. The existing ESRD requires regulation of emergency spillway flows prior to reaching the minimum 240,000 cfs flow. Folsom Dam cannot be operated according to the existing requirements of the ESRD because of structural safety deficiencies.

The major concern is the potential for erosion below the emergency spillway chute and adjacent areas. It has been identified that even small flows could cause severe erosion below the emergency spillway. Continuous flows without sufficient tailwater may allow this erosion to migrate back towards the dam. Discharges in the range of 240,000 cfs to 300,000 cfs have been estimated to provide sufficient tailwater elevation to reduce the effects of erosion downstream from the emergency spillway. Due to these concerns, the emergency spillway gates should not be operated until the discharges from the main spillway gates reach a minimum range of 240,000 cfs to 300,000 cfs.

2.3.3 Levees

The chance of levee failure and resulting 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. Damage in the lower American River (within the levee system) can occur at flows less than the objective release (115,000 cfs). The potential for levee failure and catastrophic damages due to flooding in Sacramento is magnified by the area's dependence on high earthen levees. When high levees fail, rapid flooding of the adjacent areas usually results in a significant risk to the population. Since a single weak spot in the system could cause a breach and potentially uncontrolled, life-threatening flooding, special attention must be given to the design, construction, operation, and maintenance of the levee systems.

The physical capacity of the American River to safely transport flows depends on the downstream levee system. The lower American River levees were designed to pass the most severe conditions of either a flow of 115,000 cfs with 5 feet of freeboard on the levee, or 152,000 cfs with 3 feet of freeboard on the levee. Normal flood operations at Folsom Dam would limit downstream flows to 115,000 cfs. During large storm events, American River flows are routed into the Yolo Bypass via the Sacramento Weir. With completion of the Common Features Project, it is estimated that the outflows from Folsom Dam could be increased to as much as 160,000 cfs for a sustained time (currently being evaluated) without a high probability of levee failure along the American River.

2.4 DAM SAFETY RISKS

2.4.1 Probable Maximum Flood

The PMF is used to determine the hydrologic safety of dams. Both Federal- and State-sponsored dam projects use the PMF to design spillway capacities. The PMF is the flood discharge that would result from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably considered possible in a region. The PMF does not have an assigned frequency. All prior PMF estimates for basins in California have equaled or exceeded the 0.1-percent-chance exceedence event for peak, 1-day, and 3-day volumes taken from calculated frequency curves.

Folsom Dam and Reservoir were designed to pass an estimate of the largest likely inflow event when they were constructed. However, with updated hydrology, it has been determined that Folsom Dam's existing spillway capacity is inadequate to protect the dam in the event of an extreme flood in combination with reservoir surcharging to the dam/dike crest elevation of 480.5 feet. As mentioned, it is estimated that currently the Folsom Dam spillway can pass between 70 to 75 percent of the PMF.

In October 1996, Reclamation determined a new PMF for the American River basin based on a new Probable Maximum Storm (PMS) using Hydrometeorological Report No. 58 (National Weather Service, 1998). Following the flood of January 1997, the Corps computed a new, mean 3-day PMF flow. This computation of a revised PMF incorporated rain-on-snow loss rates modeled from the January 1997 event. The resulting mean 3-day flow is greater than the 0.1-percent-chance exceedence event when compared to the flow-frequency curves presented in this report. The PMF results in a peak inflow to Folsom Dam of approximately 1,183,000 cfs.

Determination of Folsom Dam's capacity to pass the PMF is dependent on operational assumptions such as antecedent reservoir conditions, and how many gates are open. A contributing factor to the PMF is failure of L.L. Anderson Dam (French Meadows Reservoir). This is a hydropower and recreation dam owned by Placer County Water Agency (PCWA). L.L. Anderson Dam is to be modified by PCWA to pass the Federally identified PMF (see **Appendix G – Pertinent Correspondence**); the resultant PMF at Folsom Dam would be reduced to 906,000 cfs. Folsom Dam would pass 85 percent of the PMF if L.L. Anderson Dam was modified and Folsom structural dam safety modifications were in place. It is important to note that widespread flooding would also occur with floods much more frequent than the PMF.

2.4.2 Seismic and Static Retrofit

Both the Corps and Reclamation have determined that the various facilities at Folsom Dam and Reservoir require structural improvements to increase overall public safety. Reclamation has identified, under its Safety of Dams Program, the need for expedited action to reduce not only hydrologic but static and seismic risk conditions. The identified risks are among the highest of all dams in Reclamation's inventory, and Folsom Dam is among Reclamation's highest priorities within its Safety of Dams Program. Reclamation's primary interest for participating in a project meeting the needs of both Corps and Reclamation is to realize cost-sharing benefits of a combined project.

The objectives of the seismic and static retrofit are as follows:

- Expediently reduce the risk of structural failure during a potential seismic (earthquake) event in accordance with Reclamation's Public Protection Guidelines.
- Expediently reduce the risk of structural failure during a potential static (seepage) event in accordance with Reclamation's Public Protection Guidelines.

Several structural actions are described below. These actions are to be implemented independent of further actions on a recommended plan.

2.5 WITHOUT-PROJECT CONDITIONS

Currently, Folsom Dam and the downstream levee system help protect the City of Sacramento and areas in Sacramento County from major floods with an AEP of 0.0124 (about a 1-in-81 chance of occurrence in any 1 year). Although the levee system has been certified capable of protection against the Federal Emergency Management Agency (FEMA) base flood event using standard FEMA criteria, the Sacramento area has a fairly low level of flood protection for a community of its size and importance. The areas subject to major flooding from levee failure along the American River, as a result of high releases from Folsom Dam, have been identified in several Corps reports, such as the *1991 American River Watershed Investigation Feasibility Report*, the *1996 SIR*, and the *2003 Folsom Dam Modification Final Limited Reevaluation Report*.

Following is a summary of several without-project future conditions that are important in identifying a selected plan and implementing a potential project:

- Continuation of the 400,000- to 670,000-acre-foot flood pool interim operation
- Completion of the Corps Common Features Project along the American River
- Implementation of Reclamation seismic and static retrofit work at Folsom facilities
- Construction of a permanent bridge just west of Folsom Dam
- Construction of an emergency fuseplug spillway
- Modification of L.L. Anderson Dam Spillway by PCWA

It should be noted that the without-project condition being considered in the 2007 *Environmental Impact Statement/Environmental Impact Report* (EIS/EIR) prepared jointly by Reclamation and the Corps differs from the without-project condition considered in this *Post Authorization Change* (PAC) *Report*. This is because the scope of the joint EIS/EIR includes not only the potential work to address flood damage reduction issues, but Reclamation's structural dam safety actions and additional work needed for security at Folsom Dam. This PAC Report assumes that Reclamation will move forward with dam safety and security improvements at Folsom Dam independent of any flood damage reduction actions, and thus considers Reclamation's dam safety improvements as part of the without-project condition.

2.5.1 Interim Operation

Folsom Dam was originally constructed with a fixed seasonally designated flood control storage space of 400,000 acre-feet.

Currently, an interim operation agreement, authorized by Congress, exists between Reclamation and the Sacramento Area Flood Control Agency (SAFCA). This interim agreement for the operation of Folsom Dam states that the flood control storage space in the reservoir is to be changed to an available variable space ranging from 400,000 acre-feet to 670,000 acre-feet (400/670), depending on the amount of creditable vacant space in five identified significant existing upstream reservoirs within the upstream American River Watershed (see **Plates 1 and 6**). The drainage basins above these nonflood damage reduction reservoirs have accounted for a minimum of 14 percent of the unregulated inflows into Folsom Reservoir during major flood events. As these upstream reservoirs' creditable spaces are filled, the variable flood space at Folsom Reservoir can increase to as much as 670,000 acre-feet.

In WRDA 1996, Congress directed the Secretary of the Interior to continue interim operation at Folsom Dam and Reservoir until a comprehensive flood control plan for the American River Watershed was implemented.

Section 101(a) (1) (c) of WRDA 1996 (PL 104-303)

AMERICAN AND SACRAMENTO RIVERS, CALIFORNIA.

“The Secretary of the Interior shall continue to operate the Folsom Dam and Reservoir to the variable 400,000/670,000 acre-feet of flood control storage capacity as an interim measure and extend the agreement between the Bureau of Reclamation and the Sacramento Area Flood Control Agency until such time as a comprehensive flood control plan for the American River Watershed has been implemented.”

Based on this authorization, the Corps' without-project condition for this report includes a continued interim operation by Reclamation and SAFCA of 400/670 indefinitely (current agreement ends in 2018).

The authorization for the Folsom Modification Project directs the Corps to change the existing interim operation from the current 400/670 to a 400,000 acre-foot to 600,000 acre-foot (400/600) variable flood space operation once the Folsom Modification Project has been implemented. Therefore, the with-project condition for this report includes a permanent reoperation of 400/600 (see **Chapter 4**).

Section 101(a) (6) of WRDA 1999 (PL 106-53)

AMERICAN AND SACRAMENTO RIVERS, CALIFORNIA...

(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.

A permanent reoperation study is currently being developed in conjunction with the American River Watershed Project. A decision on permanent reoperation has not been made, but it is anticipated to be approved prior to completion of the Six Submerged Tainter Gate Element (6 STG Element) of the Selected Plan described in **Chapter 4**. The permanent reoperation study will focus on identifying environmental impacts and costs as well as providing a repayment strategy and repayment responsibility of potential water supply losses resulting from the reoperation. A revision to the existing water control manual will be developed in coordination and collaboration with all partners prior to completion of the auxiliary spillway, applying all available science, engineering, and applicable authorizations.

2.5.2 Common Features

Common Features consist of levee and other flood management improvements authorized in WRDA 1996 and WRDA 1999. The Common Features generally include (1) levee modification along both banks of the lower American River, (2) levee modifications along the east bank of the Sacramento River downstream from the Natomas Cross Canal, (3) installation of telemetered streamflow gages upstream from Folsom Reservoir and modifications to a flood warning system along the lower American River, and (4) continued interim reoperation of Folsom Dam and Reservoir flood control storage capacity. Below is a summary of the Common Features included in the 1996 and 1999 authorizations. The current schedule is for the Common Features Project to be completed by the end of 2007.

2.5.2.1 Water Resources Development Act of 1996 Common Features

- Approximately 19 miles of slurry wall in the levees along the lower American River.
- Approximately 12 miles of levee modifications along the east bank of the Sacramento River downstream from the Natomas Cross Canal.
- Three telemetered stream flow gages upstream from Folsom Reservoir.
- Modifications to the flood warning system along the lower American River.
- Continued interim operation of Folsom Dam and Reservoir to the variable 400,000/670,000 acre-feet of flood control storage capacity.

2.5.2.2 Water Resources Development Act of 1999 Additions to Common Features

The Common Features shown below have been refined from the descriptions given in WRDA 1999 by the *2002 2nd Addendum* to the *March 1996 SIR* (Corps):

- Raising the non-Federal levee on the left bank of the river upstream from the Mayhew Drain for a distance of 4,300 feet by an average of 2.5 feet.

- Raising the right bank of the American River levee from 1,500 feet upstream to 12,000 feet downstream from the Howe Avenue Bridge by an average of 1 foot.
- Installing a closure structure with gates near the mouth of Mayhew Drain, and adding flap gates to existing culverts and an additional flap-gated culvert under Folsom Boulevard.
- Reshaping the landside levee side slope of the north levee of the American River to provide a 2H to 1V slope from 500 feet upstream to 1,300 feet upstream from State Highway 160.
- Constructing a 4-foot-deep toe drain along the landside levee toe of the north levee of the American River. Repair work will extend from 300 feet west of Jacob Lane to Harrington Way and from 800 feet upstream of River Walk Way to 700 feet downstream from Arden Way.

2.5.3 Seismic Retrofit

As mentioned, potential modifications associated with improving seismic and static conditions that would be accomplished as part of the without-project condition include seismic work at Mormon Island Auxiliary Dam (MIAD), seismic work at the main concrete dam, and improving static conditions at the main concrete dam, the right and left wing dams, and the eight dikes. Work on the main concrete dam would prevent the concrete monoliths from sliding along the foundation contact during a large earthquake. Additional seismic modifications would include reinforcement of the existing spillway piers and gates.

Sand filters would be constructed within the downstream part of the earthen structures (right wing dam, left wing dam, MIAD, and eight dikes) to better control seepage and piping. All earthen structures would be raised to provide up to a minimum of 3 feet of additional freeboard to the existing facilities for Safety of Dams concerns through the placement of additional earthen material, construction of concrete walls, or a combination of the two measures, along the crest of the facilities. In addition, MIAD would be strengthened against deformation of the foundation and movement of the dam during a severe seismic event by either jet grouting or excavation and replacement of upstream foundation materials, followed by a massive overlay placed on the downstream portion of the dam.

2.5.4 Bridge

The existing Folsom Dam Road, which is a two-lane, undivided road about 2.3 miles long, connects Folsom-Auburn Road to the west of the American River with East Natoma Street to the east. Folsom Dam Road had become an important traffic link in the Sacramento region that, prior to the road closure, supported traffic volumes of about 16,000 vehicles per day.

The original proposal to raise Folsom Dam included construction of a temporary vehicle bridge to provide a detour during construction for public traffic that normally used Folsom Dam Road to cross the American River. In Energy and Water Development Appropriations Acts for 2004 and 2006 subsequent appropriation language, Congress directed the Corps to construct a permanent bridge in lieu of a temporary bridge, in coordination with a non-Federal sponsor, and

provided subsequent direction, respectively. The City of Folsom is the non-Federal sponsor for the permanent bridge.

The selected permanent bridge alternative consists of a prestressed concrete, cast-in-place segmental box girder structure. The bridge span and concrete abutments will be approximately 935 feet long. Two support piers will be placed above the mean river water level in the riverbank areas. The bridge span will have an estimated clearance of 180 feet from the river (top of deck to mean river surface). The bridge will be constructed by using the balanced cantilever method for post-tensioned, cast-in-place, segmental concrete bridges. It will be capable of carrying four lanes of traffic, plus a bike path.

The roadway also will consist of four lanes of traffic plus a bike path. New signaled intersections will be constructed at Folsom-Auburn Road and East Natoma Road.

2.5.5 Fuseplug Spillway for Probable Maximum Flood

In the without-project condition considered for this *PAC Report*, Reclamation would address the dam safety hydrologic risk of passing the PMF event by construction of an emergency fuseplug spillway on the south (left) abutment and downstream from the left wing dam. As mentioned, the current dam spillway and outlets do not have sufficient capacity for managing the predicted PMF flows and require the additional discharge capacity provided by an auxiliary spillway.

The new fuseplug spillway for dam safety would include an approach channel on the water side of the control section and a fuseplug embankment structure, as shown in **Plate 7**. Reclamation designed the fuseplug embankment sections to consist of a zoned embankment with an impervious core, an internal coarse shell zone, and erosion protection on the upstream face (see **Plate 8**). The goal is that the fuseplug embankment sections would erode in a predictable manner when the reservoir elevation exceeds the elevation of a pilot channel. The multiple embankment sections of the fuseplug would allow progressive passage of larger floods up to the PMF flow. Downstream from the fuseplug embankment sections, a partially lined chute would convey spillway flows to the American River.

2.5.6 L.L. Anderson Dam Spillway Modification

The work required to correct the L.L. Anderson Dam spillway deficiency is regulated by the California Division of Safety of Dams and by the Federal Energy Regulatory Commission (FERC). FERC has determined that PCWA is to modify L.L. Anderson Dam to pass the PMF under the without-project condition (see **Appendix G**).

CHAPTER 3.0 DESCRIPTION OF AUTHORIZED AND RELATED PROJECTS

3.1 FOLSOM MODIFICATION PROJECT

The Folsom Modification Project was authorized in the Water Resources Development Act (WRDA) of 1999. The authorized plan included the elements of the Folsom Modification Plan described in the Corps *1996 American River Watershed, California, Supplemental Information Report* (1996 SIR), as modified in the 1998 Sacramento Area Flood Control Agency (SAFCA) Information Paper *Folsom Dam Modification Report, New Outlets Plan*.

Because the project authorized in WRDA 1999 differed from the plan presented in the *1996 SIR*, the Draft *Folsom Modification Project Environmental Assessment/Initial Study* (EA/IS) was prepared in 2001 to document environmental effects of the authorized elements (Corps and Reclamation). At the same time, additional studies were conducted, as directed by WRDA 1999, which were documented in the February 2002 *American River Watershed Long-Term Study Final Supplemental Plan Formulation Report/Environmental Impact Statement/Environmental Impact Report* (EIS/EIR) (2002 Long-Term Study). To reconcile differences between the Folsom Dam modification features presented in the *2001 EA/IS* and the *2002 Long-Term Study*, the *Folsom Dam Modification Project Final Limited Reevaluation Report and EA/IS* (2003 LLR) was prepared in 2003. Since preparation of the *2003 LRR*, and completion of construction plans for those elements, additional studies and authorization of the Folsom Dam Raise Project have identified further changes to the Folsom Modification Project.

Following is a summary of the project authorized in WRDA 1999, refinements described in the *2003 LRR*, and additional changes subsequent to the *2003 LRR*.

3.1.1 Project Authorized in Water Resources Development Act of 1999

The *1996 SIR* features of the Folsom Modification Plan included lowering the main spillway by 15 feet, replacing the main spillway tainter gates, and enlarging the eight existing outlets. However, a tainter gate failure in 1995 that closed Folsom Dam Road for several months during repairs prompted SAFCA to evaluate alternative plans that would increase release capacity without the traffic and operational effects of lowering the spillway. SAFCA's 1998 *Folsom Dam Modification Report, New Outlets Plan*, proposed several modifications to the previously defined project. On the basis of the *1996 SIR* and SAFCA's recommendations in the 1998 report, the Folsom Modification Project authorized in WRDA 1999 (Section 101(a) (6)) included several significant features: enlarging the eight existing outlets (without lowering the main spillway), constructing five new sluiceways under the emergency spillway, and constructing a new emergency spillway stilling basin. The authorization also provided for permanent modification to the flood control storage space in Folsom Reservoir. In combination, the outlet and spillway modifications and permanent reoperation would achieve an objective release capacity of 115,000 cubic feet per second earlier than under without-project conditions. It was estimated that with the above features in place, along with completion of construction of the American River Common Features Project, the flood risk would be lowered from a 1 in 85 chance in any year to a 1 in 140 chance in any year.

The 1999 authorization also included a separate provision for the United States Department of the Interior, Bureau of Reclamation (Reclamation), to enter into an agreement with SAFCA regarding the impacts created by a permanent reoperation of Folsom Dam and Reservoir. In the agreement, 100 percent of the water needed (to the extent that the water is available) to make up for water shortages caused by the operation or impacts to recreation at Folsom Reservoir would be the responsibility of Reclamation. The authorization also defined the meaning of a significant impact to recreation. In addition, the authorization directed the United States Army Corps of Engineers (Corps) and Reclamation to update the Flood Management Plan authorized in the Department of Defense Appropriations Act of 1993. That update was to reflect forecast-based operational changes at Folsom Dam and Reservoir for flood damage reduction. This would include an attempt to gain additional flood storage space through advance release of stored water based on forecast and inflow of large storms in accordance with the provisions identified in the Department of Defense Appropriations Act of 1993 Section 9159(f)(2) and again in WRDA 1999 Section 101(a)(6) (B and E).

3.1.1.1 Benefits and Costs

The Folsom Modification Plan presented in the *1996 SIR* (which differs somewhat from the authorized Folsom Modification Project, as noted above) was estimated to reduce the probability of flooding due to levee failure to a 1 in 180 chance in any given year. Benefits and costs presented in the *1996 SIR* are as follows: total first cost of \$399 million, average annual benefits of \$98 million, average annual costs of \$44 million, and net annual benefits of \$54 million (1995 price levels).

The total first cost of the Folsom Modification Project elements, as authorized, was estimated as \$150 million in WRDA 1999. This difference is due in part to authorized design changes proposed in the 1998 SAFCA report (i.e., modifying existing outlets in lieu of lowering the spillway by 15 feet) and because the values in the *1996 SIR* include downstream levee modifications and other project elements that were either not authorized or were authorized separately.

3.1.1.2 Cost-Sharing

Of the \$150 million total estimated cost reported in WRDA 1999, the estimated Federal share was \$97.5 million and non-Federal share was \$52.5 million.

In accordance with Federal cost-sharing requirements for flood damage reduction projects set forth in WRDA 1996, project costs were apportioned 65 percent Federal and 35 percent non-Federal; non-Federal sponsors would bear all costs related to operations and maintenance, repair, replacement, and rehabilitation (OMRR&R) of flood control facilities. Reclamation and SAFCA have entered into an agreement that Reclamation is responsible for OMRR&R and SAFCA will pay for these costs upon completion of the Folsom Modification Project. Non-Federal sponsors would also be responsible for lands, easements, rights-of-way, and relocations.

3.1.2 2003 Folsom Dam Modification Project Final Limited Reevaluation Report

The 2003 LRR reconciled conflicts between the authorized Folsom Modification Project elements and recommendations in the 2002 Long-Term Study. As directed by Congress in WRDA 1999, the plan identified in the 2002 Long-Term Study included raising Folsom Dam, modifying downstream levee improvements, and implementing other elements necessary to meet current Federal dam safety standards. Recommendations from the 2002 Long-Term Study that were authorized by Congress in the Energy and Water Development Appropriations Act for fiscal year 2004 included raising the dam by 7 feet (mini-raise), spillway modifications at L.L. Anderson Dam, a permanent bridge downstream from Folsom Dam, and modification of emergency release operations to permit surcharge. These authorized features, which make up the Folsom Dam Raise Project (described later in this chapter), carry design implications for the previously authorized Folsom Modification Project, as described below.

Under the Folsom Dam Raise Project, all eight existing spillway tainter gates would be modified, spillway bridge piers would be modified, and the spillway bridge would be replaced. If the Folsom Modification Project were implemented first, as authorized, gate modifications would need to be made twice. Consequently, the 2003 LRR refined the elements related to increasing release capacity to be consistent with gate modifications in the 2002 Long-Term Study. These changes included the following:

- Construct two new upper tier outlets
- Enlarge the four existing upper tier outlets to 9 feet, 4 inches, by 14 feet, and the four existing lower tier outlets to 9 feet, 4 inches, by 12 feet
- Modify existing main spillway stilling basin

In addition, for the surcharge storage aspect of the project, the three emergency spillway tainter gates would be replaced with larger gates, as authorized, but the design would permit future expansion of these gates should the Folsom Dam Raise Project be authorized and implemented.

Table 3-1 summarizes the originally authorized elements, modified features in the 2003 LRR, and other subsequent changes to the Folsom Modification Project. It is important to note that it is the features and their respective costs described in the 2003 LRR for which changes are described in this *PAC Report*.

**TABLE 3-1
COMPARISON OF AUTHORIZED AND REFINED AUTHORIZED PROJECTS
FEATURES, FOLSOM MODIFICATION PROJECT**

Function	Project Features in 1996 SIR ¹	Authorized Project Features (WRDA 1999 ²)	Project Features in 2003 LRR ³	Recent Design Considerations (2003 to present)
Increase Release Capacity (115,000 cubic feet per second objective release)	Lower spillway crest by 15 feet	In lieu of lowering the spillway, construct 5 new outlets under the emergency spillway (two 7' x 14' slide gates per outlet)	Add 2 new upper tier outlets (9'4" x 14')	Construct new, auxiliary spillway with up to 6 submerged tainter gates (23' wide by 33' high)
	Enlarge 8 existing main dam outlets to 6' x 12'	Enlarge 8 existing main dam outlets to 6' x 12'	Enlarge 8 existing main dam outlets to 9'4" x 14' (4 upper tier outlets), and 9'4" x 12' (4 lower tier outlets)	
				Construct stilling basin modification with additional anchorage of apron slab
Modify Use of Surchage Storage	Raise impervious core in Mormon Island Auxiliary Dam, Dike 5, and Dike 7	No change from 1996 SIR	No change from 1996 SIR	Modified use of surcharge storage would not be necessary with implementation of the Folsom Dam Raise Project; modifications to existing emergency spillway tainter gates still under consideration as part of Folsom Dam Raise Project
	Modify surcharge operation to provide additional flood space	No change from 1996 SIR	No change from 1996 SIR	
	Construct parapet wall at Newcastle Powerhouse	No change from 1996 SIR	No parapet wall required	
	Raise penstock gate hoists and relocate hydraulic pumps	No change from 1996 SIR	No change from 1996 SIR	
	Replace 3 emergency spillway tainter gates with 42' x 59' tainter gates (new top of gate elevation of 476 feet)	No change from 1996 SIR	Design tainter gate foundations to permit expansion in future, if Folsom Dam Raise Project is implemented	
	Top-seal existing spillway tainter gates	No change from 1996 SIR	Top-seal not used (not technically feasible)	
Revise Interim Operation (permanent reoperation)	Reduce variable space allocated to flood control from 400-670 TAF to 400-600 TAF	No change from 1996 SIR	No change from 1996 SIR	No change from 1996 SIR
Update Folsom Dam Flood Management Plan	Revise plan to reflect operational capabilities provided by outlet modifications, surcharge storage space, and improved forecasting	No change from 1996 SIR	No change from 1996 SIR	No change from 1996 SIR
Key:	LRR = Limited Reevaluation Report SIR = Supplemental Information Report		TAF = thousand acre-feet WRDA = Water Resources Development Act	

Notes:

- American River Watershed Project, California, Supplemental Information Report, Corps, March 1996.
- Section 101(a) (6) of Water Resources Development Act of 1999 (PL 106-53).
- American River Watershed, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study, Corps, November 2003.

3.1.2.1 Benefits and Costs

The estimated costs and benefits for the Folsom Modification Project, as presented in the 2003 LRR, are summarized in **Table 3-2**. Note that in the 2003 LRR, the benefits and costs associated with the outlet works modifications were presented separately from those associated with the modified use of surcharge storage; this is because features associated with modifying surcharge space would not be required if the Folsom Dam Raise Project were authorized and implemented. The project features, costs, and benefits for the outlet works modification portion of the project are used as the basis for comparison in this *PAC Report*. Congress did not authorize the Folsom Dam Raise Project until after the 2003 LRR was completed. The plan described in the 2003 LRR would reduce the potential of flooding in Sacramento to about a 1 in 140 chance in any year.

**TABLE 3-2
BENEFITS AND COSTS FOR FOLSOM MODIFICATION PROJECT FEATURES
AS PRESENTED IN 2003 LRR (\$ MILLIONS) ¹**

Item	Outlet Works Modifications ²	Modified Use of Surcharge Space	Total
First Cost ³			
Lands and Damages	0	0	0
Relocations	0	0	0
Construction	140.3	25.1	165.4
Environmental Mitigation	0	0	0
EDS&A	43.5	5.2	48.7
Total	183.8	30.3	214.1
Investment Cost			
Total First Cost	183.8	30.3	214.1
Less PED Accrued	-3.9	0	-3.9
Interest During Construction	48.1	1.8	49.9
Total	228.0	32.1	260.1
Annual Cost ³			
Interest & Amortization	13.7	1.9	15.6
Operation and Maintenance	0	0	0
Total	13.7	1.9	15.6
Annual Flood Damage Reduction Benefits ⁴	26.0	5.2	31.2
Net Annual Benefits	12.3	3.3	15.6
Benefit-Cost Ratio	1.9	2.7	2.0
Key: EDS&A = engineering, design, supervision, and administration LRR = Limited Reevaluation Report PED = preconstruction, engineering, and design			

Notes:

1. American River Watershed, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study, Corps, November 2003.
2. The first and annual cost, as well as benefits of the outlet works, is used as the basis of comparison in this PAC Report in **Chapter 5**.
3. October 2003 price levels.
4. 50-year period of analysis and a 5-5/8 percent discount rate.

3.1.2.2 Cost-Sharing

Federal and non-Federal cost-sharing requirements for the Folsom Modification Project did not change in the 2003 LRR; in accordance with Federal cost-sharing requirements for flood damage reduction projects, costs were apportioned 65 percent Federal and 35 percent non-Federal. Of the estimated \$183.8 million first cost, the Federal contribution was estimated as \$139.5 million and the non-Federal contribution as \$74.6 million at October 2003 price levels.

Following release of the 2003 LRR, a Project Cooperation Agreement (PCA) for the Folsom Modification Project was executed on 30 March 2004. Under the PCA, The Reclamation Board of the State of California (The Reclamation Board) and SAFCA are the non-Federal sponsors.

3.1.3 Changes Since Authorization and 2003 Limited Reevaluation Report

Plans and specifications for the Folsom Modification Project were prepared in 2003 and 2004. It was decided as part of this process, in about March 2004, to divide the project into an upper tier contract (with six outlets) and a lower tier contract (with four outlets). Proposals were received in March 2005 for the upper tier outlets. The amount of the proposals exceeded the fully funded authorized costs (Section 902 limit) and the project solicitation was subsequently canceled in January 2006. The high bid estimates were largely due to key elements of high risk placed on the contractor, limited competition, and significant escalation in the cost of construction materials.

Consequently, dam operations and performance and alternate structural methods to achieve the flood damage reduction provided by the outlet modifications were reexamined. Subsequent studies also found that modification of the two outboard lower tier outlets was infeasible, and offered only a marginal increase in performance. Most recently, a gated auxiliary spillway has been identified as a viable “functionally equivalent” alternative to outlet modifications (see **Chapter 4**). The auxiliary spillway would be less costly because it would not entail the construction risk associated with the outlet modifications. In addition, material excavated from the auxiliary spillway site could be used for static and seismic dam safety improvements proposed by Reclamation. The new auxiliary spillway with submerged tainter gates would allow greater prereleases in anticipation of a large flood in a functionally similar manner to enlarging the existing outlets and constructing new outlets. Also, Reclamation identified a fuseplug with spillway that provided an opportunity for collaboration with the Corps on flood improvements at the dam.

Recent studies and direction related to the Folsom Modification Project have sought to jointly address the objective of flood damage reduction and dam safety. An engineering *Project Alternative Solutions Study* (PASS) was conducted jointly by the Corps and Reclamation in 2005 that examined five alternative auxiliary spillway and outlet modification combinations. Each scenario would pass the computed 200-year flood event (in combination with the Folsom Dam Raise Project, described below). It is estimated that the auxiliary spillway currently under evaluation would meet both the flood damage reduction improvement goals and Reclamation’s dam safety goals related to passing the Probable Maximum Flood (PMF).

Although the structural features of the Folsom Modification Project have changed over time, the scope of the authorized project remains focused on increasing the release capacity at Folsom Dam.

3.2 FOLSOM DAM RAISE PROJECT

As mentioned, the Folsom Dam Raise Project was authorized in 2003 in the Energy and Water Development Appropriations Act of 2004 based on recommendations contained in the November 2002 *Chief of Engineers Report*. This project is based on the findings in the 2002 *Long-Term Study*. Following is a summary of the authorized project and changes to the project since authorization.

3.2.1 Authorized Project

The Folsom Dam Raise Project consisted of the following major elements:

- Raise Folsom Dam, wing walls, and dikes by 7 feet
- Construct a temporary or permanent bridge downstream from Folsom Dam
- Modify L.L. Anderson Dam spillway at French Meadows Reservoir
- Implement ecosystem restoration features to benefit the lower American River

As authorized, the Folsom Dam elements involve raising the main concrete section of the dam, adding a 3.5-foot parapet wall, raising the earth embankments on either side of the dam, adding larger spillway radial gates, and raising Mormon Island Auxiliary Dam (MIAD) and the eight dikes around the lake by about 7 feet. In addition, the existing spillway stilling basin would be extended about 60 feet to provide adequate energy dissipation. These modifications would add about 95,000 acre-feet of flood storage capacity to the reservoir. A permanent bridge would reroute traffic from Folsom Dam Road during and after construction of the dam raise.

Modifications to L.L. Anderson Dam, located on the Middle Fork of the American River at French Meadows Reservoir, would involve enlarging the spillway to allow safe passage of the PMF; these improvements would reduce impacts to Folsom Dam from a potential failure of L.L. Anderson Dam.

The project authorized in 2003 differs from the project recommended in the 2002 *Long-Term Study* in that Congress approved construction of a permanent bridge rather than a temporary bridge. A permanent bridge would mitigate for the closure of Folsom Dam Road during construction, while also providing greater security for the dam. The Corps September 2006 *American River Watershed Project, California, Folsom Dam Raise, Folsom Bridge Final Post Authorization Decision Document/Environmental Impact Statement/Environmental Impact Report* (PADD) documented the change from a temporary to a permanent bridge feature.

The authorized project includes ecosystem restoration features. These features include construction of automated temperature control shutters (existing shutters are operated manually)

at Folsom Dam to benefit American River fisheries, and active habitat restoration at two sites along the lower American River – Woodlake Restoration Site and Bushy Lake Restoration Site.

3.2.1.1 Benefits and Costs

Table 3-3 includes relevant information on estimated costs and benefits from the February 2002 Long-Term Study, 2002 Chief of Engineers Report, 2004 authorization language (cost only), and Corps May 2006 American River Watershed Project, California, Draft Folsom Dam Raise, Folsom Bridge PADD. From the table, the total first cost has ranged from about \$219 million at 2001 price levels to approximately \$363 million at 2005 price levels. Primary reasons for these cost increases have been the addition of a permanent bridge at Folsom as well as overall price level changes.

**TABLE 3-3
SUMMARY OF BENEFITS AND COSTS AS AVAILABLE FOR FOLSOM DAM RAISE PROJECT (\$ MILLIONS)**

Item	2002 Long-Term Study ¹	2002 Chief of Engineers Report ²	Authorized Project ³	Folsom Dam Raise, Folsom Bridge Report ⁴
	October 2001 Price Levels	October 2001 Price Levels	October 2003 Price Levels	October 2005 Price Levels
First Cost				
Flood Damage Reduction	99.0	128.2	--	272.6
Ecosystem Restoration	27.3	27.4	--	33.1
Dam Safety	92.6	93	--	⁴
Permanent Bridge	Not included	Not included	--	57.2
Total	218.9	248.6	257.3	362.9
Annual Cost Flood Damage Reduction	7.8	10.2	--	--
Annual Flood Damage Reduction Benefits	19.2	19.2	--	--
Net Benefits	11.4	9.0	--	--
Benefit-to-Cost Ratio	2.5	1.9	--	--

Note:

1. Costs and benefits for recommended plan from the Corps February 2002 American River Watershed, California, Long-Term Study.
2. Authorized project cost estimate as described in the 5 November 2002 Chief of Engineers Report for the Long-Term Study.
3. Authorized cost cited in the 2004 Energy and Water Development Act.
4. Corps May 2006 American River Watershed Project, California, Draft Folsom Dam Raise, Folsom Bridge Post-Authorization Decision Document.
5. Costs for dam safety included as part of identified cost for flood damage reduction.

The project identified in the 2002 Long-Term Study and 2002 Chief of Engineers Report included provision to address dam safety and temporary impacts to transportation across Folsom Dam. The authorized project also included separate provisions for a permanent bridge.

Table 3-4 is from the above-referenced 2006 Corps PADD report and shows total costs for various project components based on October 2005 price levels.

As mentioned, the Folsom Modification Project and Common Features alone would reduce the risk of flood damages to a 1 in 140 chance in any year. However, in combination with the Folsom Dam Raise Project, risk of flood damages would be reduced to about a 1 in 175 chance in any given year.

**TABLE 3-4
SUMMARY COSTS FOR FOLSOM DAM RAISE PROJECT FEATURES
(\$ MILLIONS)¹**

Item	Folsom Dam Raise	Permanent Bridge ²	L.L. Anderson	Ecosystem Restoration	Total
First Cost					
Lands and Damages	0.9	8.1	0	1.10	10.1
Relocations	2.8	4.0	0	0	6.8
Construction	152.0	68.9	11.3	24.6	256.8
Environmental Mitigation	4.9	3.0	0	0	7.9
Cultural Resources	1.9	0.5	0	1.1	3.5
EDS&A	30.2	11.8	3.4	6.3	51.7
PED Sunk Costs	18.3	7.8	0	0	26.1
Total First Cost	211.0	104.1	14.7	33.1	362.9
Key: EDS&A = engineering, design, supervision, and administration PED = preconstruction, engineering, and design					

Notes:

1. Costs in October 2005 price levels as reported in Corps May 2006 American River Watershed Project, California, Draft Folsom Dam Raise, Folsom Bridge Post Authorization Decision Document.
2. Bridge costs include \$46.9 million as the cost of a temporary bridge and \$57.2 million as the remaining cost for the permanent bridge increment.

3.2.1.2 Cost-Sharing

The Folsom Dam Raise Project includes both flood damage reduction and ecosystem restoration purposes. In accordance with Federal cost-sharing requirements for flood damage reduction projects, costs allocated to flood damage reduction were apportioned 65 percent Federal and 35 percent non-Federal. Non-Federal sponsor(s) would be responsible for all lands, easements, rights-of-way, and relocations. For the ecosystem restoration elements of the project, the non-Federal sponsor(s) would be responsible for 35 percent of the costs allocated to ecosystem restoration.

Of the \$257.3 million total cost listed in Section 128 of PL 108-137, the Federal share was \$201.2 million and the non-Federal share was \$56.1 million. PL 108-137 also authorized the Secretary of the Army to accept funds from local, State, and other Federal agencies for construction of a permanent bridge, should the cost of a permanent bridge exceed the \$36 million for a temporary bridge included in the recommended plan. This act also authorized an additional \$30 million as a Federal contribution towards the permanent bridge. In fall 2005, the Energy and Water Development Appropriations Act of 2006 (PL 109-103) authorized \$30 million in Federal funds for the permanent bridge, and the \$36 million assigned to the temporary bridge could be inflated, as prescribed in Section 902 of PL 99-662.

The September 2006 *Final PADD* reports the total cost of the bridge as \$110.7 million. Of this total, the temporary bridge cost is \$47.8 million (current estimate of \$49.9 million) and the balance for the permanent bridge is \$62.9 million (current estimate of \$65.7 million). The original \$30 million Federal contribution to the permanent bridge was increased.

The \$47.8 million for the temporary bridge was part of the Folsom Dam Raise Project cost. This cost was split between dam safety and flood damage reduction. As part of the authorized project, the flood damage reduction portion would be cost-shared with The Reclamation Board and SAFCA. Local funds contributed to the temporary portion of the bridge cost are credited towards the local share of the Folsom Dam Raise Project as a whole. The dam safety portion is budgeted as a Federal cost.

The permanent portion of the bridge cost, including all lands, easements, rights-of-way, and relocations, is the responsibility of the City of Folsom, with the exception of the \$41.5 million Federal contribution authorized by Congress. Local sponsors for the project include The Reclamation Board, SAFCA, and the City of Folsom (for the permanent bridge component only). OMRR&R related to Folsom Dam would continue to be performed by Reclamation; these costs would be shared by SAFCA under an initial cost-sharing agreement. The City of Folsom would assume all responsibilities for OMRR&R of the bridge component.

3.2.2 Changes Since Authorization

Since authorization, the Folsom Dam Raise Project has been subject to cost increases due to increases in construction material costs, safety and security considerations at the dam, and a decrease in the availability of contractors. Modifications to the L.L. Anderson spillway have been dropped from further consideration in the plan because the Federal Energy Regulatory Commission has jurisdiction to resolve the dam safety issues as a separate project. Efforts are moving forward on activities to design and advance implementation of the Folsom Bridge. The bridge is scheduled for completion in December 2008. Major efforts on raising Folsom Dam have continued but at a slower pace due to the likely need to consider any dam raise along with further features to modify Folsom Dam. In addition, recent studies related to the Folsom Dam Raise Project have sought compatibility and greater efficiency between the flood damage reduction projects and Reclamation's dam safety objectives at Folsom Dam. The 2005 engineering *PASS* examined various combinations of outlet modifications and dam raises to pass the computed 200-year inflow design event. Of the alternatives considered, a 7-foot dam raise in combination with a new auxiliary spillway was selected for more detailed analysis in a second phase of engineering studies, titled *PASS II*, which was completed in 2006 (Corps and Reclamation).

PASS II indicated that the cost of the 7-foot dam raise is higher than reported in the 2002 *Long-Term Study*. Due to the higher estimated cost of a 7-foot dam raise, The Reclamation Board and SAFCA have expressed interest in exploring alternatives to raising the dam. In addition, a smaller, 3.5-foot dam raise (in combination with a new auxiliary spillway) has also been considered.

3.3 FOLSOM DAM SAFETY PROJECTS

Folsom Dam and Reservoir are important surface storage elements of the Central Valley Project (CVP). Reclamation operates the CVP to provide water supplies for agricultural, municipal and industrial (M&I), and environmental purposes. This section describes the features and operation of the American River Division, Folsom Dam Unit, of the CVP, and dam safety issues at Folsom Dam that Reclamation is seeking to address.

3.3.1 American River Division, Folsom Dam Unit

The CVP was created under the Central Valley Project Act in 1933 and became subject to Reclamation under the Rivers and Harbors Act in 1937. The American River Division of the CVP provides water for irrigation and M&I use, recreation, and hydroelectric power. The American River Division facilities consist of the Folsom Dam Unit, Sly Park Unit, and Auburn-South Unit. The Folsom Unit consists of Folsom Dam, Folsom Reservoir, the Folsom Powerplant, Nimbus Dam and Lake Natoma, Nimbus Powerplant, and Nimbus Fish Hatchery.

Folsom Dam was originally authorized for construction in the Flood Control Act of 1944 as a reservoir with 355,000 acre-feet of capacity for flood control purposes. As part of the American River Division Authorization Act in 1949, construction of Folsom Dam was reauthorized with an enlarged capacity of 1,000,000 acre-feet. In addition, the reauthorization added a 162,000-kilowatt (kW) powerplant, with Lake Natoma to serve as a regulating reservoir for the powerplant. The authorization for construction of Lake Natoma and Nimbus Dam included Nimbus Powerplant, with a 13,500 kW production capacity, and Nimbus Fish Hatchery. The Corps completed construction of Folsom Dam in 1956, at which time Reclamation took over OMRR&R of the facility. Current capacity of the reservoir and related details are described in **Chapter 2**.

3.3.2 Dam Safety

Reclamation's Safety of Dams program was officially implemented in 1978 with passage of the Reclamation Safety of Dams Act, PL 95-578, and was amended in 1984 by PL 98-404. The program receives appropriations annually on a Nation-wide basis, and then establishes priorities that are subject to changes by Congress and by the Office of Management and Budget. The Safety of Dams program has recognized Folsom Dam as its top safety priority. The inability of Folsom Dam to pass the PMF event is a dam safety risk recognized by the Corps, Reclamation, and State of California Division of Safety of Dams. Under Section 128 of the Energy and Water Development Appropriations Act of 2006 (PL 109-103), the Corps and Reclamation were directed to collaborate on activities to address dam safety and to reduce flood damage at Folsom Dam and Reservoir, and to consider reasonable modifications to existing authorized activities, including the auxiliary spillway.

Limited storage and release capacity and structural issues are concerns of the Folsom Dam Unit. The current state of these issues is described in **Chapter 2**. To address the risk to PMF dam safety, Reclamation intends to move forward with construction of a new fuseplug spillway if the Corps does not implement a flood damage reduction project. Material from excavation for the spillway would be used to construct dam safety features at MIAD.

The predicted flows of the PMF could be accommodated by the construction of an emergency fuseplug spillway in combination with the existing facilities. The spillway would mitigate the PMF through increased ability to control reservoir capacity. The ability to pass the PMF would reduce the risk of overtopping and failure of the embankment dams and dikes. This solution addresses all of the embankment features, but would have the most potential benefit for the right wing dam, left wing dam, and MIAD. The structure of the emergency fuseplug spillway is described in **Section 2.5.5** of this report; the fuseplug is shown in plan view in **Plate 7**, with a detailed view of the fuseplug in **Plate 8**. Reclamation's current plans call for excavation for the emergency fuseplug spillway to begin in 2007. Construction of the static and seismic dam safety improvements would begin in 2010 and be completed in 2014.

3.4 PROJECT COLLABORATION AND AUXILLARY SPILLWAY

As discussed above, two authorized projects of the Corps, the Folsom Modification Project and Folsom Dam Raise Project, share an objective of reducing flood risk on the lower American River primarily through structural modifications to the existing Folsom Dam and appurtenant facilities. Concurrently, Reclamation was working to implement its Reclamation Safety of Dams program for safety improvements at the Folsom facility. One of Reclamation's dam safety objectives was for the dam to pass the PMF. The timing of both of these Federal efforts created an opportunity to develop a more efficient and cost effective joint plan that addressed both flood damage reduction and dam safety objectives in a single project.

As noted, Congress directed the Corps and Reclamation to collaborate to maximize flood damage reduction and address dam safety at Folsom Dam in the Energy and Water Development Appropriations Act of 2006 (PL 109-103). PL 109-103 directed the Corps and Reclamation to consider reasonable modifications to the existing authorized activities, including an auxiliary spillway.

CHAPTER 4.0 AUTHORIZED PROJECT REFINEMENT

4.1 REFINEMENT PROCESS

As mentioned, Congress authorized both the Folsom Modification Project and the Folsom Dam Raise Project to help decrease the level of flood risk for Sacramento. The Folsom Dam Raise Project was also to resolve hydrologic dam safety issues at Folsom and provide ecosystem restoration opportunities along the lower American River. In addition, Congress authorized reasonable modifications to the authorized activities, including an auxiliary spillway to address both flood damage reduction and hydraulic dam safety, in the Energy and Water Development Appropriations Act of 2006 (Public Law (PL) 109-103). Currently, (1) no project has been implemented, (2) the United States Department of the Interior, Bureau of Reclamation (Reclamation), fully intends to resolve dam safety concerns at Folsom, and (3) it appears likely that a project that would best address both the flood damage reduction and dam safety issues would include an auxiliary spillway. For these reasons, and in accordance with congressional direction in PL 109-103 for the Secretaries of the Army and Interior to collaborate on authorized activities to maximize flood damage reduction improvements, and address dam safety needs at Folsom, there is a need to review, update, and refine existing information to identify a project to meet the needs of the two agencies and local interests. The basic process followed to identify this project in this *Post Authorization Change (PAC) Report* consisted of these steps:

- Given residual flood problems along the American River, major efforts accomplished to date to address the flood and related issues (Folsom Modification, Folsom Dam Raise, and Folsom Dam Safety issues), and desires of the non-Federal project sponsors, develop/refine a specific set of project objectives.
- Develop a set of project constraints to be used to identify and compare alternative elements that address the objectives.
- Identify the available set of potential project plans capable of meeting the project objectives consistent with the identified constraints and criteria.
- Compare the identified alternatives and identify actions for recommended implementation.

4.2 PROJECT OBJECTIVES

Major efforts have been made since the February 1986 flood to identify and document flood and related water resources problems in the American River Watershed. In addition, a series of detailed feasibility-scope studies has been conducted, each of which has resulted in congressional authorization of incremental actions to address the serious flood threat to much of the Sacramento area. Project objectives are as follows:

- Primarily from the results of approved studies and authorized projects to date, develop a modification of Folsom Dam and Reservoir capable of reducing flood damages to areas

along the American River, California, generally functionally equivalent to the flood risk reduction intended to be provided by the authorized Folsom Modification and Folsom Dam Raise projects.

- Ensure that the identified refined project provides for the following:
 - Includes features to pass the Probable Maximum Flood (PMF).
 - Allows and accounts for early implementation of the Folsom Dam Bridge.
 - Retains the capability to implement ecosystem features, as authorized for the Folsom Dam Raise Project.
- Meet the minimum community goal, as articulated by the Sacramento Area Flood Control Agency (SAFCA), of having a project capable of safely passing the 200-year computed design flood event.

As described in **Chapter 1**, single event references such as the above objective of passing the 200-year computed design flood event are not used as part of the United States Army Corps of Engineers (Corps) risk-based guidance for project development. However, this objective is considered by the non-Federal sponsor to be important and a convenient way of imparting information about project performance. Accordingly, efforts are made in this *PAC Report* to characterize the ability of alternatives considered in achieving the non-Federal objective as well as defining performance in terms consistent with Corps guidance.

4.3 CONSTRAINTS

To help guide identification and further development of a project that jointly addresses the objectives of the Corps and Reclamation, several project constraints were developed. Some of the constraints are fairly rigid, and include congressional direction; current applicable laws, regulations, and policies; and physical conditions such as topography, hydrology, and other physical limiting factors. Several major constraints are described below:

- **Project Authorization** – As mentioned, the Energy and Water Development Act of 2006 directed the Secretary of the Army and Secretary of the Interior to collaborate on activities to maximize flood damage reduction and improve dam safety needs at Folsom Dam. Earlier authorizations (see Existing Project Authorizations section in **Chapter 1**) identified actions associated with modifications to Folsom Dam and Reservoir, as well as other system improvements, to accomplish specific flood damage reduction and dam safety goals in the Sacramento area.
- **Project Area** – The primary project area for which reduced flood risk is being addressed is the lower American River. Potential alternatives to be considered in the *PAC Report* will be limited, consistent with the findings of numerous previous Federal studies and the various project authorizations described in **Chapter 1** for modifications to Folsom Dam and Reservoir.
- **Laws, Regulations, and Policies** – Numerous laws, regulations, executive orders, and policies need to be considered, including, but not limited to, the Clean Water Act, Clean

Air Act, Endangered Species Act, and Federal and State environmental compliance regulations.

Various other constraints also need to be considered to help guide development of a selected plan. These relate to economic justification, environmental compliance, technical standards, etc. Also, many of the constraints relate to local policies, practices, and conditions. Following are several additional constraints identified to help develop a selected plan:

- A selected plan is to be cost effective; that is, it should be economically feasible - producing economic annual benefits greater than average annual costs.
- To allow for maximum Federal financial participation, a selected plan needs to be shown to produce economic benefits on the ascending limb of the net benefit curve.
- A selected plan should be functionally equivalent to the originally authorized projects.
- A selected plan needs to address each of the project objectives.
- A selected plan should avoid significant hydrologic impacts to areas downstream from the American River.
- A selected plan should strive to either avoid potential adverse impacts to environmental resources, or to include features to mitigate unavoidable impacts through enhanced designs, construction methods, and/or facilities operations.
- A selected plan should not result in significant adverse impacts to existing water supplies, recreation facilities, hydropower generation, or related water resources conditions.
- A selected plan is to be developed and evaluated based on a 50-year period of analysis.
- First costs are to reflect current prices and price levels, and annual costs are to include a Federal discount rate and allowance for interest during construction. There are three levels of cost estimates to be considered; each is to be used for different purposes in the analysis. Following are the three cost estimate levels and the purpose for which they are to be used:
 - **Cost Distribution** – Cost estimates were prepared for various modifications of Folsom Dam and auxiliary spillway configurations to develop a method to be used to distribute costs primarily between the purpose of flood damage reduction and the function of dam safety. This distribution method is described in **Appendix F - Cost Distribution**. It uses cost estimates developed to a level of specificity sufficient to distinguish between the purposes/function, and adequate for application to any alternatives identified for implementation.
 - **Alternatives Comparison** – Cost estimates were developed for numerous alternatives for the purpose of identifying which alternative or combination of alternatives best addressed the scope of the two authorized projects. These estimates

are to a feasibility level of development. They are appropriate to adequately describe the relative differences in costs, and sufficient for use in the economic comparison of the alternatives.

- **Selected Plan** – Detailed microcomputer-aided cost engineering system (MCACES) cost estimates were developed for the plan selected and described at the end of this chapter. These estimates are also to a feasibility level of development but include additional detail sufficient to support the recommendation contained in this *PAC Report*.

4.4 POTENTIAL FEATURES

Numerous structural and nonstructural measures that could contribute to helping reduce flood damages primarily to areas of Sacramento along the American River have been exhaustively developed in various prior studies and reports. Many of these features, especially related to levee improvements, flood management, and evacuation planning, have been incorporated into various plans and implemented in previous projects. In addition, previous evaluations have found that further increases to downstream levee capacity would be less efficient at reducing flood risk compared to improvements at Folsom Dam.

From the measures identified in previous studies and projects, following is a brief summary of several of the most significant potential plan features that have been identified as possible components for addressing the project objectives. Again, these are not the only potential features to address the project objectives. However, they are the significant features primarily associated with modifications of Folsom Dam and Reservoir found in previous studies to have the greatest potential to benefit flood damage reduction, and/or dam safety.

4.4.1 Increase Objective Release

This feature consists of increasing the objective release from Folsom Dam of 115,000 cubic feet per second (cfs) to about 180,000 cfs, similar to that for the Stepped Release Plan in the Corps *1996 Supplemental Information Report* (1996 SIR) for the American River Watershed Investigation (ARWI). It is estimated that Folsom Dam, with the existing objective release of 115,000 cfs, can control floods with up to about a 1 in 81 chance of occurring in any year. For larger events, greater outflows are required to maintain the allowable flood control space in the reservoir. As a result of levee modifications (Common Features Project described in **Chapter 2**) being made in accordance with the Water Resources Development Act (WRDA) of 1996 and WRDA 1999, the safe channel-carrying capacity of the American River will be increased to about 160,000 cfs. This feature would require further modifications, primarily to levees and related flood damage reduction facilities along the lower American River and further downstream, to accommodate the increased flow from Folsom Dam. Although this feature would depend on a change in the operation of Folsom Dam and Reservoir, it would also require major system modifications significantly divergent from the existing authorizations; therefore, this feature was not considered further.

4.4.2 Replace Main Spillway Gates

The 1996 SIR included lowering the spillway crest of the five bays of the main spillway at Folsom Dam by about 15 feet through removing existing concrete from each bay. It also included replacing the existing spillway tainter (radial arm) gates with larger (higher) gates. This work would allow releases through each spillway to be made sooner during a flood, thus increasing the effectiveness of the flood storage space behind the dam. This feature was included as part of the Folsom Modification Plan in the 1996 SIR. It was accordingly included in the WRDA 1999 authorization but was subsequently deleted from consideration during more detailed planning and design evaluations as part of the Corps 2003 American River Watershed, California, Folsom Dam Modification Final Limited Reevaluation Report and Environmental Assessment/Initial Study (2003 LRR). However, should Folsom Dam be raised over about 3.5 feet, the existing main spillway gates would need to be replaced. Accordingly, a feature to lower the spillway was eliminated from alternatives for a potential selected plan, but replacing the spillway tainter gates was retained for alternatives requiring a significant raise of Folsom Dam.

4.4.3 Modify Outlets

This feature includes enlarging six of the eight existing outlets and constructing two new outlets. A major feature in the 1999 authorized project called for enlarging the eight existing outlets and constructing five new outlets under the emergency spillway. In the 2003 LRR, the plan was changed to enlarging the eight existing outlets and constructing two new lower tier outlets. However, during subsequent evaluations, it was determined that while physically feasible, because of major difficulties associated with constructing the two new outlets while maintaining a full or nearly full reservoir pool, the estimated cost to accomplish this feature would be prohibitive. This feature was retained for consideration, as appropriate, in alternatives for a potential Selected Plan.

4.4.4 Modify Folsom Flood Space

This feature includes increasing the seasonal flood control storage space in Folsom Reservoir. In 1995, an interim operation agreement was reached between Reclamation and SAFCA to increase the seasonal flood space in Folsom Reservoir from 400,000 acre-feet to a space varying from 400,000 to 670,000 acre-feet. This seasonal increase significantly increases the ability of Folsom Reservoir to accommodate storm flood events. As part of the authorization for the Folsom Dam Modifications in WRDA 1999, this variable space could be reduced to 400,000 to 600,000 acre-feet once the modifications were completed (see **Plate 9**). The authorized Folsom Dam Raise Project (Energy and Water Development Appropriations Act of 2004) included an increase in this flood storage capacity of 95,000 acre-feet. The concept of modifying Folsom flood space was retained for inclusion in alternatives to determine a potential Selected Plan.

4.4.5 Surcharge Storage

Folsom Reservoir has approximately 14.5 feet of freeboard above the gross pool elevation of 466 feet. A portion of this freeboard has occasionally been “encroached” upon

during flood operations. This space above gross pool is called “surcharge” space. This feature consists of crediting much of the surcharge space to regular flood operations. This would primarily include (1) changing the release diagram for the emergency spillway, (2) replacing the three existing emergency spillway tainter gates with larger (higher) gates, (3) raising the penstock hydraulic control pumps and controls, and (4) raising the height of the impervious core in Dikes 5 and 7 and Mormon Island Auxiliary Dam (MIAD). This feature was included as part of the Folsom Modification Plan in the *1996 SIR*. It was also included in the WRDA 1999 authorization and retained for more detailed evaluations as part of the *2003 LRR*. **Plate 10** illustrates the differences between the existing and replaced emergency spillway gating necessary for this feature. As mentioned, the Folsom Dam Raise Project negated the need for replacing the three existing emergency spillway tainter gates as part of the Folsom Dam Modification Project. Accordingly, structural measures to allow further use of surcharge storage were eliminated from further consideration. However, reservoir operations relying on the use of surcharge storage space remains an effective measure for flood damage reduction and was retained for consideration in all alternatives.

4.4.6 Advanced Release

Section 101(a)(6)(E) of WRDA 1999 directed the Corps and Reclamation to update the flood management plan to reflect operational capabilities created by the Folsom Dam Modification Project and improved weather forecasts. This innovative means of further reducing the risk of flooding involves eliminating reliance on simple rule curves that respond to reservoir surface elevation and observed inflow, and instead making flood operation decisions based on inflow forecast by measuring precipitation in the watershed or, alternatively, based on precipitation forecasts by observing incoming storms. Watershed precipitation forecasts could allow for releases as many as 3 days in advance. The effect of advance release is to create additional flood space in Folsom Reservoir by temporarily reducing water supply storage. Because forecast-based operation is still being formulated, and is not yet approved by the Corps or Reclamation, it is uncertain how this operation will be performed. Accordingly, forecast-based operation was not specifically considered further in reservoir operation scenarios for alternative plans in this *PAC Report*. However, the Corps intends to pursue assessing the potential to improve flood operations at Folsom Dam and Reservoir using forecast-based operations.

4.4.7 Raise Folsom Dam

This feature primarily includes increasing the height of Folsom Dam. In addition to flood damage reduction benefits, this concept could also resolve hydrologic dam safety issues at Folsom Dam, passing the PMF. Various dam raise options up to 30 feet have been considered in previous studies. As previously mentioned, however, in the Energy and Water Development Appropriations Act of 2004, Congress authorized a plan to raise Folsom Dam consistent with the *Chief of Engineers Report* dated 5 November 2002. This report called for raising the dam 7 feet, replacing five main dam spillway gates and three emergency spillway gates, and modifying various reservoir area dikes (see **Plate 11**). Other dam raise options, ranging from 3.5 feet to 12 feet, were considered in supporting studies. A project to raise Folsom Dam, as authorized, would also include enlarging the existing spillway at L.L. Anderson Dam (the *2002 Long-Term*

Study and 2002 Chief of Engineer's Report made the L.L. Anderson feature dependent on the Federal Energy Regulatory Commission (FERC) and California Department of Water Resources (DWR)); ecosystem restoration and habitat improvements; and building a permanent bridge just downstream from Folsom Dam. Subsequent studies have determined that modifications of L.L. Anderson Dam will be accomplished independently of any actions associated with further efforts to address flood problems on the American River. In addition, construction of the Folsom Dam Permanent Bridge was authorized for advance construction in the Energy and Water Development Appropriations Act of 2004. Raising Folsom Dam, and associated project elements, as authorized in the Energy and Water Development Appropriations Act of 2004, was retained for inclusion in alternatives to determine a potential Selected Plan.

4.4.8 Auxiliary Spillway

This feature consists of the construction of an auxiliary spillway southwest of the existing Folsom Dam (**Plate 12**). This spillway was site-adapted from DWR's Oroville Dam flood control structure primarily to provide enhanced flood damage reduction and hydrologic risk reduction. For flood damage reduction, this feature primarily includes (1) an approach channel beginning in Folsom Lake, (2) control structure, including six submerged tainter gates, (3) a spillway chute, and (4) stilling basin in the American River. This feature was developed following a determination in approximately 2004 that new outlets and enlarging the existing eight outlets would cost significantly more than previously estimated, and that the 902 limitation would be exceeded. This feature was retained for consideration in alternatives to determine a potential Selected Plan.

The auxiliary spillway would address the flood damage reduction objective and would be capable of addressing hydrologic dam safety issues at Folsom. An alternative to the auxiliary spillway described above that addresses dam safety only has been designed by Reclamation. This would involve construction of an "emergency fuseplug" control structure (in lieu of the six submerged tainter gate control structure) and spillway, designed to be used only during extremely rare events. The fuseplug spillway alignment is shown in **Plate 7**; various plan, profile, and section views of the fuseplug sections and spillway are included in **Plate 8**. The fuseplug would be constructed of embankment materials near the upstream end of the structure and designed to erode at a predicted rate during a PMF event. This feature is a major element of the No-Action Plan and is included in one of the action alternative plans.

4.5 ALTERNATIVES

From the above features identified for further consideration, numerous conceptual alternatives were developed (see **Appendix A - Folsom Modification Project Engineering Design Report** and **Appendix B - Folsom Dam Raise Project Engineering Design Report**), some of which addressed only flood damage reduction objectives (**Appendix A**) and others that addressed both flood damage reduction and dam safety objectives (**Appendix B**). From these conceptual alternatives, and in coordination with representatives from Reclamation, SAFCA, and DWR, four action alternative plans that addressed both flood damage reduction and dam safety objectives were developed by the Corps. These action alternative plans, along with the No-Action Plan, are described below. The action alternative plans are believed sufficient to cover

the viable range of possible actions. The primary method used in the development of alternatives was to consider, in various combinations, the features retained for further consideration from **Section 4.4**. From these combinations, numerous potential action alternative plans were developed; however, those listed below are considered to be the most likely to continue to be economically feasible, closely meet the objectives and accomplishments of the two authorized projects, and provide the greatest net benefits, and could be supported by the non-Federal sponsor. All of the action alternative plans address the project objectives and constraints above. Each would result in a reduction of flood damages along the American River. In addition, each would include provisions to pass the PMF, as defined by the Corps and Reclamation. All of the action alternative plans allow for early implementation of the Folsom Dam Bridge and retain the capability for inclusion of ecosystem restoration features. In addition, all of the action alternative plans retain the ability for further improvements in flood protection, including a further raise of Folsom Dam and Reservoir.

4.5.1 No-Action Plan

This alternative plan consists of the Federal Government taking no further action to reduce flood damages in the Sacramento area. It does assume, however, completion of flood damage reduction efforts currently underway, as described in **Chapter 2**. As mentioned, this primarily includes (1) continuing the 400,000 to 670,000 acre-foot variable space flood pool interim operation at Folsom, (2) completing the Common Features Project along the American River, (3) implementing seismic and static retrofit work at Folsom facilities, (4) constructing a new permanent bridge just west of Folsom Dam, (5) constructing an emergency fuseplug spillway project to pass the PMF near the south abutment of the main Folsom Dam, and (6) modification of the L.L. Anderson Dam spillway by Placer County Water Agency.

As part of the interim operation above, and described in **Section 2.5**, this alternative plan also includes a temporary modification to the Folsom Dam Flood Control Diagram adopted by Reclamation and SAFCA. This modification was agreed to by the two interests under a contract dated 6 December 2004 (see Reclamation transmittal letter in **Appendix G – Pertinent Correspondence**). Basically, this modification includes the following:

- Limit the outflow from Folsom Dam to a maximum of 145,000 cfs while the lake level is below elevation 470 feet. Outflows greater than 115,000 cfs would be limited to very infrequent flood events.
- Use 100 percent gate openings for the eight 5-foot by 9-foot outlet gates in conjunction with the use of the service spillway, if required. This operation would be limited to very infrequent flood events after total outflows exceed 115,000 cfs.

Once the Common Features Project is completed, it is expected that the above interim operation actions would no longer be needed.

It is important to compare the existing conditions with the No-Action Plan as it pertains to the PMF pool elevation. Under the existing conditions, the PMF pool elevation would be 483.3 feet (2.8 feet above top of dam). **Table 4-1** compares pertinent elevations under the existing

conditions and the No-Action Plan. Under the No-Action Plan, and with the fuseplug spillway in place, the PMF pool would be 477.6 feet.

**TABLE 4-1
COMPARISON OF PERTINENT ELEVATIONS FOR THE EXISTING
CONDITIONS AND NO-ACTION PLAN (feet)**

Item	Existing Conditions	No-Action Plan (with fuseplug spillway)
Top of Dam	480.5	480.5
Maximum Authorized Flood Pool Elevation	466.0	466.0
0.5% Chance Pool ¹ Elevation	474.6	474.6
PMF Pool Elevation	483.3	477.6
Key: PMF = Probable Maximum Flood		

Note:

1. Pool elevation equal to that reached under the non-Federal sponsors' design flood event objective.

The authorized top of flood pool at Folsom Reservoir is at reservoir water surface elevation 466 feet. With the No-Action Plan, the current PMF reservoir elevation, with induced surcharge (space above flood pool), is 477.6 feet. For perspective, the pool elevation associated with a 200-year flood event would be at elevation 474.6 feet (outflows greater than 350,000 cfs). Folsom Dam currently is unable to pass the PMF without overtopping the dam because the top of dam is 480.5 feet. The emergency fuseplug would be constructed to pass the PMF near the south abutment of the main Folsom Dam.

Despite downstream levee improvements, Folsom Dam operations would not change significantly and therefore would not use improved downstream channel capacity.

In accordance with policy at the time, real estate interests were defined to be the authorized top of flood pool elevation plus 10 feet of elevation. The original take line for associated real estate was determined to be at elevation 476.0 feet.

Under the No-Action Plan, much of the Sacramento area would have protection from the 100-year single event flood. This equates to a flood with an annual exceedence probability (AEP) of 0.0124 (about a 1 in 81 chance in any 1 year). The estimated expected annual damages in Sacramento are about \$198.2 million (October 2006 price levels). A description of estimated flood damages under the No-Action Plan as well as for each of the action alternative plans below is contained in **Appendix E – Economics**.

4.5.2 Alternative A – Eight Main Dam Outlets and Fuseplug Spillway

This action alternative plan consists of three major features: (1) enlarging six of the eight existing outlets, (2) constructing two new outlets along the upper outlet tier, and (3) constructing an emergency fuseplug spillway. Because of hydrologic, geotechnical, and structural problems, the two lower tier outside outlets (Outlets 1 and 4) would not be modified and would retain their original dimensions. The resulting outlet modifications would be capable of releasing 115,000 cfs at a spillway crest elevation of 418.0 feet. The four upper tier gates would be enlarged to 9 feet, 4 inches wide, by 14 feet high, and the four lower tier outlets would be enlarged to 9 feet, 4

inches, by 12 feet. More detailed information on this feature is contained in the Corps 2003 LRR for the authorized Folsom Dam Modification Project. The second major feature is the emergency fuseplug spillway (see **Plates 7 and 8**). As mentioned, lacking implementation of major features to help reduce flood damages along the lower American River, Reclamation plans to construct an emergency fuseplug spillway as part of an effort to address dam safety at Folsom Dam. The fuseplug spillway would be composed of an earthen embankment on top of concrete lining and a concrete-lined chute that would convey flows away from the fuseplug to the American River. The earthen embankment would be designed to erode at a predicted rate as the pool level approaches the minimum freeboard level. After the embankment is washed away, the remaining concrete spillway (combined with discharge facilities from the main dam) would be capable of passing the PMF. In addition to the above, this alternative also includes retention of a variable flood space in Folsom Reservoir that would range between 400,000 and 600,000 acre-feet. Fuseplug spillway construction would be to address the PMF (dam safety), and the outlet modification and retained reservoir operation would be for flood damage reduction.

4.5.2.1 Accomplishments

The primary accomplishments of this action alternative plan are flood damage reduction and dam safety.

- Flood Damage Reduction** – As shown in **Table 4-2**, this plan would result in a reduced flood risk to Sacramento by reducing the AEP of flooding along the American River from 0.0124 to 0.0068 (from a 1 in 81 chance in any year to a 1 in 147 chance). This plan would provide the capability for Folsom Dam and Reservoir to pass, with sustained outflows of 160,000 cfs, the 180-year design flood event. Accordingly, this would not meet the minimum requirement of SAFCA and The Reclamation Board of the State of California (The Reclamation Board). Over the course of a decade (see **Table 4-2**), it is estimated that there would be a 6.6 percent chance of flooding with this plan versus about a 12 percent chance under existing conditions. Within the span of a 30-year home mortgage, it is estimated that there would be an 18.5 percent chance of flooding with this plan versus a 30 percent chance under existing conditions. Further, over a 50-year period, there would be an estimated 28.9 percent chance of being flooded versus a 47 percent chance under the existing project. With this plan, average annual equivalent flood damages would be reduced by approximately 43 percent to about \$114 million.

**TABLE 4-2
 LONG-TERM RISK AND ANNUAL EXCEEDENCE PROBABILITY OF ALL
 ALTERNATIVE PLANS**

Item	Alternative				
	No-Action	A	B	C	D
Annual Exceedence Probability (AEP)	0.0124 (1 in 81) ¹	0.0068 (1 in 147)	0.0064 (1 in 156)	0.0054 (1 in 185)	0.0047 (1 in 213)
Long-Term Risk (%)					
10 Years	11.8	6.6	6.2	5.3	4.6
30 Years	31.3	18.5	17.6	15.1	13.3
50 Years	46.5	28.9	27.5	23.8	21.1

Note:

- Chance of flooding in any 1 year.

The floods of 1986 and 1997 were the largest events in the American River basin over the period of record (1905 to date). Both these events had a 0.014 probability of occurrence in terms of the unregulated 3-day inflow volume. These events are about two-thirds of the 3-day unregulated inflow volume for the maximum flood that can be controlled with the following action alternative plans. Historically, peak discharge from Folsom Dam has not exceeded 135,000 cfs. This plan, as well as all the action alternative plans, would control a flood with a 3-day volume approximately 50 percent greater than the 1986 and 1997 events.

- **Probable Maximum Flood** – This plan and the other action alternative plans would provide the ability for the PMF to be passed through Folsom Dam and Reservoir.
- **Other Benefits** – Similar to the other action alternative plans considered, this plan would allow early implementation of the Folsom Dam Bridge and ecosystem restoration features, and future raising of Folsom Dam for increased flood protection.

4.5.2.2 Economics

Following is a summary of estimated costs and economic benefits for Alternative A. Similar information is provided in following paragraphs for the other action alternative plans. Estimates of first costs are based on October 2006 price levels. Annual costs and benefits were derived using a Federal rate of 4-7/8 percent and a 50-year period of analysis. For large civil works projects that include a dam and reservoir, a 100-year period of analysis is normally used in the economic analysis for evaluating annual costs and benefits. However, Folsom Dam and Reservoir have been in service for 50 years. Accordingly, it was determined that a 50-year period of analysis should be used for the current evaluations. Use for all action alternative plans of either period of analysis would result in slightly different annual costs and benefits; however, resulting conclusions relative to benefits and costs between the alternatives would remain unchanged.

It is important to note that for comparison purposes only, costs for all action alternative plans have been prepared to the same level of development. Alternatives and features of alternatives are at different levels of design. Cost estimates include appropriate contingencies and line items to allow alternatives to be compared. Further, annual costs for all alternatives do not include the ongoing costs to replace water supplies foregone due to continued reoperation of the original Folsom Dam operation for flood damage reduction. A preliminary estimate of these costs is included in the *1996 SIR* for the American River Watershed Project; they are to be reevaluated in future studies. The resulting conclusion relative to benefits and costs between the alternatives due to resources replacement would remain unchanged.

- **Costs** – As mentioned in **Section 4.3** above, cost estimates were developed for each of the action alternative plans considered in this *PAC Report*. These estimates are at a level of detail sufficient to adequately compare the costs of each alternative and relative differences in costs between each alternative. The estimated total first cost for this plan is \$630 million. The portion of the annual cost attributable to flood damage reduction only is \$33.0 million.

- **Benefits** – As mentioned, estimates of flood damages under the No-Action Plan (without-project conditions) and for each action alternative plan, and potential economic benefits attributable to flood damage reduction, are contained in **Appendix E**. Based on information from **Appendix E**, and excluding potential benefits for the Folsom Dam Bridge and ecosystem restoration, the total estimated average annual benefit for flood damage reduction of this plan is \$84.7 million.

4.5.3 Alternative B – Six Submerged Tainter Gate Auxiliary Spillway

This action alternative plan primarily includes construction of a new gated auxiliary spillway southwest of Folsom Dam. The auxiliary spillway would be at a location similar to that in Alternative A, above (see **Plate 12**). However, it would be constructed at a lower elevation (sill elevation 368.0), and include significantly more excavation. Major features include (1) a 1,100-foot-long approach channel beginning in Folsom Lake, (2) control structure, including six submerged tainter flood gates 33 feet high by 23 feet wide, (3) 3,000-foot-long spillway chute with a bottom width of about 169 feet, and (4) stilling basin in the American River (see **Plates 12** and **13**). The stilling basin includes an exit channel to return flows to the American River. It also includes modification of the flood control storage space in Folsom Reservoir from a variable space ranging from 400,000 acre-feet to 670,000 acre-feet, to 400,000 acre-feet to 600,000 acre-feet.

4.5.3.1 Accomplishments

The primary accomplishments of this action alternative plan are increased flood damage reduction and improved features for PMF dam safety.

- **Flood Damage Reduction** – This plan would result in a reduced level of flood risk to Sacramento by reducing the AEP of the American River due to levee failure from 0.0124 to 0.0064 (from a 1 in 81 chance in any year to a 1 in 156 chance). It would provide the capability for Folsom Dam and Reservoir to pass, with outflows of 160,000 cfs for a sustained period of time (currently under evaluation), the 200-year computed design flood event. This equals the minimum requirement of SAFCA and The Reclamation Board. With this plan, there would be a 6.2 percent chance of being flooded over the course of 10 years, a 17.6 percent chance in 30 years, and a 27.5 percent chance in 50 years (see **Table 4-2**). Similar to other action alternatives, this plan would control a flood with a 3-day volume approximately 50 percent greater than the 1986 and 1997 historic flood events. With this plan, average annual equivalent flood damages of about \$198 million would be reduced by approximately 45 percent to about \$108 million.
- **Probable Maximum Flood** – With this plan, and including reservoir emergency operating criteria developed by the Corps, it is estimated that Folsom Dam would pass the PMF.
- **Other Benefits** – Similar to the other action alternative plans considered, this plan would also allow early implementation of the Folsom Dam Bridge and ecosystem restoration features, and future raising of Folsom Dam for increased flood protection.

4.5.3.2 Economics

- **Costs** – The estimated first cost for this plan is \$876 million. The estimated annual cost for the flood damage reduction component is \$35.2 million. For comparison of benefits and costs between action alternative plans, the total first cost of this alternative is reduced by an estimate of the cost attributable to dam safety. These costs are being developed by Reclamation. However, for this analysis, \$200 million was used to account for the cost of the emergency fuseplug spillway. In addition, neither this nor other action alternative plans included features or costs of the new Folsom Dam Bridge or ecosystem restoration elements contained in the Folsom Dam Raise Project.
- **Benefits** – Excluding potential benefits for the Folsom Dam Bridge and ecosystem restoration, the total estimated average annual benefits attributable to flood damage reduction for this plan are \$89.9 million.

4.5.4 Alternative C – Six Submerged Tainter Gate Auxiliary Spillway, 3.5-Foot Dam Raise, and Three Emergency Spillway Gate Replacements

This action alternative plan primarily consists of construction of a new gated auxiliary spillway southwest of Folsom Dam similar to Alternative B, above, raising Folsom Dam by 3.5 feet, and replacing the three emergency spillway gates at Folsom Dam. It also includes modification of the flood control storage space in Folsom Reservoir from a variable space ranging from 400,000 acre-feet to 670,000 acre-feet, to 400,000 acre-feet to 600,000 acre-feet. The auxiliary spillway would primarily include (1) 1,100 foot-long approach channel beginning in Folsom Lake, (2) control structure, including six submerged tainter gates, (3) 3,000-foot-long spillway chute with a bottom width of about 169 feet, and (4) stilling basin with exit channel to return flows to the American River.

4.5.4.1 Accomplishments

The primary accomplishments of this action alternative plan are increased flood damage reduction and improved features for PMF dam safety.

- **Flood Damage Reduction** – This plan would result in a reduced level of flood risk to Sacramento by reducing the AEP of flooding along the American River from 0.0124 to 0.0054 (from a 1 in 81 chance in any year to a 1 in 185 chance). This plan would provide the capability for Folsom Dam and Reservoir to pass, with outflows of 160,000 cfs for a sustained period of time (currently being evaluated), the 240-year design flood event. This exceeds the minimum requirement of SAFCA and The Reclamation Board. With this plan, there would be a 5.3 percent chance of being flooded over the course of 10 years, a 15.1 percent chance in 30 years, and a 23.8 percent chance in 50 years (see **Table 4-2**). This plan, similar to the other action alternatives, would control a flood with a 3-day volume approximately 50 percent greater than 1986 and 1997 historic flood events. With this plan, average annual equivalent flood damages would be reduced by approximately 54 percent to about \$91 million.

- **Probable Maximum Flood** – With this plan, the PMF could be passed through Folsom Dam and Reservoir.
- **Other Benefits** – This plan would also allow, as other increments, early implementation of the Folsom Dam Bridge and ecosystem restoration features.

4.5.4.2 Economics

- **Costs** – The estimated first cost for this plan is \$988 million. The total annual cost attributable to flood damage reduction is estimated at \$40.0 million.
- **Benefits** – Excluding potential benefits for the Folsom Dam Bridge and ecosystem restoration, the total estimated average annual benefits for this plan are \$107.1 million. For this and other action alternative plans, the benefits attributable to dam safety are estimated to be equal to the least costly plan to accomplish that purpose.

4.5.5 Alternative D – Six Submerged Tainter Gate Auxiliary Spillway, 7-Foot Dam Raise, and Eight Emergency and Service Spillway Gate Replacements

This action alternative plan is similar to Alternatives B and C above in that it includes constructing an auxiliary spillway with six submerged tainter gates near the south wing dam of Folsom Dam. The size and location of the spillway and gates are as described for Alternative B. This alternative also includes raising Folsom Dam and appurtenant structures by 7 feet and replacing all eight (five service and three emergency) spillway tainter gates at Folsom Dam.

The dam raise portion of this plan is similar to that for the authorized Folsom Dam Raise Project. The raise would be a combination of raising the concrete monolith and embankments and adding a 3.5-foot parapet wall. The five new service and three emergency spillway gates would be 66 feet high, 16 feet taller than the existing five main gates and 13 feet taller than the existing three emergency gates. The top of the new gates would be at elevation 484.0 feet. To accommodate the increased height and loading, the existing piers would be extended and strengthened, and new trunions would be located on the top of new pier extensions. New high-strength, post-tensioned steel cables would be cored and grouted into the existing pier/dam section to provide for trunion anchorages. New hoisting motors and chains, and new catwalks would be constructed. Other major features include replacement of the spillway bridge and modification of the elevator tower. Alternative D also includes modification of the flood control storage space in Folsom Reservoir from a variable space ranging from 400,000 acre-feet to 670,000 acre-feet, to 400,000 acre-feet to 600,000 acre-feet.

4.5.5.1 Accomplishments

The primary accomplishments of this action alternative plan are increased flood damage reduction and improved features for PMF dam safety.

- **Flood Damage Reduction** – This plan would lead to a reduced level of flood risk to Sacramento by reducing the AEP of flooding along the American River from 0.0124 to 0.0047 (from a 1 in 81 chance in any year to a 1 in 213 chance). This plan would provide

the capability for Folsom Dam and Reservoir to pass, with outflows of 160,000 cfs for a sustained time (currently being evaluated), the 275-year design flood event. This plan exceeds the minimum requirement of SAFCA and The Reclamation Board. With this plan, there would be a 4.6 percent chance of being flooded over the course of 10 years, a 13.3 percent chance in 30 years, and a 21.1 percent chance in 50 years (see **Table 4-2**). Similar to other action alternatives, this plan would control a flood with a 3-day volume approximately 50 percent greater than 1986 and 1997 historic flood events. With this plan, the average annual equivalent flood damages would be reduced by approximately 60 percent to about \$79 million.

- **Probable Maximum Flood** – With this plan, Folsom Dam and Reservoir could pass the PMF.
- **Other Benefits** – Similar to the other action alternative plans considered, this plan would allow early implementation of the Folsom Dam Bridge and ecosystem restoration features.

4.5.5.2 Economics

- **Costs** – The estimated first cost for this plan is \$1,439 million. The total annual cost attributable to flood damage reduction is estimated at \$73.8 million.
- **Benefits** – Excluding potential benefits for the Folsom Dam Bridge and ecosystem restoration, the total estimated average annual flood damage reduction benefits for this plan are \$118.9 million.

4.6 COMPARISON OF ACTION ALTERNATIVES

To help identify the Selected Plan, the above action alternative plans were compared using the four general criteria contained in the Federal Water Resources Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (or P&G) (1983). These criteria include (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability. Below is a description of each criterion and its application. **Table 4-3** shows the comparison of the four action alternative plans based on their relative ability to address each of the four criteria. As can be seen in the table, and described below, each alternative was assigned a relative ranking ranging from very low to very high for each criterion. Each comparison criterion for the action alternative plans in the table received the same weighting and resulted in an overall relative ranking. This overall ranking was used, along with other information, to identify the Selected Plan.

Because this *PAC Report* primarily constitutes a design refinement, a primary criterion in ultimate plan selection was engineering criteria. To identify a plan that is functionally equivalent to the Folsom Modification Project and Folsom Dam Raise Project, AEP associated with each alternative was compared.

**TABLE 4-3
SUMMARY COMPARISON OF ACTION ALTERNATIVE PLANS**

Action Alternative Plans	Comparison Criteria				Status and Relative Ranking
	Completeness	Effectiveness	Efficiency	Acceptability	
A – Eight Main Dam Outlets & Fuseplug Spillway - Modify Folsom Outlets (six), Construct Two Additional Outlets, and Construct Emergency Fuseplug Spillway	Considered complete. However, low level of reliability to effectively modify existing and new outlets at Folsom Dam. Also, reduced level of reliability for safe operation of fuseplug in spillway.	Relatively low increase in helping reduce flood damages. Can pass the PMF.	High net economic benefits.	Very low potential for non-Federal sponsorship (does not meet minimum performance goal).	Although very high net economic benefits, Alternative A is not identified for further consideration as the Selected Plan. Very low potential for non-Federal sponsorship.
<i>Relative Rank</i>	<i>Moderate</i>	<i>Low</i>	<i>High</i>	<i>Very Low</i>	<i>Low to Moderate</i>
B – Six Submerged Tainter Gate Auxiliary Spillway – Construct a New Auxiliary Spillway with Six Submerged Tainter Gates	Considered complete. Likely meets functional equivalency requirements and very high reliability as it depends primarily on auxiliary spillway with operable gates and appurtenant facilities for overall performance.	Moderately effective in helping reduce flood damages. Can pass the PMF. Highly compatible with new bridge and future actions for higher levels of flood protection and other project goals.	High net economic benefits.	High potential for non-Federal sponsorship as it meets minimum goal of passing at least the 200-year computed design flood event.	Although highly efficient, Alternative B is not identified for further consideration as the Selected Plan. This is primarily because Alternative C can accomplish a higher level of flood protection than Alternative B and can provide greater net economic benefits.
<i>Relative Rank</i>	<i>High</i>	<i>Moderate</i>	<i>High</i>	<i>Very High</i>	<i>High</i>
C – Six Submerged Tainter Gate Auxiliary Spillway, 3.5-Foot Dam Raise, & Three Emergency Spillway Gate Replacements – Construct a New Auxiliary Spillway with Six Submerged Tainter Gates, Raise Folsom Dam 3.5 Feet, and Replace Three Emergency Spillway Gates	Similar to Alternative B.	Relatively high effectiveness in meeting project objectives for flood damage reduction. Can pass the PMF. Highly compatible with new bridge and future actions for higher levels of flood protection and other project goals.	Very high net economic benefits when compared with other alternatives considered.	High potential for non-Federal sponsorship as it meets minimum goal of passing at least the 200-year computed design flood event.	Identified as the Selected Plan. Highest overall relative ranking of alternatives considered.
<i>Relative Rank</i>	<i>High</i>	<i>High</i>	<i>Very High</i>	<i>Very High</i>	<i>High to Very High</i>
D – Six Submerged Tainter Gate Auxiliary Spillway, 7-Foot Dam Raise, & Eight Emergency and Service Spillway Gate Replacements – Construct a New Auxiliary Spillway with Six Submerged Tainter Gates, Raise Folsom Dam 7 Feet, and Replace Eight Emergency and Main Dam Service Spillway Gates	Similar to Alternative B.	Relatively high effectiveness in meeting project objectives for flood damage reduction. Can pass the PMF. Highly compatible with new bridge and future actions for higher levels of flood protection and other project goals.	Low net economic benefits when compared with other alternatives.	Relatively low potential for non-Federal sponsorship, primarily because the plan is expensive.	Not identified as the Selected Plan. This is primarily due to low economic justification and relatively low potential for sponsorship by non-Federal interests.
<i>Relative Rank</i>	<i>High</i>	<i>High</i>	<i>Low</i>	<i>Low</i>	<i>Moderate</i>
Key: PMF = Probable Maximum Flood					

4.6.1 Completeness

Completeness is a determination of whether a plan includes all elements necessary to realize planned effects. It is also an indication of the degree that the intended benefits of the plan depend on the actions of others. The major subcriteria selected for this evaluation include (1) consistency, (2) future actions, and (3) physical implementability. Consistency here is primarily a measure of an alternative's ability to address the project objectives and to be functionally equivalent to the authorized Folsom Modification and Folsom Dam Raise projects. Functional equivalency can be measured in terms of (1) project accomplishments, such as level of flood damage reduction, (2) net economic benefits, and (3) performance. Performance would include factors such as the ability to maintain the objective release from Folsom Dam to the American River under similar conditions within Folsom Reservoir.

The Folsom Modification Project, as amended by the 2003 LRR, was previously estimated to increase the level of flood protection to a 1 in 140 chance in any given year. The Folsom Dam Raise Project, assuming implementation of the Folsom Modification Project, would increase the level of flood protection to a 1 in 175 chance in any give year (see **Table 5-9** in **Chapter 5** for additional information). As shown in **Table 4-4**, each of the action alternative plans would provide increases in annual expected exceedence of at least 1 in 140. Further, all but one (No-Action) of the alternative plans would result in net economic benefits of at least \$40 million. However, the alternative most superior for this subcriterion would be Alternative C. This is primarily because functionally, this alternative would be considered the closest equivalent to the Folsom Modification and Folsom Dam Raise projects.

A subcriterion of future actions refers to the ability of an alternative to be reliably implemented and operated with no future actions required other than normal operation, maintenance, repair, replacement, and rehabilitation (OMRR&R). It is believed that all of the alternatives considered could be fully implemented. Physical implementability refers to the relative ability to construct the project. As mentioned, following completion of the Folsom Modification Project described in the 2003 LRR, it was determined that the cost to construct outlet works modifications, as defined for that plan, would be significantly more costly than expected. Although not anticipated during planning for that project, it was determined that the actual physical implementability of the project was much lower than anticipated. Of the alternatives above, it is believed that Alternatives B and C would provide the highest level of confidence because they do not include further modification of the Folsom Dam outlets, and do not include raising Folsom Dam over 3.5 feet, which inherently includes other factors of uncertainty.

4.6.2 Effectiveness

Effectiveness is the extent to which an alternative can alleviate problems and achieve the project objectives. As can be seen in **Table 4-4**, each of the action alternatives considered can provide increased levels of flood protection greater than a 1 in 140 chance in any year, which was the level identified for the Folsom Modification Project. In addition, each of the alternatives can pass the PMF. There is a potential for lower adverse impacts under extremely rare flood events to areas downstream from Folsom Dam for alternatives that do not include an emergency

fuseplug spillway. In addition, each of the alternatives effectively allows (as other increments) implementation of a new Folsom Dam Bridge and downstream environmental accomplishments.

**TABLE 4-4
SUMMARY OF ACTION ALTERNATIVE PLANS CONSIDERED**

Item	Alternative			
	A	B	C	D
Major Features				
Outlet Conduits (new and enlarged)	8 outlets	NA	NA	NA
Emergency and Main Spillway Gate Replacement	NA	NA	3 gates	8 gates
No. of Submerged Tainter Gates ¹ or Fuseplug	Fuseplug	6 gates	6 gates	6 gates
Folsom Dam Raise (feet)	NA	NA	3.5	7
Performance				
Passes PMF	Yes	Yes	Yes	Yes
Probability of Flooding				
Annual Exceedence Probability	0.0068	0.0064	0.0054	0.0047
1 in X Chance in Any Year	1 in 147	1 in 156	1 in 185	1 in 213
Design Flood Event (frequency in years) ²	180	200	240	275
First Cost (\$ millions)³	630	876	988	1,439
Annual Cost (\$ millions)⁴				
Total	33.0	45.3	50.1	83.9
Flood Damage Reduction (less dam safety)	33.0	35.2	40.0	73.8
Annual Flood Damage Reduction Benefits (\$ millions)	84.7	89.9	107.1	118.9
Net Annual Flood Damage Reduction Benefits (\$ millions)	51.7	54.7	67.1	45.1
Residual Damages (\$ millions)	113.5	108.3	91.1	79.3
Percent Damage Reduction	43	45	54	60
Key: NA = not applicable No. = number PMF = Probable Maximum Flood				

Notes:

1. Auxiliary spillway submerged tainter gates are 33 feet high by 23 feet wide.
2. Design flood event given as the frequency of the maximum computed event that can be safely passed.
3. October 2006 price levels.
4. 50-year period of analysis and 4-7/8 percent discount rate. Does not include ongoing costs to replace water supplies foregone due to continued interim operation; they are to be reevaluated in future studies.

4.6.3 Efficiency

Efficiency is the extent to which an alternative is the most cost-effective means for realizing project objectives consistent with protecting the Nation's environment. One measure of efficiency is monetary costs versus benefits. Efficiency is displayed as net economic benefits and is the extent to which the economic benefits exceed costs for alternatives providing increased levels of flood damage reduction. Included in **Table 4-4** is an estimate of net economic benefits for each of the alternatives. **Figure 4-1** is a plot of net benefits for each alternative. It is important to note in the table and figure that the annual net economic benefits are for flood damage reduction. An allowance for potential benefits for passing the PMF is not included in the information presented in the table. Future evaluations will need to establish a cost

appropriate for passing the PMF. It is believed that the value of benefits to pass the PMF will be at least equal to those costs.

It is also important to note in **Figure 4-1** that the net benefits curve tends to maximize at an AEP of about a 1 in 185 chance in any year with Alternative C. It should be mentioned that likely other types of alternatives, not including modifications at Folsom Dam and Reservoir, would economically provide greater levels of flood damage reduction.

4.6.4 Acceptability

Acceptability is the workability and viability of a plan with respect to its potential acceptance by other Federal agencies, State and local governments, and public interest groups and individuals. As mentioned, both the State of California, through The Reclamation Board, and SAFCA will be the non-Federal sponsors for the Selected Plan. Also, as mentioned, both entities have identified that passing the 200-year computed design flood event is a primary request for their participation. As can be seen in **Table 4-4**, Alternatives B, C, and D all are capable of passing the 200-year computed design flood event. On the basis of coordination with the non-Federal sponsors, they prefer Alternative C. These entities may not support Alternative D, as it would result in greater costs to them.

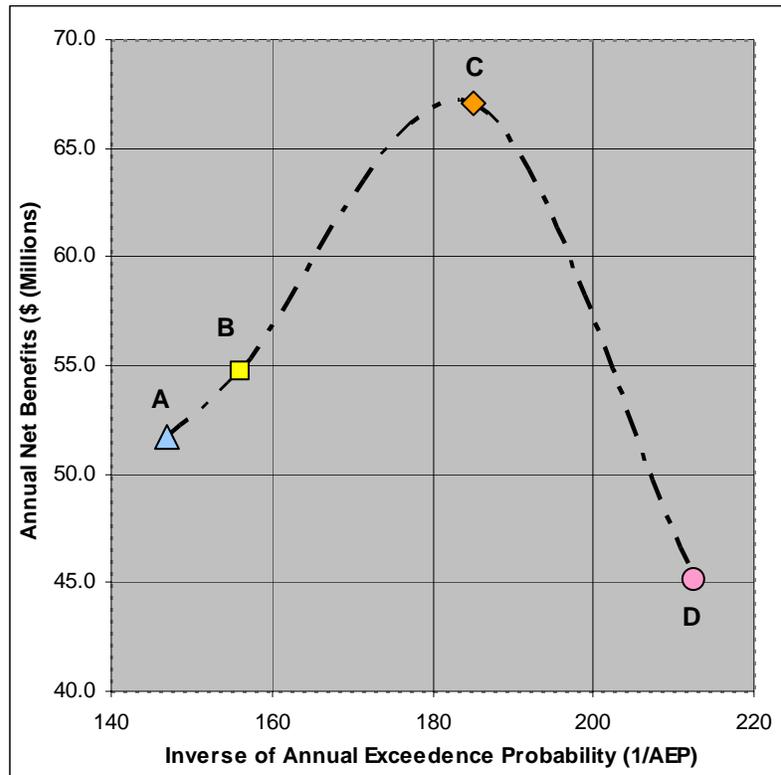


FIGURE 4-1
RELATIONSHIP OF PERFORMANCE TO NET BENEFITS
FOR ALTERNATIVES CONSIDERED

For the purposes of this evaluation, a major part of determining functional equivalency is the relationship of the authorized projects to alternative plans based on AEP. AEP can be used to determine if an alternative plan is capable of producing comparable engineering performance to the Folsom Modification Project and Folsom Dam Raise Project. The estimated cumulative AEP (see **Table 5-9** in **Chapter 5**) of the originally authorized projects is 0.0057 (1 in 175 chance of occurrence in any year). Using updated system operation modeling, it is currently estimated that the cumulative AEP of the projects is 0.0053 (1 in 187 chance equivalency). As shown in **Table 4-4**, of the four action alternative plans, Alternative C compares most closely to the originally authorized projects. The AEP for Alternative C is nearly the same as that of the originally authorized projects. Accordingly, this plan is considered to be functionally equivalent to the authorized projects.

4.6.5 Result

As described above and listed in **Table 4-3**, Alternative C is identified as the Selected Plan. This is because Alternative C would provide a reduction in flood risk similar to the Folsom Modification and Folsom Dam Raise Projects, is functionally equivalent to those projects, incorporates dam safety risk reduction, and meets local objectives, while providing the greatest net benefits of all the alternatives considered (including those mentioned above and many other combinations of major project features).

4.7 REFINED AUTHORIZED PROJECTS

The preferred alternative, or Selected Plan, for the Folsom Modification and Folsom Dam Raise projects is Alternative C. The Refined Authorized Projects (RAP) primarily include the Selected Plan, but also include two Other Features. These Other Features are (1) ecosystem restoration components described in the authorized Folsom Dam Raise Project and (2) a permanent bridge increment, also authorized as part of the Folsom Dam Raise Project. The primary non-Federal project sponsor for the Selected Plan portion of the RAP is the State of California through DWR. The likely non-Federal sponsor for the Other Features of the RAP would be SAFCA (ecosystem restoration) and the City of Folsom (bridge). SAFCA is a co-sponsor to DWR and will enter into a cost-sharing agreement with Reclamation to pay for any portion of the OMRR&R costs related to the new flood damage reduction features.

It is important to note that, as shown in **Figure 4-2**, this Selected Plan is made up of two fundamental elements: (1) the Six Submerged Tainter Gate Element (6 STG Element) with primary structural components consisting of a new auxiliary spillway with six submerged tainter gates, and (2) the Dam Raise Element (DR Element) with primary structural features consisting of a 3.5-foot dam raise and three emergency spillway tainter gate replacements. The 6 STG Element has been characterized as the Joint Federal Project, or JFP, in recent studies and in **Appendix C - Joint Federal Project Engineering Design Report** of this *PAC Report*. The 6 STG Element can be divided into two efforts: a Corps Work Package and a Reclamation Work Package. These work packages are described in **Chapter 6**.

4.7.1 Accomplishments

The Selected Plan component of the RAP would reduce the level of flood risk to Sacramento by reducing the probability of flooding from the American River due to levee failure from an AEP of 0.0124 (a 1 in 81 chance in any 1 year) to 0.0059 (a 1 in 185 chance in any 1 year). This plan would control a flood with a 3-day inflow volume to Folsom Reservoir of about 50 percent larger than the floods of record (1986 and 1997) in the American River basin. These flood events each have a probability of occurrence of about 0.014 in terms of the unregulated 3-day inflow volume.

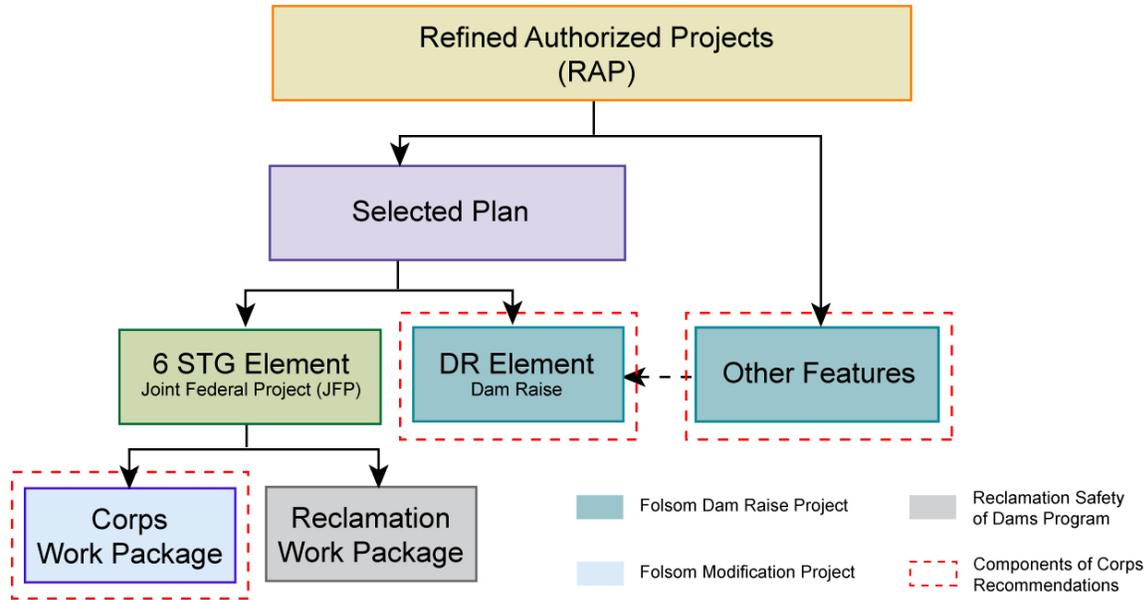


FIGURE 4-2
COMPONENTS AND RESPONSIBILITIES OF THE REFINED AUTHORIZED PROJECTS (RAP)

In the RAP, Other Features are companion to the DR Element of the Selected Plan. The 6 STG Element is divided into Corps and Reclamation Work Packages.

A very important goal of SAFCA is for the American River to safely pass the 200-year computed design flood event without levee failures and without impacting downstream areas. It is estimated that the RAP would exceed this goal. The RAP is considered functionally equivalent to a combination of both the Folsom Modification Project and the Folsom Dam Raise Project, and consistent with provisions of section 128 of PL 109-103. This plan would increase the release capacity at Folsom Dam earlier in the flood event, thereby reducing flood risk to areas downstream from Folsom Dam.

It is estimated that the Selected Plan could reduce average annual equivalent flood damages in Sacramento (currently estimated at \$198 million) by about 54 percent. Accordingly, the residual flood damage potential in Sacramento would be reduced to about \$91 million.

As mentioned in **Chapter 2**, under the without-project condition, Reclamation intends to address the dam safety hydrologic risk of passing the PMF event at Folsom by constructing an emergency fuseplug spillway on the south abutment and downstream from the south wing dam. This fuseplug would rely on a zoned embankment with an impervious core designed to erode in a predictable manner when the reservoir elevation generally exceeds the elevation of the inlet approach channel. It is important to note that during a PMF event, massive and catastrophic flooding would occur in the Sacramento area. However, there would be significant warning for this event. Without the capability to pass the PMF through the emergency spillway at Folsom Dam, a danger would exist of the dam failing during the PMF and causing additional catastrophic damages throughout the Sacramento area. The submerged tainter gate and auxiliary spillway portion of the RAP would be constructed at the same location as the emergency

fuseplug spillway. A major advantage of the RAP is that not only can the auxiliary spillway provide significant reductions in flood risk, but it can do so while reliably passing the PMF at Folsom Dam, and at a major cost savings over constructing a project to accomplish the two objectives separately.

The RAP would be constructed consistent with the expedited implementation of a new bridge just downstream from Folsom Dam. The bridge would allow safe and efficient transportation from east Folsom to areas north of the American River near Folsom Reservoir. The RAP would also preserve the potential to implement ecosystem restoration features authorized by the Folsom Dam Raise Project along the lower American River.

4.7.2 Major Components

Current design refinements have been made that are both consistent with, and considered functionally equivalent to, the Folsom Modification and Folsom Dam Raise projects. Detailed information on these refinements is contained in **Appendix A**, **Appendix B**, **Appendix C**, and **Appendix D - Real Estate**. Following is a summary of the major components included in the RAP.

4.7.2.1 Flood Control Storage Space

Folsom Reservoir is currently operated under an interim operation agreement with a variable flood control space ranging from 400,000 acre-feet to 670,000 acre-feet. As shown in **Plate 6**, beginning on 1 October of each year, Folsom Reservoir is required to begin maintaining vacant space for flood control. The magnitude of the space requirements depends on incidental vacant storage space in three reservoirs upstream from Folsom – French Meadows, Hell Hole, and Union Valley reservoirs. Consistent with Section 101(a) (6) (B) of WRDA 1999, once the Selected Plan is implemented, the space requirements would change to a variable flood space operation ranging from 400,000 acre-feet to 600,000 acre-feet, as shown in **Plate 9**.

Construction of the 6 STG Element would increase project discharge capacity at a lower pool elevation with no increase in pool elevation. This allows a lowering of the maximum pool and for a decrease in the need for use of surcharge storage space in the reservoir. As shown in **Table 4-5**, the PMF pool elevation would be lowered from 483.3 feet to 480.2 feet with the Selected Plan. This consists of an initial reduction in the PMF pool elevation to 476.2 feet upon completion of the 6 STG Element. The DR Element would result in a raise of this elevation to 480.2 feet, but still well below the new top of dam elevation. For perspective, the authorized flood pool elevation associated with the 200-year flood event would be lowered from elevation 474.6 feet to 466.3 feet, limiting the maximum discharge to 160,000 cfs. Raising Folsom Dam 3.5 feet to 484.0 feet would allow for reducing discharges to 160,000 cfs, thereby controlling events larger than the 200-year design event by limiting discharges to a maximum of 160,000 cfs, the downstream capacity, by creating additional flood control space in the reservoir. The authorized top of flood pool would remain at reservoir water surface elevation 466 feet, as shown in **Table 4-5**. In accordance with guidelines for take line requirements, the current (and No-Action Plan) take line at 476 feet (top of authorized flood pool elevation plus 10 feet) is the same or greater than the maximum pool elevation during a controlled flood event with the Selected Plan.



**FIGURE 4-3
CONCEPTUAL RENDERING OF THE PERMANENT BRIDGE, AUXILIARY SPILLWAY, SUBMERGED TANTIER
GATE STRUCTURE, AND APPURTENANT FACILITIES**

4.7.2.4 Raise Folsom Dam 3.5 Feet

Raising Folsom Dam and appurtenant facilities by 3.5 feet would result in an increase in flood storage capacity in Folsom Reservoir for flood damage reduction uses by approximately 46,200 acre-feet. This would be above (to elevation 474 feet msl) the current authorized flood pool storage of 1.02 million acre-feet associated with a pool elevation of 470 feet above msl. Primary features of the raise would include raising MIAD and auxiliary dikes around Folsom Reservoir by 3.5 feet.

4.7.2.5 Other Features

The Other Features are companion to the DR Element of the Selected Plan would include the ecosystem restoration component of the Folsom Dam Raise Project and a permanent bridge increment. The ecosystem restoration component is to be continued. Funds identified for the permanent bridge increment would be combined with those identified for a temporary bridge in the Selected Plan. Implementation of the permanent bridge will commence in advance of the Selected Plan. As mentioned, although a necessary part of the authorized Folsom Dam Raise Project, construction of a new Folsom Bridge is part of the without-project condition.

4.7.2.6 Work Packages

The auxiliary spillway is the principal facility to be constructed as part of the 6 STG Element. Reclamation and the Corps have equitably divided work for the 6 STG Element, or JFP, based on criteria identified in **Chapter 6**. The set of assigned work items that make up the 6 STG Element of the Selected Plan are called work packages. Reclamation's Work Package emphasizes work that will expeditiously implement interim and permanent hydrologic risk reduction and further expedite implementation, construction, and completion of the 6 STG Element. As currently anticipated, Reclamation's Work Package includes excavation of the auxiliary spillway chute, stilling basin, and a portion of the control structure. The Corps' Work Package would then include the remainder of the excavation for the control structure, excavation of the approach channel and construction of the spillway chute, stilling basin, and control structure.

4.7.3 Environmental Considerations

The Selected Plan component of the RAP would generally have impacts primarily associated with temporary construction-related impacts on air quality, noise levels, local traffic, recreational impacts, and water quality during construction. Mitigation measures and best management practices (BMP) proposed in the Reclamation 2007 *Final Folsom Dam Safety and Flood Damage Reduction Environmental Impact Statement/Environmental Impact Report* (2007 EIS/EIR) would reduce all of these impacts to less than significant levels, except air quality. All appropriate permits would be coordinated with the specific agencies and obtained prior to construction. All BMPs, included in the permits, would be implemented and included in the construction plans and specifications. For the temporary short-term increases in air quality emissions, the Corps, Reclamation, and the construction contractors would continue to seek opportunities to reduce construction-related emissions to a less than significant level and will

coordinate with the Sacramento Municipal Air Quality Management District (SMAQMD) prior to and during construction.

Through coordination with the State Historic Preservation Office under Section 106, all cultural resources located within the area of potential effect will be evaluated for inclusion in the National Registry on Historic Places and the California Register of Historic Resources. A memorandum of agreement (MOA) or a programmatic agreement will be developed prior to initiation of construction to mitigate impacts to any identified historic properties or historic resources. The implementation of the agreement document would reduce any identified impacts to historic properties or historic resources to a less than significant level.

4.7.3.1 6 STG Element

Impacts

The primary construction impacts would be those associated with the 6 STG Element in Reclamation's Work Package. Most of these impacts would be related to excavation materials for the spillway and processing/placement of concrete and other materials. Project-related impacts on the physical and social environment are analyzed and discussed in detail in the Reclamation 2007 EIS/EIR.

Reducing the variable flood control storage space in Folsom Reservoir to between 400,000 acre-feet and 600,000 acre-feet would likely result in beneficial operational impacts to the lake resources. It would reduce some adverse impacts on water supply and power production from the existing operation. An ongoing study will determine actual impacts of permanent reoperation.

Mitigation

Reclamation would be responsible for implementing all mitigation for impacts of constructing the 6 STG Element, with the exception of air quality, and any other permitting requirements (e.g., water quality), which would be the responsibility of each agency for its work package. The Corps, however, as a cooperating agency, will continue to coordinate closely with Reclamation in mitigation planning efforts. The separation of work and project responsibilities is described in more detail in **Chapter 5**.

Impacts to vegetation and wildlife, and special-status species would require mitigation to reduce project impacts to less than significant levels. Reclamation and the United States Fish and Wildlife Service (USFWS) are working together to finalize mitigation for vegetation and wildlife impacts according to the work described in the Reclamation Work Package. Compensation for special-status species would be implemented as described in the project biological opinion.

4.7.3.2 DR Element

Impacts

Construction of the 3.5-foot dam raise would impact approximately 8.46 acres of oak woodland. An increase to maximum reservoir water surface elevation of the reservoir beyond current dam crest elevation is not anticipated in order to provide flood damage reduction

benefits. The maximum reservoir water surface elevation under the RAP would not exceed the existing take line for a 200-year design event, and there would be an anticipated lower maximum water surface elevation than for the without-project condition for all flood events inclusive of a PMF event, eliminating the risk that surrounding properties would be inundated. Therefore, no inundation of surrounding habitats above the without-project condition would be expected.

Because there would be no expected inundation of surrounding habitats above the without-project condition, no property takes, flowage easements, or additional small-scale impoundment features such as dikes or berms beyond the existing take line are included in the Reclamation 2007 EIS/EIR. The DR Element of the Selected Plan will undergo further design during the Corp's Preconstruction, Engineering, and Design (PED) phase and, if needed, supplemental National Environmental Policy Act/California Environmental Quality Act (NEPA/CEQA) documentation would be prepared.

Mitigation

The Corps would be responsible for implementing all mitigation for impacts of constructing the DR Element. Replacement of 11.16 acres of oak woodland would compensate for this adverse impact. Mitigation acreage was estimated through Habitat Evaluation Procedure (HEP) analysis conducted by USFWS and the Corps and through an incremental cost analysis conducted by the Corps. These estimates are based on the information currently available, and further coordination on mitigation with USFWS would occur during the Corps' PED phase when final design information is available for the dam raise portion of the Selected Plan.

Mitigation for project-related effects on vegetation due to the implementation of the dam raise portion of the Selected Plan would take place at various sites along the American River, in the American River Parkway, downstream from the Sunrise Bridge in areas located upstream from the American River levee system. The sites would be selected in consultation with numerous local agencies, including the Corps, SAFCA, USFWS, Sacramento County Parks Department, and The Reclamation Board. Generally, the sites targeted for mitigation would be sites that County Parks has identified as beneficial for establishment of additional habitat or increasing the habitat quality of degraded areas along the parkway. These habitats would be established and monitored for 3 years.

4.7.4 Operation, Maintenance, Repair, Replacement, and Rehabilitation

For the Selected Plan component of the RAP, physical operation of the enlarged Folsom Dam and Reservoir and emergency gates would be as under existing conditions. Timing and duration would be modified based on an updated Water Control Manual. The auxiliary spillway and gating system would require additional OMRR&R support. The spillway structure includes a grouting gallery and foundation drain. These facilities would need to be monitored and inspected as part of periodic monitoring activities at Folsom Dam. The gate system, including tainter gates and upstream bulkhead gates, would also require periodic inspection, exercise operation, and replacement of sensitive parts such as seals.

Reclamation would continue to operate and maintain the existing portion of Folsom Dam and Reservoir and appurtenant facilities for which it has responsibility today. The non-Federal

sponsor would enter into an agreement with Reclamation, as necessary, to facilitate the non-Federal sponsor's OMRR&R activities.

4.7.5 12 Actions for Change

The 12 Actions for Change are a set of actions that were identified by the Corps and other investigative teams. They point to the need to transform the way the Corps serves the Nation and its Armed Forces. The Corps will use the 12 Actions to guide ongoing and future work, and to ensure the Corps is an organization that is adaptable, flexible, and responsive to the needs of the Nation. The 12 Actions guide the development of projects to ensure that engineered systems are designed, constructed, maintained, and updated to be more robust. The RAP accounts for and contributes to the 12 Actions, as described further in **Appendix H - 12 Actions for Change**.

4.7.6 Economics

Estimates of costs and benefits for the RAP are based on October 2006 price levels, a current discount rate of 4-7/8 percent, and a 50-year period of analysis.

As mentioned in **Section 2.5.1**, a study to identify environmental impacts, costs, and repayment strategy and responsibility for potential water supply losses associated with a permanent reoperation of Folsom Reservoir is being developed. This study on reoperation under without-project conditions is to be completed prior to completion of the 6 STG Element of the Selected Plan. It is estimated that the study will generally confirm previous findings that there is a fairly significant cost related to the continued use of an increase in flood control storage space from conditions that existed prior to implementation of the variable storage space concept in the mid-1990s. As described in the *1996 SIR*, it was estimated at that time that implementation of a variable storage space would result in adverse impacts to CVP and State Water Project (SWP) water supplies, hydropower production, local water supplies, recreation at Folsom Reservoir, and cultural resources around Folsom Lake. It is important to understand, however, that the RAP will likely reduce the amount of the variable space over the without-project conditions; therefore, impacts to the above resources would be reduced. However, impacts would still be greater than prior to implementation of the variable space concept. Since impacts would be reduced with the RAP over conditions without the plan, no mitigation (resources replacement) costs are included in the plan. This information will be included in the permanent reoperation study report.

4.7.6.1 Costs

The estimated first and annual costs for the RAP are included in **Table 4-6**. The estimated first cost for the Selected Plan based on 2006 price levels is \$848.2 million (less the Reclamation dam safety features). The first cost for the RAP in **Table 4-6** is \$973.7 million.

The resulting total average annual cost for the Selected Plan component of the RAP attributable to flood damage reduction is \$43.5 million. This cost accounts for interest during construction, interest and amortization over the period of analysis, and a current Federal interest rate of 4-7/8 percent.

**TABLE 4-6
SUMMARY OF COSTS AND BENEFITS FOR CORPS PORTION OF
SELECTED PLAN AND REFINED AUTHORIZED PROJECTS (\$ MILLIONS) ¹**

Item	Refined Authorized Projects		
	6 STG Element (Corps Work Package Only)	DR Element + Other Features	Total
First Cost			
Land	0.0	0.2	0.2
Roads and Relocations	0.0	0.0	0.0
Construction	538.6	73.6	612.2
Environmental Mitigation	0.4 ²	3.0	3.4
Cultural Resources	0.0	0.8	0.8
EDS&A	144.0	37.7	181.7
Subtotal – Selected Plan (less Reclamation Work Package)	683.0	115.3	798.3
Temporary Bridge Increment	0.0	49.9	49.9
Total - Selected Plan (less Reclamation Work Package)	683.0	165.2	848.2
Other Features			
Ecosystem Restoration	0.0	59.8	59.8
Permanent Bridge Increment	0.0	65.7	65.7
Total - RAP (less Reclamation Work Package)	683.0	290.7	973.7
Investment Cost			
First Cost (Selected Plan) ³	683.0	115.3	798.3
Less Cultural Resources	0.0	-0.8	-0.8
Less Sunk Costs	-55.9	-22.1	-78.0
IDC	75.1	8.9	84.0
Total	702.2	101.3	803.5
Annual Cost (Selected Plan) ^{3, 4}			
Interest and Amortization	37.7	5.5	43.2
Operation and Maintenance	0.2	0.1	0.3
Subtotal	37.9	5.6	43.5
Annual Flood Damage Reduction Benefits	89.9	17.2	107.1
Net Annual Flood Damage Reduction Benefits	52.0	11.6	63.6
Benefit-to-Cost Ratio for Flood Damage Reduction	2.4	3.1	2.5
Key: DR = dam raise EDS&A = engineering, design, supervision, and administration IDC = interest during construction MCACES = microcomputer-aided cost engineering system RAP = Refined Authorized Projects STG = submerged tainter gate			

Notes:

1. MCACES October 2006 price levels.
2. Environmental mitigation for previous work and treated as a portion of sunk costs.
3. First and annual cost for the Selected Plan portion of RAP only - less Reclamation Work Package and Other Features costs.
4. 50-year period of analysis, and 4-7/8 percent interest rate.

4.7.6.2 Benefits

As shown in **Table 4-6**, total annual average benefits for flood damage reduction are about \$107.1 million (including future growth in the floodplain over the project life).

4.7.6.3 Economic Justification

As **Table 4-6** shows, the estimated net annual flood damage reduction benefits of the RAP are about \$63.6 million. The resulting benefit-cost ratio for this plan is 2.5 to 1.

CHAPTER 5.0 CHANGES FROM AUTHORIZED PROJECT PLANS

5.1 CHANGES IN SCOPE

The basic scope of the Folsom Modification Project and Folsom Dam Raise Project has been to accomplish the following:

- Increase the release capacity at Folsom Dam to maintain releases at or below the objective release of 115,000 cubic feet per second (cfs) for large events.
- Increase the flood detention storage space within Folsom Reservoir through operational changes and/or physical modifications at Folsom Dam to delay the onset of excessive releases.

In addition, the United States Department of the Interior, Bureau of Reclamation (Reclamation), has consistently needed to recognize issues related to dam safety at Folsom Dam and Reservoir. Vehicle transportation across Folsom Dam is also a major interest to Reclamation.

Fundamental features included in the Folsom Modification Project authorization to accomplish the above purposes included enlarging the existing eight outlets, constructing two new outlets, constructing a new emergency spillway stilling basin, and permanently modifying the seasonal flood control storage space in Folsom Reservoir. As mentioned, the authorized Folsom Modification Project is similar to the project identified in the Corps *1996 American River Watershed Project, California, Supplemental Information Report* (1996 SIR); instead of lowering and modifying the existing spillway and gates, the project includes new outlets.

To further address the above goals, the authorized Folsom Dam Raise Project included raising the main dam, replacing spillway gates, and improving the wing dams, stilling basin, Mormon Island Auxiliary Dam (MIAD), and various dikes around Folsom Reservoir. To ensure that the improvements would also conform with dam safety needs at Folsom, the project included enlarging the spillway at L.L. Anderson Dam.

As described in **Chapter 4**, the Refined Authorized Projects (RAP) include the Selected Plan plus two Other Features. The Selected Plan comprises two fundamental elements: (1) an auxiliary spillway with six submerged tainter gates (6 STG Element) and (2) raising Folsom Dam (DR Element). The two Other Features consist of ecosystem restoration and a permanent bridge increment, both of which are companion to the DR Element. Describing the Selected Plan and RAP as separate elements presents challenges. As an example, whereas the hydrologic dam safety function of the authorized projects rested in the Folsom Dam Raise Project, as described in **Chapter 6**, this function currently is an important part of the 6 STG Element. Currently, the 6 STG Element is composed of two work packages: the Corps Work Package and Reclamation Work Package. These work packages are summarized in **Chapter 6**. Regardless of how the Selected Plan and RAP are separated, it is important to note that collectively, the scope of the project has not changed from that of the combined authorized projects.

Project scope can be measured in a number of ways. Following is a consideration of scope from the standpoint of annual exceedence probability (AEP), discharge, dam height, and storage capacity.

5.1.1 Annual Exceedence Probability

AEP expresses the probability that the project will perform satisfactorily given any storm that may occur. It is the statistical probability that a specific capacity or target stage will be reached or exceeded in any given year, expressed as a decimal, and/or chance of occurrence. AEP expected at the time of authorization for the Folsom Modification Project was 0.0075 (Corps November 2003 *American River Watershed, California, Folsom Dam Modification Project Final Limited Reevaluation Report and Environmental Assessment/Initial Study* (2003 LRR)), which equates to a 1 in 140 chance of occurrence in any year. On the basis of updated modeling (2006), the current estimated AEP for the Folsom Modification Project is 0.0065, or a 1 in 154 chance in any year. As shown in **Table 5-1**, it is estimated that the AEP for the 6 STG Element is 0.0064 or a 1 in 156 chance in any year. This constitutes about an 1½ percent increase in flood damage reduction from what was authorized (from 1 in 140 to 1 in 156).

**TABLE 5-1
COMPARISON OF 6 STG ELEMENT TO FOLSOM MODIFICATION PROJECT**

Attributes	2003 Limited Reevaluation Report ¹ Ten-Outlet Plan	Updated Limited Reevaluation Report ² Ten-Outlet Plan	6 STG Element
Features	Enlarge 8 outlets, construct 2 new outlets	Same features as the 2003 LRR plan	Auxiliary spillway with 6 STG, invert elevation 368 feet
Operation Objective Release ³ Emergency Release ⁴	<ul style="list-style-type: none"> • Begins at 10-year inflow design event, ends at 150-year inflow design event • Release reached at 160-year inflow design event, release not held 	<ul style="list-style-type: none"> • Begins at 10-year inflow design event, ends at 100-year inflow design event • Begins at 110-year inflow design event, ends at 200-year inflow design event 	<ul style="list-style-type: none"> • Begins at 10-year inflow design event, ends at 100-year inflow design event • Begins at 110-year inflow design event, ends at 210-year inflow design event
Resulting Flood Risk, Annual Exceedence Probability (1 in X chance in any year) ⁴	0.00714 (140)	0.0065 (154)	0.0064 (156)
Dam Safety	No significant dam safety function	No significant dam safety function	Passes PMF
Key: PMF = probable maximum flood		STG = submerged tainter gate	

Notes:

1. Ten-Outlet Plan is the plan described in the Corps November 2003 *American River Watershed, California, Folsom Dam Modification Report Final Limited Reevaluation Report and Environmental Assessment/Initial Study* (2003 LRR) without surcharge storage.
2. Authorized plan in 2003 LRR updated based on current (2006) reservoir operation modeling process.
3. 115,000 cubic feet per second (cfs) sustained flow; downstream levees remain intact.
4. If flow persists, 160,000 cfs downstream levees are at risk of failure.

The AEP for the authorized Folsom Dam Raise Project was 0.0050, which equated to a 1 in 175 chance in any year (1 in 200 equivalency based on updated operations), as shown in **Table 5-2**. Assuming the 6 STG Element is in place, current features included in the DR Element are estimated to have an AEP of 0.0054 (1 in 185 chance equivalency), an increase of about 6 percent.

**TABLE 5-2
COMPARISON OF DR ELEMENT TO FOLSOM DAM RAISE PROJECT**

Attributes	Authorized Plan (Corps 2002 Chief of Engineers Report) 7-foot Raise, Flood Pool at 482 Feet	Updated 7-foot Raise, Flood Pool at 482 Feet ¹	DR Element of Selected Plan: 3.5-foot Raise, Replace 3 Emergency Spillway Gates
Features	<ul style="list-style-type: none"> • Raise Folsom Dam embankments 7 feet • Raise the top of flood space from elevation 474 to elevation 482 	Features are the same as the authorized plan	<ul style="list-style-type: none"> • Raise Folsom Dam embankments by 3.5 feet • Replace 3 emergency spillway tainter gates with taller gates
Operation	Flood damage reduction achieved by increase in detention of 95,000 acre-feet	Operation changed due to revised routing criteria	<ul style="list-style-type: none"> • Raise the top of flood space from elevation 470 to elevation 474 • Flood damage reduction achieved by increase in detention of 46,200 acre-feet
Flood Risk, Percent Chance Exceedence (1 in X chance in any year)^{2,3}	0.0057 (175)	0.0050 (200)	0.0054 (185)
Dam Safety	Includes dam safety function	No dam safety function	No dam safety function
Key: DR = dam raise			

Notes:

1. Authorized dam raise in Corps 2002 Chief of Engineers Report, updated based on current (2006) reservoir operations modeling processes.
2. All performance data (exceedences) and economic benefits are without forecast-based advance release, which is not part of the without-project condition.
3. Assumes Folsom Modification Project (6 STG Element) is in place.

5.1.2 Storage Discharge Capacity

Changes in scope for the Folsom Modification Project features can be measured in terms of hydraulic performance. In this case, hydraulic performance is defined as storage discharge in relation to the reservoir pool elevation at which the discharge can be made. The authorized Folsom Modification Project had a target of being able to discharge 115,000 cfs at elevation 418 feet, which is the existing spillway crest. Current features have the potential to discharge 115,000 cfs at elevation 405 feet. This constitutes a 13-foot decrease in elevation from the authorized project at which the same storage discharge would occur.

It should be noted that at elevation 418 feet, the 6 STG Element with the existing outlets at Folsom would have a design release potential of 173,922 cfs. However, an auxiliary spillway with four submerged tainter gates is the plan that is functionally equivalent to the authorized Folsom Modification project; the additional capacity provided by the two additional submerged tainter gates is necessary for passing the Probable Maximum Flood (PMF). This constitutes a shifting of authority for addressing the PMF from the authorized Folsom Dam Raise Project to

the Folsom Modification Project, but does not constitute a scope change for flood damage reduction for the authorized Folsom Modification Project. Hydraulic performance is not a measure of scope for the Folsom Dam Raise Project because that project would not significantly increase discharge capacity.

From another perspective, the authorized Folsom Modification Project and the 6 STG Element would fundamentally be able to pass a portion of the PMF. As mentioned, the authorized Folsom Modification Project could pass roughly 75 percent of the PMF, while the project with the 6 STG Element could pass 100 percent of the PMF.

5.1.3 Height of Dam Raise

The authorized Folsom Dam Raise project included raising the existing dam 7 feet. Current features include raising the existing dam 3.5 feet. This constitutes a 50 percent decrease in the physical scope of the project. However, the height of the dam raise is not necessarily the most pertinent criterion for measuring scope change associated with the Folsom Dam Raise Project authority. The purpose of the raise is to increase storage space; therefore, it is more appropriate to measure the increased storage space in the reservoir pool due to a dam raise.

5.1.4 Storage Capacity

It is difficult to directly compare the storage space attributable to flood damage reduction between the two authorized projects and the Selected Plan. This is primarily due to dam safety being accommodated in the 6 STG Element of the RAP instead of being part of the authorized Folsom Dam Raise Project.

The original Folsom Modification Project had a usable maximum flood pool elevation of 470 feet without the surcharge storage component. In this application, surcharge is storage in excess of the normal full pool. Normal full pool, or gross pool, corresponds to the top reservoir level allocated for routine flood damage reduction, recreation, water supply, or other authorized storage uses. The maximum surcharge elevation, adopted as a basis for project design, results from routing an extreme flood event through the reservoir. (As a contingency, the surcharge space provides protection against an extraordinarily rare event that could threaten the integrity of the dam itself.) With the surcharge component, the maximum pool elevation was 474 feet. These elevations were based on physical constraints of the existing project and, to some extent, the need to ensure that the project would pass at least the same percentage of the PMF as without the project. The Folsom Dam Raise Project included raising the top of dam to elevation 487.5 feet; considering vacant space necessary for freeboard, the maximum flood pool could be elevation 482 feet. However, because the project would need to pass the PMF, the maximum elevation that could actually be used for flood damage reduction (an outflow of 160,000 cfs or less) was about 478 feet. Accordingly, it could be argued that the actual increase in flood control space was from elevation 474 feet (Folsom Modification Project including surcharge) to elevation 478 feet, which would be about 47,000 acre-feet. However, it is probably more appropriate to attribute the increase of flood control space for the authorized Folsom Dam Raise Project from elevation 470 feet to 478 feet because the Folsom Dam Raise Project incorporated the surcharge component. Therefore, the increase from 470 feet to 478 feet results in an increase of space of about 93,000 acre-feet.

A different method was used to determine the top of the flood pool for the plans described in this *Post Authorization Change (PAC) Report*. The Folsom Modification Project has a maximum authorized flood pool (the elevation below which not more than 160,000 cfs can be released) of 466 feet. The Selected Plan would have a maximum flood pool of 474 feet. With a dam raise of 3.5 feet, the total increased space that could be used for flood damage reduction purposes would be about 81,000 acre-feet. This includes 46,200 acre-feet due to the physical dam raise and approximately 35,000 acre-feet resulting from a change in flood operations in Folsom Reservoir.

Routing criteria for the originally authorized Folsom Modification and Folsom Dam Raise projects have been modified from those used for the current features. This limits the ability to compare post authorization changes to the projects as they were originally authorized. Further, gate rating curves will be refined during detailed designs. The comparison information presented in this *PAC Report* is considered appropriate to show the basic comparison of the previous and current features of the authorized projects.

5.2 CHANGES IN LOCATION

The project area for the RAP and its major elements is the same as that of the authorized Folsom Modification Project and Folsom Dam Raise Project. The project area includes Folsom Dam and Reservoir; inflowing rivers and streams, including the North, South, and Middle forks of the American River; the American River downstream to its confluence with the Sacramento River in the City of Sacramento; and other affected flood facilities, including the Sacramento River, Yolo Bypass, and Sacramento Weir. The American River watershed covers about 2,100 square miles northeast of the City of Sacramento and includes portions of Placer, El Dorado, and Sacramento counties.

The RAP features have locations within the basin similar to those for the authorized projects. Whereas much of the construction effort for the Folsom Modification Project focuses on Folsom Dam, the bulk of construction effort for the 6 STG Element would relate the auxiliary spillway and appurtenant facilities. As shown in **Plate 12**, the new spillway would be located immediately adjacent to the left wing dam at Folsom Dam, about 1,000 feet from Folsom Dam. Considering that the circumference of Folsom Lake is about 75 miles, this is considered to be an insignificant distance. Most of the major features of the Folsom Dam Raise Project and DR Element of the Selected Plan have similar locations.

5.3 CHANGES IN PROJECT PURPOSES

There is no change in purposes from the authorized projects. The two primary purposes of the RAP are the same as for the authorized Folsom Modification and Folsom Dam Raise projects, and include flood damage reduction and ecosystem restoration. The RAP also includes a goal to support Reclamation's resolution of hydrologic dam safety issues at Folsom Dam, similar to the Folsom Dam Raise Project. Again, however, the dam safety component of the RAP rests with the Reclamation Work Package, which is a significant part of the 6 STG Element rather than a part of the DR Element. It is important to note that modification of the L.L. Anderson Dam component of the Folsom Dam Raise Project is included in the RAP. L.L. Anderson Dam modifications are being accomplished independently by Placer County Water

Agency (PCWA). In addition, there is recognition that Folsom Bridge is being implemented in advance of the DR Element. The ecosystem restoration purpose is retained as an Other Feature (companion to the DR Element). However, because the analysis presented in this *PAC Report* does not affect the separable ecosystem restoration project features, it is planned that the ecosystem restoration components will continue to be implemented under the Folsom Dam Raise authorization. The new Folsom Bridge, which is part of the Folsom Dam Raise Project, is expected to be implemented before the Selected Plan.

5.4 CHANGES IN DESIGNS

For flood damage reduction, major physical components of the authorized Folsom Modification Project are as described in the 2003 LRR. The originally authorized Folsom Modification Project consisted of two major components: (1) outlet works modification and (2) surcharge storage. The outlet works modification consisted of three basic features: (1) enlarging eight existing outlets and constructing two new outlets, (2) modifying the existing spillway stilling basin, and (3) constructing a flat bulkhead and seal assembly on the upstream face. The surcharge storage components included (1) replacing the three emergency spillway tainter gates, (2) revising the Emergency Spillway Release Diagram to modify surcharge operation, and (3) raising the impervious core in MIAD and Dikes 5 and 7 to allow dependable use of the surcharge storage.

Major physical components of the Folsom Dam Raise Project, as originally authorized, included (1) raising the top of Folsom Dam 7 feet, (2) replacing spillway gates, (3) and making a number of improvements to the stilling basin and reservoir auxiliary dams and dikes. This dam raise would be a combination of raising the concrete monolith and embankments and adding a 3.5-foot parapet wall. Modifications to the L.L. Anderson Dam spillway were also part of the original authorized project; however, these modifications are now to be accomplished by PCWA and are considered part of the future without-project condition of this PAC Report.

The 6 STG Element includes (1) 1,100-foot-long approach channel beginning in Folsom Lake, (2) control structure, including six submerged tainter gates, (3) 3,000-foot-long spillway chute with a bottom width of about 168 feet, and (4) stilling basin in the American River. These features are considered to be functionally equivalent to the authorized work defined for the Folsom Modification Project. The 6 STG Element would not only allow for reduced flood risk but would also satisfy hydrologic dam safety issues at Folsom.

The DR Element primarily includes modifying three emergency spillway gates, and raising various facilities around Folsom Reservoir by 3.5 feet. Companion to the DR Element are the Other Features of the authorized Folsom Dam Raise project, including the Folsom permanent bridge and ecosystem restoration components. Modifications to the L.L. Anderson Dam spillway are to be accomplished as a without-project condition.

Table 5-3 compares the basic features for both of the authorized projects and for the RAP. The primary reasons for the design changes are recent findings that the auxiliary gated spillway would be a more effective and efficient method of evacuating the flood space in Folsom Reservoir earlier in a storm event, while also addressing hydrologic dam safety issues at Folsom Dam. **Table 5-4** displays the changes from the authorized projects by feature.

**TABLE 5-4
SUMMARY OF AUTHORIZED PROJECTS AND CHANGES**

Authorized Feature	Recommended Change	Basis for Change	Changes for Refined Authorized Projects				
			Total Project Cost	Scope	Location or Design	Project Purpose	
Folsom Modification Project							
Enlarge 8 existing outlet works	Construct new auxiliary spillway with 6 submerged tainter gates	Auxiliary spillway is a less costly method of attaining basic outputs and addressing dam safety problem (passes the PMF)	Exceeds allowable increases in price level changes	Annual Exceedence Probability: Authorized 1 in 140; change to 1 in 156 Hydraulic Performance: Authorized discharge 115,000 cfs at elevation 418 feet; change to 115,000 cfs at 405 feet Annual Benefits: Authorized \$35.3 million (at 2006 price levels); change to \$89.9 million Includes dam safety (PMF)	No significant change	No change	
Add 2 new outlets	Construct new auxiliary spillway with 6 submerged tainter gates					No change	
Surcharge storage: Replace 3 emergency spillway tainter gates. Raise impervious core at several dikes, Revise Emergency Spillway Release Diagram.	Revise Emergency Spillway Release Diagram as part of dam raise project	Gate replacement and modification to impervious dam and dike cores no longer needed with raised dam.			No change	No change	
Folsom Dam Raise Project							
Raise dam, wing walls and dikes 7 feet	Raise dam, wing walls, and dikes 3.5 feet Modification of 3 emergency spillway tainter gates	Height of raise reduced because auxiliary spillway addresses dam safety problem (raise no longer needed to pass PMF)	Within allowable increases in price level changes	Annual Exceedence Probability: Authorized 1 in 175; change to 1 in 185 Storage: Authorized: 93 TAF change: 81 TAF Annual Benefits: Authorized \$23 million (at 2006 price levels); change to \$17.2 million Does not include dam safety (PMF)	No change in location; design will be refined for smaller dam raise	No change	
Construct bridge	No change; separable project from Selected Plan	–				No change	No change
Modify L.L. Anderson spillway	PCWA to resolve dam safety issues via separate project	Revised future without project condition				No change	No change
Implement ecosystem restoration features	No change; separable project from Selected Plan	–				No change	No change
Key:	– = does not apply cfs = cubic feet per second PCWA = Placer County Water Agency	PMF = Probable Maximum Flood RAP = Refined Authorized Projects TAF = thousand acre-feet					

5.5 CHANGES IN TOTAL PROJECT FIRST COST

This section describes the magnitude of changes in first cost and the primary reasons for the changes.

5.5.1 Changes in First Cost

Table 5-5 shows the estimated first costs for the Folsom Modification Project under various conditions. Included in the table are estimates of the first costs as included in the original project as authorization (see Column b) and as presented in the 2003 LRR (Column a), authorized project cost updated to October 2006 price levels (Column c), and the 2003 LRR costs updated to October 2006 price levels (Column d). It is important to note that the outlet works modification component of the 2003 LRR shown in **Table 5-5** (Column d) is being used as the basis for much of the description of the authorized Folsom Modification Project. This is primarily because the physical modifications for the surcharge element of the project would not apply to the RAP and little is known or available about the genesis of the original costs and other supporting information associated with the 1999 authorization. Also included in **Table 5-5** is the estimated cost for the 6 STG Element of the Selected Plan (Column e). This cost is for the flood damage reduction only (Corps Work Package) portion of the Selected Plan. If estimated costs of the authorized project were repriced at 2006 October price levels (e.g., reevaluated using current construction costs), not updated using cost indices, these costs would be much higher and closer to those shown for the RAP in the table. Repricing includes identifying the estimated project cost using current market costs, while cost updating is an escalation of original costs using price indices.

Table 5-6 shows the estimated first costs for the Folsom Dam Raise Project under various conditions. Included is the estimated first cost reported to Congress based on October 2001 price levels (see Column a), the project costs as authorized by Congress based on October 2003 price levels (Column b), and the authorized cost and project cost updated to October 2006 price levels (Columns c and d). Also included is an estimate of the first cost of the DR Element plus the Other Features component of the RAP at October 2006 price levels. It is also important to note that the estimated costs of the authorized project, if it were repriced to October 2006 price levels (not updated by price levels), would be much greater, at nearly \$740 million, than the RAP shown in the table.

As shown in **Table 5-7**, the total first cost for the Selected Plan (less the cost for dam safety in the Reclamation Work Package) portion of the RAP is \$848.2 million and the total cost of the RAP is \$973.7 million. **Table 5-7** was prepared from both **Tables 5-5** and **5-6**. It includes the estimated authorized project cost updated to 2006 price levels, and the estimated cost of the Selected Plan and RAP with their primary elements. The purpose of this table is to compare the authorized project costs at current prices to the current costs of the Corps portions of the Selected Plan and RAP.

**TABLE 5-5
TOTAL PROJECT FIRST COST HISTORY – FOLSOM MODIFICATION PROJECT
AND REFINED AUTHORIZED PROJECTS INCREMENT (\$ MILLIONS)**

Item	Project Cost Last Presented to Congress ¹	Cost Authorized by Congress ²	Authorized Cost (Column b)	Project Cost (Column a)	6 STG Element of Selected Plan (Corps Work Package) ⁴
	October 2001 Price Levels	October 1999 Price Levels	Updated to October 2006 Price Levels ³	Updated to October 2006 Price Levels	October 2006 Price Levels
	Column a	Column b	Column c	Column d	Column e
Outlet Works Modification	183.8 ⁵	–	–	208.2 ⁵	683.0
Surcharge Storage Modifications	30.3	–	–	34.3	0.0
Total First Cost	214.1	150.0	201.1	242.5 ⁶	683.0
Key: – = Does not apply STG = submerged tainter gate					

Notes:

1. Corps November 2003 American River Watershed, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study.
2. As cited in Section 101(a) (6) of WRDA 1999 (PL 106-53).
3. Authorized cost updated to October 2006 price levels using Civil Works Construction Cost Index System (CWCCIS) per ER 1110-2-1302.
4. Does not include costs for dam safety, which are included in the Reclamation Work Package.
5. Construct two new low-level outlets and enlarge the eight existing outlets.
6. Cost of project repriced to current price levels would be significantly greater at about \$655 million (\$613 million for outlet works modification and \$42 million for surcharge storage facilities).

**TABLE 5-6
TOTAL PROJECT FIRST COST HISTORY – FOLSOM DAM RAISE PROJECT AND
REFINED AUTHORIZED PROJECTS INCREMENT (\$ MILLIONS)**

Item	Project Cost Last Submitted to Congress ¹ October 2001 Price Levels Column a	Cost Authorized by Congress ² October 2003 Price Levels Column b	Authorized Cost (Column b) Updated to October 2006 Price Levels ³ Column c	Project Cost (Column a) Updated to October 2006 Price Levels ⁴ Column d	DR Element and Other Features of RAP at October 2006 Price Levels ⁵ Column e
Authorized Project					
Folsom Dam Raise	174.1	–	–	208.5	115.3
L.L. Anderson Spillway Modification	12.1	–	–	14.5 ⁶	0
Ecosystem Restoration	27.4	–	–	32.8	59.8 ⁷
Temporary Bridge	35.0	–	–	41.9	49.9 ⁸
Subtotal	248.6	257.3	303.6	297.7	225.0
Permanent Bridge Increment	–	–	–	–	65.7
Subtotal Total	248.6	257.3	303.6	297.7 ⁹	290.7 ¹⁰
Key: – = does not apply DR = dam raise RAP = Refined Authorized Projects					

Notes:

1. Authorized project cost estimate as described in the 5 November 2002 Chief of Engineers Report for the 2002 Long-Term Study (Corps), October 2001 price levels.
2. Authorized cost cited in the 2004 Energy and Water Development Appropriations Act, October 2003 price levels.
3. Authorized cost updated to October 2006 price levels using Civil Works Construction Cost Index System (CWCCIS) per ER 1110-2-1302.
4. Cost estimate of the authorized project updated to October 2006 price levels.
5. Cost estimate in RAP at October 2006 price levels.
6. Cost of L.L. Anderson Dam spillway modification updated to October 2006 price levels. However, since authorization, it has been determined that Placer County Water Agency would be responsible for the cost to modify the spillway under licensing requirements by the Federal Energy Regulatory Commission and the State of California.
7. Revisions to costs for temperature shutters have raised ecosystem restoration costs since publication in the 2002 Chief of Engineers Report (Corps) (see **Chapter 7**).
8. Cost of temporary bridge limited by 2006 Energy and Water Development Appropriations Act Section 128.
9. Cost of project repriced to current price levels would be significantly greater at about \$737 million.
10. Includes the cost attributed to the permanent bridge increment, which is the total cost of the bridge at \$115.6 million, less the cost of the temporary bridge.

**TABLE 5-7
SUMMARY OF TOTAL FIRST COSTS (\$ MILLIONS)**

Item	Authorized Project Cost October 2006 Price Levels	Refined Authorized Projects October 2006 Price Levels			
		6 STG Element (Corps Work Package)	DR Element and Other Features	Subtotal Selected Plan ¹	Total ¹
Folsom Modification Project					
Flood Damage Reduction	242.5	683.0	–	683.0	683.0
Dam Safety	0	²	–	²	²
Total	242.5	683.0	–	683.0	683.0
Folsom Dam Raise Project					
Flood Damage Reduction	–	–	–	–	–
Dam Raise	111.6	–	115.3	115.3	115.3
Temporary Bridge ³	41.9	–	49.9	49.9	49.9
Dam Safety ⁴	111.4	–	–	–	–
Subtotal	264.9	–	165.2	165.2	165.2
Other Features					
Ecosystem Restoration ⁵	32.8	–	59.8	–	59.8
Permanent Bridge	–	–	65.7	–	65.7
Subtotal	32.8	–	125.5	–	125.5
Subtotal	297.7	–	290.7	165.2	290.7
Total	540.2 ⁶	683.0	290.7	848.2	973.7
Key: – = does not apply DR = dam raise RAP = Refined Authorized Projects STG = submerged tainter gate					

Notes:

1. Corps portion of the Selected Plan and RAP.
2. Plan elements to be accomplished under the Reclamation Safety of Dams Program.
3. Cost estimate for the temporary bridge in the 2002 Long-Term Study (Corps) updated to October 2006 price levels. Current plans call for construction of a permanent bridge at significantly greater cost, which is considered a sunk cost in the Selected Plan. Cost estimate for the temporary bridge limited by 2006 Energy and Water Development Appropriations Act, Section 128.
4. See Note 3. In addition, the authorized project includes the cost of L.L. Anderson Dam spillway modifications primarily as part of dam safety. L.L. Anderson modifications are excluded from the RAP because it has been determined that Placer County Water Agency would be responsible for the cost to modify the spillway under dam licensing requirements by the Federal Energy Regulatory Commission and the State of California.
5. Ecosystem restoration is retained in the RAP but considered as a continued project element.
6. Total cost of the authorized projects repriced to current price levels would be significantly greater at about \$1,390 million.

5.5.2 Reasons for Changes in Project First Cost

5.5.2.1 6 STG Element

As can be seen in **Table 5-7**, the estimated first costs, updated to 2006 price levels, of the authorized Folsom Modification Project are about \$242.5 million (if repriced at current price levels, this cost would be significantly greater). The estimated first costs for the 6 STG Element of the Selected Plan are about \$683.0 million (excluding dam safety), a cost difference of \$440.5 million. Changes in costs are attributable to preconstruction, engineering, and design as well as significantly greater construction costs than reflected in price level updates. A major cost component difference between the Folsom Modification Project and the 6 STG Element relates to the significantly different features making up the two project elements. The eight outlets portion of Alternative A, described in **Chapter 4**, would provide a reduction in flood risk similar to the Folsom Modification Project. As mentioned, however, that plan would need to include an emergency fuseplug spillway. The 6 STG Element would provide a significant reduction in flood damages compared with the originally authorized Folsom Modification Project. Further, the Folsom Modification Project would not satisfy the fundamental goals of the non-Federal sponsor. Accordingly, most of the cost increase is due to (1) significant reduction of the chance of flooding in Sacramento and (2) features to pass the PMF.

5.5.2.2 DR Element and Other Features

Also shown in **Table 5-7** is a comparison of the current estimated first cost for the authorized Folsom Dam Raise Project to the DR Element of the Selected Plan and Other Features of the RAP. The estimated first costs for the Folsom Dam Raise Project and the DR Element are about \$264.9 million and \$165.2 million, respectively (October 2006 price levels). The bulk of the cost reduction is associated with the cost of the raise components in the authorized project attributable to dam safety. Again, however, the cost of the authorized project would be significantly greater if repriced at current price levels. Accordingly, the actual cost reduction is much greater.

The major reason for the cost reduction is that the DR Element includes a 3.5-foot raise instead of the 7-foot raise included in the authorized project. In addition, the Folsom Dam Raise Project included replacing all eight of the spillway tainter gates, whereas the DR Element includes replacing only the three emergency spillway tainter gates.

In addition, **Table 5-7** shows costs for ecosystem restoration and the permanent Folsom Dam Bridge increment of the Folsom Dam Raise Project. Because the analysis presented in this *PAC Report* does not affect the separable ecosystem restoration project features, it is planned that the ecosystem restoration components will continue to be implemented under the Folsom Dam Raise Project authorization.

5.5.2.3 Refined Authorized Projects

As shown in **Table 5-7**, the total estimated first cost of the RAP, including ecosystem restoration and a permanent bridge increment (i.e., Other Features), is \$973.7 million (less cost for Reclamation Safety of Dams Program/Reclamation Work Package) while the first cost for the authorized Folsom Modification and Folsom Dam Raise projects combined is \$540.2 million (an increase of \$433.5 million). As described previously, the bulk of the cost increase relates to the 6 STG Element and is due to the greater cost required to construct the auxiliary spillway. However, the auxiliary spillway referenced in the Energy and Water Development Appropriations Act of 2006 (see **Chapter 1**) provides a significantly greater reduction in flood risk to Sacramento and is also capable of passing the PMF. In addition, authorized project costs updated by price levels only are believed to be significantly underestimated for the actual cost of constructing the authorized project features at current price levels.

It is important to understand that much more is known today about which physical features can be safely implemented at Folsom Dam. It was found that enlarging the existing outlets and constructing the two new outlets would require much more underwater work within Folsom Reservoir, which would significantly increase the difficulty of construction. Based on this knowledge, and the desire to ensure passage of the PMF, the auxiliary spillway concept was identified as part of a *Project Alternative Solutions Study* (PASS) (Corps, Reclamation, The Reclamation Board, and SAFCA, 2005) process. Accordingly, through a combination of designs and costs for the authorized projects, and improved knowledge about project requirements, the current features are estimated to cost less than the authorized features if both were considered for implementation today.

5.6 CHANGES IN PROJECT BENEFITS

Economic output is generally a measure of post authorization changes to scope. The changes in average annual benefits for flood damage reduction are due to changes in price level, interest rate, updated estimated flood damages, evolving without-project conditions, and increasing understanding about hydrologic and levee uncertainties, and other factors used in the risk analysis model. Price levels have changed from October 2003 and October 2001 for the Folsom Modification and Folsom Dam Raise projects, respectively, to October 2006 price levels. The interest rate for the two authorized projects has decreased from 6-1/8 and 5-5/8 percent, respectively, to 4-7/8 percent. The inventory of damageable property was updated to current conditions and significant adjustments have been made to account for revised hydrologic conditions along the American River due to changes in reservoir operations. Flood damages and updated flood damage reduction benefits are described in **Appendix E – Economics**. Because of these factors, estimates of project benefits for the authorized projects are difficult to compare to estimated benefits of the currently recommended features, and are not considered to be a good measure of post authorization changes.

The changes in benefits for each project and major element are summarized in **Table 5-8**. Flood damage reduction benefits in the table for the authorized Folsom Modification and Folsom Dam Raise projects are based on October 2003 and October 2001 price levels, respectively. These benefit values are also updated to October 2006 price levels. The ecosystem restoration benefit for the Folsom Dam Raise Project and DR Element of the Selected Plan is the increase in

average annual habitat units. No change has been made in the estimated number of habitat units potentially generated from the ecosystem restoration component of the Folsom Dam Raise Project. Because the analysis presented in this *PAC Report* does not affect the separable ecosystem restoration project features, it is planned that the ecosystem restoration components will continue to be implemented under the Folsom Dam Raise Project authorization.

**TABLE 5-8
CHANGE IN PROJECT BENEFITS**

Item		Authorized Projects			Refined Authorized Projects ⁴		
		Folsom Modification Project	Folsom Dam Raise Project	Total	6 STG Element	DR Element Plus Ecosystem Restoration	Total
Annual Flood Damage Reduction Benefits	2001/2003 Price Levels (\$ millions)	31.2 ¹	19.2 ²	50.4 ³	–	–	–
	2006 Price Levels (\$ millions)	35.3 ⁴	23.0 ⁴	58.3 ⁴	89.9	17.2	107.1
Annual Habitat Units		–	894	894	–	894	894
Key:		– = does not apply DR = dam raise			STG = submerged tainter gate		

Notes:

1. As presented in the Corps 2003 American River Watershed, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study (Outlet Works Modification only).
2. As presented in Corps November 2002 Chief of Engineers Report.
3. Total of reported benefits values.
4. Benefits presented at October 2006 price levels. No additional benefits are attributable to permanent bridge increment.

As shown in **Table 5-8**, total average annual flood damage reduction benefits for the RAP are estimated at \$107.1 million and the combined flood damage reduction benefits for the two authorized projects are about \$50.4 million at October 2001 and 2003 prices and \$58.3 million at October 2006 prices. Part of the increase in benefits of the RAP over the authorized projects is due to an updated understanding about levee conditions and reservoir operations reflected in the analytical process. Another major reason for the change is that a significant increase has occurred in property units and values within the floodplain. Updating by price levels has not been sufficient to capture this increase. Not only have the number and types of property units increased, but the value of these units has increased. Accordingly, a significant reason for the difference is that price level updates insufficiently reflect actual conditions, similar to that for project cost changes.

Table 5-9 shows the relationship between the collective changes in flood threat among the Folsom Modification Project, Folsom Dam Raise Project, and RAP. The Other Features components of the RAP do not affect flood damage reduction; thus, project performance of the RAP is equal to that of the Selected Plan. As can be seen from **Table 5-9**, and as summarized in **Section 5-1**, the relative difference between what was believed to be the resulting reduction in flood threat from the authorized projects at the time they were authorized is closely comparable to that for the RAP.

**TABLE 5-9
COMPARISON OF RELATIVE PROJECT PERFORMANCE**

Project	Annual Exceedence Probability (1 in x chance in any year)	
	Without-Project Conditions	With-Project Conditions
Authorized Projects ¹		
Folsom Modification Project ²	0.0111 (1 in 90)	0.0071 (1 in 140)
Folsom Dam Raise Project ³	0.0073 (1 in 137)	0.0057 (1 in 175)
Combined Project	0.0111 (1 in 90)	0.0057 (1 in 175)
Refined Authorized Projects ⁴		
6 STG Element	0.0123 (1 in 81)	0.0064 (1 in 156)
DR Element	0.0064 (1 in 156)	0.0054 (1 in 185)
Selected Plan ⁵	0.0123 (1 in 81)	0.0054 (1 in 185)
Key: DR = dam raise STG = submerged tainter gate		

Notes:

1. Based on operation modeling at the time of authorization. See **Tables 5-1 and 5-2** for Annual Exceedence Probability under current (2006) operations modeling.
2. Assumes Common Features Project is completed, without advanced releases from Folsom Dam.
3. Assumes Common Features and Folsom Modification projects are completed, without advanced releases from Folsom Dam.
4. Based on current (2006) operations modeling.
5. Other Features of the Refined Authorized Projects (RAP) do not affect flood damage reduction.

5.7 CHANGES IN BENEFIT-COST RATIO

Table 5-10 shows a summary of first costs; average annual flood damage reduction costs, benefits, and net economic benefits; and resulting benefit-to-cost ratios for the Folsom Modification and Folsom Dam Raise projects and the RAP. Information for the two authorized projects is based on data from the 2003 LRR and 2002 Chief of Engineers Report, updated to October 2006 price levels and reflecting current interest rates. **Table 5-10** shows that the major elements for flood damage reduction of the RAP are economically feasible even though the cost of the RAP is significantly higher than the updated combined cost for the authorized projects (see **Table 5-5** and **Table 5-6**). The economic benefits and net benefits in **Table 5-10** are compared to annual costs of the authorized and RAP components for flood damage reduction only. At \$848.2 million (total first cost less other features (\$973.7 million less \$125.5 million)), the first cost for the Selected Plan portion of the RAP is about \$452.2 million greater than the authorized projects cost (\$396 million) updated to 2006 price levels. Even so, the net flood damage reduction benefits are significantly greater than for the authorized projects. The estimated economic benefits for the Other Features in the RAP are estimated to be at least equal to their costs.

**TABLE 5-10
SUMMARY COMPARISON OF COSTS AND BENEFITS (\$ MILLIONS)**

Item	Authorized Projects					Refined Authorized Projects (2006 Price Levels)		
	Folsom Modification		Folsom Dam Raise		Combined Projects	6 STG Element (Corps Work Package)	DR Element and Other Features	Total
	2003 LRR ¹		2002 Chief of Engineers Report ²					
	2003 Price Levels	2006 Price Levels	2001 Price Levels	2006 Price Levels	2006 Price Levels			
First Cost								
Flood Damage Reduction	214.1	242.5	128.2	153.5	396.0	683.0	165.2	848.2
Other Features	0	0	120.4 ³	144.2 ³	144.2 ³	⁵	125.5 ⁶	125.5
Total	214.1	242.5⁴	248.6	297.7⁴	540.2⁴	683.0	290.7	973.7
Annual Cost (Flood Damage Reduction)	15.6	17.7	10.2	12.2	29.9	37.9 ⁷	5.6 ⁷	43.5 ⁷
Annual Benefits (Flood Damage Reduction)	31.2	35.3	19.2	23.0	58.3	89.9	17.2	107.1
Net Benefits	15.6	17.6	9.0	10.8	28.4	52.0	11.6	63.6
Benefit-to-Cost Ratio	2.0	2.0	1.9	1.9	1.9	2.4	3.1	2.5
Key:	DR = dam raise LRR = Limited Reevaluation Report				RAP = Refined Authorized Projects STG = submerged tainter gate			

Notes:

1. Corps 2003 American River Watershed, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study, November.
2. Corps 2002 Chief of Engineers Report, American River Watershed, California, Long-Term Study, 5 November.
3. Includes ecosystem restoration and dam safety at \$27.4 million and \$93 million, respectively, at 2001 price levels, and \$32.8 million and \$111.4 million, respectively, at 2006 price levels.
4. Total cost of the authorized projects repriced to current price levels would be significantly greater at about \$1,390 million (\$655 million for Folsom Modification Project and \$737 million for Folsom Dam Raise Project).
5. Plan elements to be accomplished under Reclamation Safety of Dams Program.
6. Includes ecosystem restoration (continued increment) at \$59.8 million and permanent bridge increment at \$65.7 million.
7. Annual costs from **Table 4-5**.

5.8 CHANGES IN COST ALLOCATION

Table 5-11 shows the cost allocation and percent allocation of first costs among flood damage reduction, ecosystem restoration, dam safety, and the permanent bridge increment of the authorized projects based on price levels at the time of authorization, when last presented to Congress, and the RAP (less dam safety). As mentioned, Reclamation is to implement the dam safety portion of the RAP, as defined in the Reclamation Work Package summarized in **Chapter 6**. In **Table 5-11**, costs for dam safety are not included in the RAP.

TABLE 5-11
SUMMARY COMPARISON OF COST ALLOCATION BY PROJECT PURPOSE
INCLUDING DAM SAFETY (\$ MILLIONS)

Item	Authorized Projects ¹						Refined Authorized Projects (2006 Price Levels)					
	Folsom Modification (2003 prices)		Folsom Dam Raise (2001 prices)		Combined (at indicated prices)		6 STG Element (Corps Work Package)		DR Element and Other Features		Total	
	First Cost	% of Total	First Cost	% of Total	First Cost	% of Total	First Cost	% of Total	First Cost	% of Total	First Cost	% of Total
Flood Damage Reduction	214.1	100	128.2	52	342.3	74	683.0	100	165.2 ²	57	848.2	87
Ecosystem Restoration ³	0	0	27.4	11	27.4	6	0	0	59.8	20	59.8	6
Dam Safety	0	0	93.0	37	93.0	20	⁴	0	0	0	⁴	0
Permanent Bridge ⁵	–	–	–	–	–	–	0	0	65.7	23	65.7	7
Total	214.1	100	248.6	100	462.7	100	683.0	100	290.7	100	973.7	100
Key:	– = does not apply DR = dam raise						STG = submerged tainter gate					

Notes:

1. Combination of costs at the time of authorization and/or last updated (Corps 2003 American River Watersehd, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study – Outlet Works Modification only). Total combined first cost updated to October 2006 price levels would be \$540.2 million.
2. Includes features cost-shared at 65 percent Federal and 35 percent non-Federal, as well as temporary bridge cost, which includes a Corps-budgeted dam safety cost that is subject to Reclamation determination of which part, if any, may be subject to reimbursement by the Central Valley Project.
3. Continued increment in Refined Authorized Projects (RAP). Not a part of Selected Plan.
4. Reclamation Dam Safety Work Package to be accomplished under the Reclamation Safety of Dams Program.
5. Advanced construction increment and temporary bridge increment as part of RAP. Not a part of Selected Plan.

5.9 CHANGES IN COST APPORTIONMENT

The estimated apportionment of costs has been updated for each of the authorized projects to October 2006 price levels. The updated apportionment of the authorized Folsom Modification Project was made following the same procedure contained in the 2003 LRR, which is different than the procedure used to estimate the apportionment of the RAP (described in **Chapter 7**). The distribution of first costs, based on those shown in **Table 5-5**, was made proportionally to the costs contained in the 2003 LRR.

Table 5-12 compares the updated estimated apportionment of costs for the Folsom Modification Project to the 6 STG Element in the Selected Plan portion of the RAP. As can be seen in the table, the costs are designated as Federal or non-Federal. As previously mentioned, costs and the apportionment of costs for the Reclamation Safety of Dams Program are being handled separately under the Reclamation Work Package.

Similarly, **Table 5-13** compares the updated estimated apportionment of costs for the Folsom Dam Raise Project and the DR Element plus the Other Features of the RAP. The updated apportionment of the authorized Folsom Dam Raise Project was made following the procedures contained in an economic evaluation and cost apportionment special analysis for the 7-foot raise for the Folsom Dam Raise Project. This special analysis was a supplement to the Corps 2002 Long-Term Study. It was used to support development of costs and cost apportionment for the recommendation made in the Corps 2002 Chief of Engineers Report.

Table 5-14 is a summary comparison of costs allocated among the two authorized projects and costs of the RAP. The table summarizes first costs, costs either deleted or continued from the authorized projects, dam safety costs (authorized project only), and related costs. As can be seen from the table, the overall percentages of total costs are very similar for the combined authorized projects and RAP.

**TABLE 5-12
SUMMARY COMPARISON OF COST APPORTIONMENT – AUTHORIZED FOLSOM
MODIFICATION PROJECT AND 6 STG ELEMENT OF SELECTED PLAN / REFINED
AUTHORIZED PROJECTS (\$ MILLIONS) ¹**

MCACES Account	Item	Authorized Project			Refined Authorized Projects		
		Folsom Modification Project ^{2,3}			6 STG Element (Corps Work Package) ⁴		
		Federal	Non- Federal	Total	Federal	Non- Federal	Total
	First Cost						
01	Land & Damages	0	0	0	0	0	0
02	Relocations	0	0	0	0	0	0
08,11	Construction	183.9	0	183.9	538.6	0	538.6
06	Environmental Mitigation ⁵	3.4	0	3.4	0.4 ⁶	0	0.4 ⁶
18	Cultural Resources	0	0	0	0	0	0
30,31	EDS&A	55.2	0	55.2	144.0	0	144.0
	Total	242.5	0	242.5	683.0	0.0	683.0
	Reclamation Safety of Dams Program	–	–	–	7	7	7
	Subtotal	242.5	0	242.5	683.0	0.0	683.0
	5% Cash	(12.1)	12.1	0	(34.1)	34.1	0
	Subtotal	230.4	12.1	242.5	648.9	34.1	683.0
	Cash Adjustment (65% Federal, 35% non-Federal)	(72.8)	72.8	0	(204.9)	204.9	0
	Total	157.6	84.9	242.5	444.0	239.0	683.0
	Percentage	65	35	100	65	35	100
Key: – = does not apply EDS&A = engineering, design, supervision, and administration MCACES = microcomputer-aided cost engineering system STG = submerged tainter gate							

Notes:

1. All costs at October 2006 price levels.
2. Based on apportionment of authorized project described in Corps 2003 American River Watershed, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study using estimated authorized project costs at October 2006 price levels (see **Table 5-5**).
3. Cost of project repriced to current price levels would be significantly greater at about \$613 million.
4. Based on cost-sharing shown in **Chapter 7**.
5. Includes biological mitigation only. Air and water quality mitigation costs are included in construction.
6. Environmental mitigation for previous work and treated as a portion of sunk costs.
7. Plan elements to be accomplished under the Reclamation Safety of Dams Program.

**TABLE 5-13
SUMMARY COMPARISON OF COST APPORTIONMENT – AUTHORIZED FOLSOM DAM RAISE PROJECT AND DR
ELEMENT OF SELECTED PLAN / REFINED AUTHORIZED PROJECTS (\$ MILLIONS)**

MCACES Account	Item	Authorized Project (2006 Price Levels)					Refined Authorized Projects (2006 Price Levels)				
		Folsom Dam Raise Project ^{1,2}					DR Element and Other Features ³				
		Federal	Non-Federal	Subtotal	Dam Safety	Total	Federal	Non-Federal	Subtotal	Dam Safety	Total
	First Cost										
01	Land & Damages	0.6	0.2	0.8	–	0.8	0.2	0	0.2	–	0.2
02	Relocations	0	2.9	2.9	–	2.9	0	0	0	–	.0
08,11	Construction	194.3	0	194.3	–	194.3	73.6	0	73.6	–	73.6
06	Environmental Mitigation	4.8	0	4.8	–	4.8	3.0	0	3.0	–	3.0
18	Cultural Resources	1.7	0	1.7	–	1.7	0.8	0	0.8	–	0.8
30,31	EDS&A	44.3	0.7	45.0	–	45.0	37.7	0	37.7	–	37.7
	Sunk PED Cost	15.4	0	15.4	–	15.4	0	0	0	0	0
	Total	261.1	3.8	264.9	–	264.9	115.3	0	115.3	0	115.3
	Reclamation Safety of Dams Prog.	(111.4)	0	(111.4)	111.4	–	0	0	0	0	0
	Subtotal	149.7	3.8	153.5	111.4	264.9	115.3	0	115.3	0	115.3
	Less Cultural Resources	(1.7)	0	(1.7)	–	(1.7)	(0.8)	0	(0.8)	–	(0.8)
	Subtotal	148.0	3.8	151.8	111.4	263.2	114.5	0	114.5	0	114.5
	5% Cash	(7.6)	7.6	0	–	0	(5.7)	5.7	0	–	0
	Subtotal	140.4	11.4	151.8	111.4	263.2	108.8	5.7	114.5	0	114.5
	Cash Adjustment (65% Federal, 35% non-Federal)	(41.7)	41.7	0	–	0	(34.4)	34.4	0	–	0
	Subtotal	98.7	53.1	151.8	111.4	263.3	74.4	40.1	114.5	0	114.5
	Percentage	65	35	100	–	100	65	35	100	–	100
	Cultural Resources	1.7	0	1.7	–	1.7	0.8	0	0.8	–	0.8
	Subtotal	100.4	53.1	153.5	111.4	264.9	75.2	40.1	115.3	0	115.3
	Temporary Bridge				–	–	40.0	9.9	49.9 ⁴	–	49.9 ⁴
	Total (Selected Plan of RAP)	100.4	53.1	153.5	111.4	264.9	115.2	50.0	165.2	0	165.2
	Ecosystem Restoration	21.3	11.5	32.8	–	32.8	38.9	20.9	59.8	–	59.8
	Permanent Bridge	–	–	–	–	–	41.6	24.1	65.7	–	65.7
	Total	121.7	64.6	186.3	111.4	297.7	195.7	95.0	290.7	0	290.7

Key: – = does not apply
DR = dam raise
EDS&A = engineering, design, supervision, and administration

MCACES = microcomputer-aided cost engineering system
PED = preconstruction, engineering, and design
RAP = Refined Authorized Projects

Notes:

1. Based primarily on apportionment of authorized project described in a supplement to the Corps 2002 Long-Term Study (Special Analysis of Folsom Dam Seven-Foot Raise), which supports information in the Corps 2002 Chief of Engineers Report.
2. Cost of project repriced to current price levels would be significantly greater at about \$737 million.
3. Based on cost-sharing shown in **Chapter 7**.
4. Includes a Corps-budgeted dam safety cost of \$21.5 million that is subject to Reclamation determination of which part, if any, may be subject to reimbursement by the Central Valley Project.

**TABLE 5-14
SUMMARY COMPARISON OF COST APPORTIONMENT BY PROJECT PURPOSE
(\$ MILLIONS)**

Item	Authorized Projects ¹ (2006 price levels)					Refined Authorized Projects (RAP) (2006 price levels)				
	Federal ²	Non-Federal	Subtotal	Dam Safety ³	Total	Federal ²	Non-Federal	Subtotal	Dam Safety ³	Total
	Folsom Modification Project					6 STG Element (Corps Work Package)				
First Cost										
Flood Damage Reduction	157.6	84.9	242.5	–	242.5	444.0	239.0	683.0	–	683.0
Dam Safety	–	–	–	–	0	–	–	–	⁴	⁴
Total	157.6	84.9	242.5	–	242.5	444.0	239.0	683.0	–	683.0
Percent – Flood Damage Reduction	65	35	100	–	100	65	35	100	–	100
Percent – Total Cost	65	35	100	–	100	65	35	100	–	100
	Folsom Dam Raise Project					DR Element				
First Cost										
Flood Damage Reduction	100.4	53.1	153.5	–	153.5	115.2 ⁵	50.0 ⁵	165.2	–	165.2
Dam Safety	–	–	–	111.4	111.4	–	–	–	0	0
Ecosystem Restoration	21.3	11.5	32.8	–	32.8	38.9	20.9	59.8	–	59.8
Permanent Bridge	–	–	–	–	–	41.6	24.1	65.7	–	65.7
Total	121.7	64.6	186.3	111.4	297.7	195.7	95.0	290.7	–	290.7
Percent – Flood Damage Reduction	65	35	100	–	100	70 ⁵	30 ⁵	100	–	100
Percent – Total Cost	41	22	63	37	100	67	33	100	0	100
	Combined Projects					Total RAP				
First Cost										
Flood Damage Reduction	258.0	138.0	396.0	–	396.0	559.2	289.0	848.2	–	848.2
Dam Safety	–	–	–	111.4	111.4	–	–	–	⁴	⁴
Ecosystem Restoration	21.3	11.5	32.8	–	32.8	38.9	20.9	59.8	–	59.8
Permanent Bridge	–	–	–	–	–	41.6	24.1	65.7	–	65.7
Total	279.3	149.5	428.8	111.4	540.2	639.7	334.0	973.7	⁴	973.7
Percent – Flood Damage Reduction	65	35	100	–	100	66	34	100	–	100
Percent – Total Cost	52	28	79	21	100	66	34	100	0	100
Key:	– = does not apply DR = dam raise					RAP = Refined Authorized Projects STG = submerged tainter gate				

Notes:

1. The cost of the authorized projects repriced to current price levels would be significantly greater than shown in this table, at about \$1,390 million (\$655 million for the Folsom Modification Project and \$737 million for Folsom Dam Raise Project).
2. Corps of Engineers' budgetary responsibility.
3. Reclamation Safety of Dams Program item.
4. Plan elements to be accomplished under the Reclamation Safety of Dams Program.
5. Includes features cost-shared at 65 percent Federal and 35 percent non-Federal, as well as temporary bridge cost of \$21.5 million that is subject to Reclamation determination of which part, if any, may be subject to reimbursement by Central Valley Project water or power contractors.

5.10 CHANGES IN LOCAL COOPERATION REQUIREMENTS

After the *PAC Report* is approved and pending funding, design would proceed at Federal expense upfront. This effort will be based on the Project Cooperation Agreements (PCA) between the Department of the Army and the non-Federal sponsors. The Department of the Army will enter into a PCA with the State of California and possibly the Sacramento Area Flood Control Agency (SAFCA) for the Folsom Modification Project, and with the State of California and SAFCA for the Folsom Dam Raise Project, at which time, the non-Federal share of the design phase would be recouped. The Department of the Army and the City of Folsom have signed a separate PCA for the Folsom Bridge.

5.11 CHANGES IN ENVIRONMENTAL IMPACTS

Following is a summary of the environmental compliance background and impact changes between the authorized projects and the RAP.

5.11.1 Environmental Compliance Background

5.11.1.1 *Authorized Folsom Modification Project*

In support of the Folsom Modification Project, *Final Environmental Assessments/Initial Studies* (EA/IS) and *Findings of No Significant Impact/Mitigated Negative Declarations* (FONSI/MND) were prepared in 2001 and 2005 that identified potential effects of the authorized project design (enlarging eight existing outlets and constructing two new outlets on the main dam). In these *EA/ISs*, the Corps determined that while proposed modifications would have potentially significant impacts to vegetation and wildlife, special-status species, and air quality, all adverse impacts could be mitigated to less than significant levels. As a result, a *FONSI* and an *MND* accompanied each *EA/IS*.

5.11.1.2 *Authorized Folsom Dam Raise Project*

An *Environmental Impact Statement/Environmental Impact Report* (EIS/EIR) was completed for the Folsom Dam Raise (Corps *Long-Term Study*) in 2002. This document analyzed the impacts of raising Folsom Dam 7 feet. Potentially significant adverse effects to geology and soils, fisheries, traffic, cultural resources, and water quality were identified. Proposed mitigation measures, such as implementation of best management practices (BMP) and mitigation for impacts to vegetation and wildlife and special-status species, would reduce these impacts to less than significant levels. Adverse impacts that could not be mitigated to less than significant levels were identified for air quality, noise, and recreation.

5.11.1.3 *Refined Authorized Projects*

Reclamation, as the National Environmental Policy Act (NEPA) lead Federal agency, prepared the *Final Folsom Dam Safety and Flood Damage Reduction EIS/EIR* (2007), with the Corps participating as a cooperating agency. The *EIS/EIR* analyzes alternatives that address Reclamation dam safety objectives, as well as Corps flood damage reduction objectives, as discussed in this *PAC Report*. Potentially significant adverse effects have been identified for

geology and soils, traffic, water quality, fisheries, recreation, cultural resources, and noise. Proposed mitigation measures, such as implementation of BMPs and mitigation for impacts to vegetation and wildlife, special status-species, and air quality, would reduce these impacts to less than significant levels, with the possible exception of recreation.

It should be noted that the without-project condition discussed in the *Final Folsom Dam Safety and Flood Damage Reduction EIS/EIR* prepared jointly by Reclamation and the Corps (2007) differs from the without-project condition considered in this *PAC Report*. This is because the scope of the joint *EIS/EIR* includes not only the potential work to address flood damage reduction issues, but Reclamation's structural dam safety actions and additional work needed for security at Folsom Dam. This *PAC Report* assumes that Reclamation will move forward with dam safety and security improvements at Folsom Dam independent of any flood damage reduction actions, and thus considers Reclamation's dam safety improvements as part of the without-project condition.

Table 5-15 displays the estimated changes in impacts of the Selected Plan as it compares to the authorized Folsom Modification and Folsom Dam Raise projects and the Reclamation constructed emergency fuseplug auxiliary spillway (part of the future without-project condition for the Selected Plan evaluation). It is important to note that the effects associated with the authorized Corps projects (Folsom Modification and Folsom Dam Raise projects) are the impacts identified in the original environmental documents for those projects, and impacts are not updated to a current assessment. It was determined that the original environmental evaluations were an adequate representation of effects for the purposes of comparison of the effects of the Selected Plan.

5.11.1.4 Public Review

Public review of the Corps *Draft PAC Report* (2006d) and Reclamation *Draft Folsom Dam Safety/Flood Damage Reduction EIS/EIR* (2006c) occurred from 1 December 2006 to 26 January 2007. Public meetings were held on 9 January 2007 and 10 January 2007. Primary subjects of public comment are as follows:

- **Recreation and Economic Impacts** - Comments pertained to the loss of convenient access to recreational opportunities, including hiking, boating, swimming, picnicking, biking, and nature watching, and how this loss could potentially impact businesses and home values in the local area.
- **Public Review Process** - Concerns were expressed about inadequate notification of the proposed project and inadequate notification of the public hearings. Requests were made in a public hearing format for additional meetings, and provision of additional presentation materials.
- **Affected Property** - During the public review period, several written comments were received concerning potential hydraulic impacts to specific properties, along with requests for detailed property impact maps and property acquisition details.

**TABLE 5-15
CHANGES IN ENVIRONMENTAL IMPACTS**

Resource Area	Change in Impact - Folsom Modification Project	Comparison to Impact of W/O Project Condition (Reclamation Fuseplug Auxiliary Spillway) ¹	Change in Impact – Folsom Dam Raise Project
Water Quality	Increase in potential for water quality impacts from in-water blasting and excavation of 900-foot approach channel for auxiliary spillway. These impacts would be mitigated to less than significant levels by implementation of BMPs, such as sediment curtains.	Potential for water quality impacts would be similar for Selected Plan auxiliary spillway and fuseplug auxiliary spillway. These impacts would be mitigated to less than significant levels by implementation of BMPs, such as sediment curtains - no significant change.	Decrease in potential disturbance to water quality due to removal of the need for in-reservoir borrow activities with the 3.5-foot raise.
Air Quality	Authorized Folsom Modification Project would exceed the threshold for NO _x by 112 lbs/day in peak construction activity years. Selected Plan auxiliary spillway (Reclamation dam safety work combined with auxiliary spillway in air quality analysis) would exceed the NO _x threshold by 1,816 lbs/day - an increase.	Fuseplug auxiliary spillway would exceed the threshold for NO _x by 1,649 lbs/day. The Selected Plan auxiliary spillway would exceed the NO _x threshold by 167 lbs/day more than the fuseplug auxiliary spillway – an increase.	<i>Long-Term Study</i> ² air quality analysis shows that NO _x threshold would be exceeded by 226 lbs/day for a 7-foot raise, and by 246 lbs/day for a 3.5-foot raise – an increase. Possible explanations – trucking material from off site for 3.5-foot raise, and shorter construction time; therefore, impacts are more concentrated over fewer years.
Aquatic Resources	Increase in potential for water quality impacts from in-water blasting and excavation of 900-foot approach channel for auxiliary spillway. These impacts would be mitigated to less than significant levels by implementation of BMPs, such as sediment curtains. Original Mods had some potential for impact to the aquatic habitat (i.e., increased turbidity from concrete excavation and grouting, etc.), but impacts were mitigable as well with BMPs.	In-water work would be similar for the approach channel for the fuseplug auxiliary spillway and the Selected Plan auxiliary spillway – no significant change.	Decrease in potential disturbance to aquatic habitat due to removal of the need for in-reservoir borrow activities with the 3.5-foot raise.
Terrestrial Vegetation and Wildlife	Area of 7.5 acres compensation implemented for Mods Staging Area. Approximately 39 additional acres would be needed for the auxiliary spillway footprint – increase.	Fuseplug auxiliary spillway footprint would require approximately 39 acres compensation – no change.	From the <i>Long-Term Study</i> , ² 80 acres of compensation would be needed for a 7-foot raise, and 14 acres would be needed for a 3.5-foot raise – a decrease.
Soils	Loss of soil resources through excavation – 3.5 million cubic yards excavated. However, this is a less than significant impact, as the soils are not of high ecological or agricultural value. Also, increased potential for erosion and naturally occurring asbestos disturbance, but these impacts are mitigable to less than significant levels by implementation of BMPs. This is an increase, but a less than significant impact.	Fuseplug auxiliary spillway would require approximately 5.8 million cubic yards of excavation. The Selected Plan auxiliary spillway would require approximately 3.5 million cubic yards of excavation – a decrease.	Decrease in the need for borrow material, as the 3.5-foot raise would likely be a concrete parapet wall, and off-site commercial materials would be used, whereas the 7-foot raise would require borrow from sites within and around the reservoir.
Visual Resources	Increase in potential for significant, unavoidable impacts to visual resources due to change in landscape at auxiliary spillway site. Original Mods work would be confined to main dam and not readily visible to the public.	Fuseplug auxiliary spillway would have similar impacts to visual resources – no change.	Permanent loss of lake views from trails, shoreline, and residences due to new parapet walls and embankments. No major change from 7-foot raise to 3.5-foot raise. Perhaps a slight decrease in impact with a shorter raise, but this may be countered by the fact that a 3.5-foot raise would likely be a parapet wall instead of an earthen raise, which is a more natural-appearing feature.

**TABLE 5-15
CHANGES IN ENVIRONMENTAL IMPACTS (CONTINUED)**

Resource Area	Change in Impact - Folsom Modification Project	Comparison to Impact of W/O Project Condition (Reclamation Fuseplug Auxiliary Spillway) ¹	Change in Impact – Folsom Dam Raise Project
Transportation and Circulation Element	Authorized Folsom Modification Project (2001 analysis) assumed 200 daily trips for project construction crews and materials would not result in any changes in LOS for local roadways (less than significant impact). Selected Plan auxiliary spillway work (combined with Reclamation dam safety work in analysis) would result in change in LOS in 2 of the years of construction activity – an increase in transportation impacts; however, this impact is mitigable to less than significant levels with implementation of BMPs.	Fuseplug auxiliary spillway work (combined with Reclamation dam safety work in analysis) would result in change in LOS in 2 of the years of construction activity, similar to effects of construction of the Selected Plan auxiliary spillway – no significant change .	Would be 57 peak hour construction trips with 7-foot raise, and 36 peak hour trips with 3.5-foot raise – a decrease .
Noise	Noise levels would increase , and additional sensitive receptors would be impacted, but implementation of mitigation measures, such as sound barriers, would reduce impacts to less than significant levels .	Noise impacts would be similar for the fuseplug auxiliary spillway and Selected Plan auxiliary spillway – no significant change .	Noise impacts of a 3.5-foot raise would be less than significant. Borrow activities at Mississippi Bar for a 7-foot raise would have noise impacts on sensitive receptors that could not be mitigated to less than significant levels – a decrease in noise impacts.
Cultural Resources	Increase in potential for disturbance of cultural resources in auxiliary spillway footprint, as original Mods work would be confined to main dam. Also, construction of an auxiliary spillway may affect the integrity of the dam as a historic resource.	Potential for impacts to cultural resources would be similar for the fuseplug auxiliary spillway and the Selected Plan auxiliary spillway – no significant change .	A decrease in borrow sites; therefore, decrease in potential for disturbance of cultural resources in reservoir.
Recreation	Potential for significant loss of visitor days and recreation revenues due to construction staging at Folsom Point. This would be an increase over original Mods, which would use the staging area below the left wing dam, which is not open to the public.	Fuseplug auxiliary spillway would have the potential for recreation impacts at Folsom Point for 5 years, whereas the Selected Plan auxiliary spillway would have the potential for recreation impacts at Folsom Point for 6 years, due to a longer construction schedule for the Selected Plan auxiliary spillway – an increase .	A decrease in recreation impacts from in-reservoir borrow and barging of material.
Population and Housing	No change .	Fuseplug auxiliary spillway and Selected Plan auxiliary spillway would not have adverse affects on population and housing – no change .	From <i>Long-Term study</i> , ² potential short duration, infrequent impacts to 16 properties with 7-foot raise, and to 8 properties with 3.5-foot raise – a decrease .
Key:	BMP = best management practice lbs = pounds LOS = level of service	NO _x = nitrogen oxides W/O = without	

Notes:

1. Impact Analysis for the 6 STG Element includes impacts from all Reclamation Safety of Dams Program work as well; therefore, impacts of Corps portion of auxiliary spillway work alone would be less than described.
2. Corps, The Reclamation Board, and SAFCA. 2002. American River Watershed, California, Long-Term Study, Final Supplemental Information Plan Formulation Report/Environmental Impact Statement/Environmental Impact Report. February.

- **Auburn Dam** - Comments received on the *Draft Folsom Dam Safety and Flood Damage Reduction EIS/EIR* questioned why the Auburn Dam project was not being considered a viable alternative to the modifications being proposed for Folsom Dam.
- **Operations** - Comments were received questioning why the *Draft Folsom Dam Safety/Flood Damage Reduction EIS/EIR* did not address in greater detail operations and proposed changes to the Water Control Manual. Topics of concern included potential downstream impacts, water supply, and existing condition assumptions.
- **Relationship of Safety of Dams, Dam Security, Joint Federal Project, and Flood Damage Reduction** - Several comments relating to the *Draft Folsom Dam Safety and Flood Damage Reduction EIS/EIR* indicated a need for additional explanation as to the components of Folsom Dam Safety/Flood Damage Reduction.
- **Transportation and Circulation** - Comments on the *Draft Folsom Dam Safety and Flood Damage Reduction EIS/EIR* questioned the effects of potential increases in traffic.
- **Noise** - Specific comments included concerns relating to haul trucks, general construction, and increased traffic.
- **Air Quality** - Specific issues included concerns regarding fugitive dust/particulate matter and emissions from construction machinery and vehicles.

Reclamation, with participation from the Corps as a cooperating agency, has finalized the *Folsom Dam Safety and Flood Damage Reduction EIS/EIR* (2007) to clarify areas that received public comment and to respond to those comments, including analyzing potential solutions to minimize recreation and economic impacts of restricting access to Folsom Point and other areas in the Folsom Lake State Recreation Area.

5.11.2 Summary of Environmental Impact Changes

Various categories of changes are revealed when comparing estimated changes in environmental impacts of the Selected Plan to the authorized Folsom Modification and Folsom Dam Raise projects and the Reclamation constructed emergency fuseplug auxiliary spillway, as shown in **Table 5-15**. These categories include (1) increase in environmental impacts that would be mitigated to less than significant levels, (2) decrease in impacts, (3) significant increases in impacts, (4) and increase in impacts due to a change in legal and institutional recognition (cultural resources). Some resources can quantifiably be measured for comparison. Some resources are qualitative; in those cases, the measure for comparison is the significance of the environmental impact.

An increase in impacts that can be mitigated is believed neutral in terms of a change and is not a key measure of change to scope. A decrease in impacts is desirable and the goal of agency policy, and not a key measure of change to scope. In some cases, the Selected Plan appears to have a discernable increase in impacts from the authorized Folsom Modification or Folsom Dam Raise projects; however, if the authorized projects' associated impacts were

“updated,” the increase would be minor. The biggest increase in impacts to resources would be due to construction of the 6 STG Element auxiliary spillway. It is important to note that the auxiliary spillway replaces the need for Reclamation to construct an emergency fuseplug spillway, which is considered to be constructed as part of the future without-project condition in this *PAC Report*. The fuseplug spillway would have included similar, yet greater, impacts than construction of the 6 STG Element auxiliary spillway. Therefore, from a Federal perspective, there is no considerable increase in impacts, and this is also not a key measure of change to scope for this project. From a Corps perspective, it is planned that Reclamation would do excavation associated with the 6 STG Element auxiliary spillway; impacts are disclosed in the Reclamation 2007 *Final Folsom Dam Safety and Flood Damage Reduction EIS/EIR*. The net environmental impacts of the originally authorized projects, when considering the fuseplug spillway as part of the future without-project condition, are similar to those of the Selected Plan.

CHAPTER 6.0 JOINT FEDERAL PARTICIPATION

6.1 JOINT FEDERAL PROJECT

Previous sections of this *Post Authorization Change Report* have demonstrated that the six submerged tainter gate element (6 STG Element) of the Refined Authorized Projects (RAP) would be effective and efficient in reducing flood damages, and is functionally equivalent to the Folsom Modification Project. In addition, the 6 STG Element would effectively address the United States Department of the Interior, Bureau of Reclamation's (Reclamation), objective of resolving hydrologic dam safety problems at Folsom.

As discussed in **Chapter 4**, the 6 STG Element of the RAP is also referred to as the Joint Federal Project, or JFP. Because of all of the various structural features of projects addressing United States Army Corps of Engineers (Corps) flood damage reduction and Reclamation seismic and hydrologic risk objectives, these agencies have developed the JFP terminology to improve interagency coordination and support development of project agreements.

Both agencies have agreed that each would fund and construct its respective portions of the JFP through its existing authorities. Each agency has an interest in restricting its construction responsibilities and associated construction risk as much as possible to features it would have built if it were constructing its own single purpose project. A procedure was developed to equitably divide costs and related construction responsibilities so that both agencies might enjoy the cost savings inherent in the 6 STG Element (i.e., JFP). Work items, which in aggregate can be considered each agencies' full contribution to a complete project, are called work packages. Each agency will construct its own work package.

The work package procedure is believed to achieve an equitable distribution of construction work and cost. Both agencies and their respective project beneficiaries will realize reduced costs in comparison to independent implementation of single purpose projects. This approach differs from traditional cost allocation in which costs are accumulated and equitably allocated among benefit-generating project purposes. This procedure seeks not only equitable costs between flood damage reduction and dam safety, but also a way for the two Federal agencies to partner in constructing a single complete project.

6.2 SUMMARY OF WORK PACKAGES

Feasibility-level cost estimates have been completed by each agency for its respective work package consistent with each agency's policies and guidelines. As mentioned, the Corps and Reclamation are to implement their work packages as a part of larger comprehensive dam safety or flood damage reduction program modifications to Folsom Dam under respective agency authorities. Each agency is to report only the work and associated cost it is responsible for to meet budgetary and authorization purposes, and exclude the portions not allocated to it in determining its total work and associated costs.

Each agency has assumed responsibility for its work package and will continue working cooperatively through completion of final JFP designs and construction. Reclamation will implement construction of its work packages in stages, with emphasis on completing design features common to the dam safety stand-alone fuseplug auxiliary spillway, consistent with the Reclamation Safety of Dams Program. The Corps, after obtaining project approval, is to implement its work package under the authorized Folsom Modification Project and authority contained in Energy and Water Development Appropriations Act of 2006 (Public Law 109-103). Absent timely Corps approvals, Reclamation has indicated that it intends to undertake work necessary to complete the fuseplug auxiliary spillway, as described in **Chapter 3**.

Although the project contains joint features and costs needed for both flood damage reduction and dam safety, for project implementation and cost-sharing purposes, the Corps Work Package cost will be treated as a flood damage reduction cost, and the Reclamation Work Package will be treated as a dam safety cost. As mentioned, each agency is to report the cost of its work package as that portion of the cost of the JFP attributable to its authorized project purposes. Although engineering and construction considerations have been used to identify major items for inclusion in the work packages, the Reclamation Work Package consists primarily of excavation that would be required for the fuseplug spillway. Thus, the Reclamation Work Package approximates the fuseplug spillway. The Corps Work Package approximates the additional work needed to make a flood damage reduction spillway. Using this rationale, the Corps Work Package may be considered a flood damage reduction cost.

Reclamation's contribution is limited to excavation work. The Corps contribution includes the gate structure and all other additional work for a fuseplug spillway required for flood damage reduction. Following is a summary of each agency's work package.

6.2.1 Reclamation Work Package Summary

Under the Reclamation Work Package, Reclamation would be responsible for excavating the spillway chute, stilling basin, and a portion of the control structure. Primary work tasks would consist of the following:

- Initial site preparation, including roads and utilities
- Chute excavation
- Stilling basin excavation
- Partial control structure excavation
- Initial control structure foundation remediation
- Permitting for Reclamation Work Package
- Physical site security
- National Environmental Policy Act (NEPA)/California Environmental Quality Act (CEQA) mitigation/cultural resources mitigation

6.2.2 LERRD in Reclamation Work Package

The responsibility to provide lands, easements, rights-of-way, relocations, and disposal areas (LERRD) is generally that of the Corps' non-Federal Sponsor and is cost-shared in accordance with the cost-sharing provisions established in the Water Resources Development Act (WRDA) of 1986. Reclamation is to provide and/or perform most of the tasks generally associated with LERRD acquisition. Reclamation's performance of these work items does not affect or lessen the fiscal cost-sharing of the Corps' non-Federal Sponsor. **Appendix D – Real Estate** provides more detailed information on LERRDs associated with the full 6 STG Element, or JFP, of the RAP. The Reclamation Work Package requires the following LERRDs for the project as a whole:

- Accomplishment of environmental mitigation.
- Relocation of a 42-inch water pipeline (Natomas Pipeline) that provides raw water from Folsom Reservoir to the City of Folsom and California Department of Corrections.
- Relocation of the Sacramento Municipal Utility District's 12-kilovolt power line.
- Relocation of the 4,160-volt power line that serves Reclamation's yard on the right abutment.

Although these LERRDs are required for the 6 STG Element (JFP) to be constructed, they are included in the Reclamation Work Package, and are Reclamation's responsibility. Reclamation will provide these LERRDs using its own regulations and procedures. Other than a right-of-entry to construct, no LERRDs are identified in the Corps Work Package.

6.2.3 Corps Work Package Summary

Under the Corps Work Package, major responsibilities include the remainder of excavating the spillway control structure and approach channel, and construction of the chute, stilling basin, and control structure. Primary work tasks would consist of the following:

- Follow-up site preparation
- Stilling basin construction
- Chute construction
- Remaining control structure excavation
- Control structure construction
- Remaining control structure foundation remediation
- Approach channel excavation
- Permitting for the Corps Work Package
- Site restoration

6.2.4 Corps Work Package Cost Estimate

As described above, once work package items were defined, each agency developed its own cost estimate, complete with contingencies, mitigation costs, and program costs for its work package. The Corps developed a new cost estimate for its work package. Costs are in microcomputer-aided cost engineering system (MCACES) format, and in accordance with Corps cost engineering principles and practice. Costs were adjusted back to first costs, with interest during construction added to develop the investment cost. The costs of the Corps Work Package are summarized in **Table 6-1**. Reclamation prepared a cost estimate, using its own cost engineering and program cost procedures, for its Work Package as part of information developed to support the Reclamation Work Package.

**TABLE 6-1
 FIRST COST OF CORPS WORK PACKAGE FOR 6 STG ELEMENT ¹**

Cost Account	First Cost (\$ millions)
Lands	0.0
Relocations	0.0
Construction	538.6
Environmental Mitigation ²	0.4
Cultural Resources	0.0
PED	99.9
S&A	44.1
Total ³	683.0
Key: PED = preconstruction, engineering, and design S&A = supervision and administration STG = submerged tainter gate	

Notes:

1. First costs presented at October 2006 price levels.
2. Sunk cost is biological mitigation for work area that was constructed preliminary to enlargement of Folsom Dam's low-level outlets.
3. Includes sunk costs expended through October 2006, which are \$55.9 million. Total costs without sunk costs are \$627.1 million.

6.3 COMMON LANGUAGE

In early 2007, both the Corps and Reclamation developed a written understanding regarding each agency's involvement in the JFP. This written understanding is known as "Common Language." The intent of the common language is to establish common terms, overall project understanding, and information about how each agency intends to proceed toward implementing its responsibilities in the JFP. The following sections of this chapter are the "Common Language" developed jointly by the agencies.

JOINT FEDERAL PROJECT

The consideration of the hydrologic dam safety risk along with the limitations of the existing flood control system in the Sacramento area has recently received increased public attention in the aftermath of the 2005 Gulf Coast hurricanes. Planning of significant standalone improvements for flood protection and dam safety has been underway for some years and the Joint Federal Project (JFP) is the product of a comprehensive effort to identify and implement an alternative meeting Dam Safety and Flood Damage Reduction objectives. The JFP is the result of Federal and local collaboration on multiple agreements and partnerships between numerous agencies and organizations. These organizations are notably the United States Department of the Interior, Bureau of Reclamation (Reclamation), the United States Department of Defense, Army Corps of Engineers (Corps), the State of California Department of Water Resources (DWR) Reclamation Board (Reclamation Board), and the Sacramento Area Flood Control Agency (SAFCA).

Section 128 of the Energy and Water Development Appropriations Act of 2006 (PL 109-103) directed the Secretary of the Interior and the Secretary of the Army to collaborate on authorized activities to expeditiously address dam safety needs and maximize flood damage reduction improvements at Folsom Dam. In accordance with this direction, the two agencies collaboration was developed on the principles of expeditiously improving overall public safety and realizing a distribution of work, costs and savings between Reclamation's Dam Safety Program and the Corp's Folsom Modification and Folsom Dam Raise Projects, which are for the purpose of flood damage reduction.

As directed by Congress and in accordance with each agency's respective congressional authorizations, Reclamation and the Corps have coordinated with the Corp's local project sponsors, Reclamation Board and SAFCA, to develop and implement an optimal alternative. Through the collaborative effort, The Joint Federal Project has been identified as the optimal alternative which meets respective agency objectives and authorities and to serves the public benefit of reducing dam safety hydrologic risks by withstanding the PMF and meeting the flood damage reduction local objective of safely passing the 1 in 200 year or greater design storm. Reclamations findings under the direction provided by PL 109-103 are presented below within its Folsom Dam Modification Report. The Corps findings under PL 109-103 are presented within this PAC report.

The Folsom Facility was constructed by the Corps. Upon completion in 1956, the Folsom Facility was transferred to Reclamation for operation and maintenance (O&M) as an integrated feature of the Central Valley Project (CVP). Both Federal agencies have obligations and interests in relation to the Folsom Facility but differ in respect to Congressional objectives, mandates, authorities, funding, and time lines. Through cooperation, Reclamation and the Corps seek to integrate dam safety improvements with flood damage reduction measures under a single Joint Federal Project. In addition to the JFP, both

agencies will undertake additional separate actions to comprehensively meet their respective agency responsibilities.

The JFP will be executed under a Memorandum for Record between Reclamation and the Corps. The Memorandum for Record will describe how the two agencies will together design and construct the JFP.

The JFP is an auxiliary spillway with six submerged tainter gates. The spillway is comprised of an upstream approach channel, a concrete control structure that regulates releases through submerged tainter gates into a downstream concrete lined spillway chute and stilling basin, before discharging into the American River downstream of the main Folsom dam.

The JFP auxiliary spillway would be located southwest of the existing main concrete dam. Principle features of the new auxiliary spillway include (1) an approximately 1,100 foot-long approach channel beginning in Folsom Reservoir, (2) a concrete control structure, including six submerged tainter gates, (3) a spillway chute approximately 3,000-foot long and (4) a stilling basin which acts as an energy dissipation structure prior to discharges converging with the American River below the main concrete dam. The control structure will operate in conjunction with existing spillway gates on Folsom Dam to manage flood flows from Folsom Reservoir.

Reclamation and the Corps developed an equitable work distribution agreement for execution of the JFP. The work distribution between the two agencies established a number of work packages based on separable features consistent with each agency's responsibilities.. The work distribution of the JFP was determined to be proportional to the costs of separate least-cost, single-purpose dam safety (DS) and flood damage reduction (FDR) alternatives necessary to meet each agency's responsibilities.

AUTHORITIES & AGREEMENTS

Authorities

United States Department of the Interior, Bureau of Reclamation

Authority for Reclamation participation in dam safety activities at Folsom Dam is authorized by the Reclamation Safety of Dams Act of 1978 (Public Law 95-578) and the Reclamation Safety of Dams Act Amendments of 1984 (Public Law 98-404), 2000 (Public Law 106-377), 2002 (Public Law 107-117), and 2004 (Public Law 108-439). Together, these are collectively referred to as the Safety of Dams Act.

United States Army Corps of Engineers

Authority for the Corps participation in flood damage reduction activities at Folsom Dam are under two specific authorizations; (1) Section 101(a) (6) of Water Resources Development Act (WRDA) 1999 (Public Law (PL) 106-53)

provides authorization for the Folsom Modification Project, and (2) Section 128 (a) of the Energy and Water Development Appropriations Act for 2004 (PL 108-137) provides authorization for the Folsom Dam Raise Project.

Joint Project

Authority for the Corps and Reclamation to coordinate and develop a joint project was clarified in Section 128, PL 109-103, the Energy and Water Development Appropriations Act for 2006.

National Agreements

Partnership Agreement

The MOU was established pursuant to the national Partnership Agreement between the Bureau of Reclamation and the U.S. Department of the Army, Assistant Secretary of the Army (Civil Works) executed February 11, 2005.

Memorandum of Agreement

Should any funding exchange be required, it shall be achieved through Support Agreements as detailed in the national Memorandum of Agreement between the U.S. Army Corps of Engineers and the Bureau of Reclamation executed August 22, 2006.

Amended Transfer Agreement

Letter of Agreement (No DA-04-167-eng133) dated May 25, 1955 transferred the Folsom Dam Project to Reclamation for coordination and integration with the Central Valley Project. The Corps and Reclamation responsibilities are further defined in a subsequent amendment to article 4 of that Agreement (dated July 1981).

JOINT FEDERAL PROJECT DEFINITION

The Joint Federal Project (JFP) is explicitly as:

The proposed Joint Federal Project (JFP) consists of an auxiliary spillway adjacent to the existing Folsom Dam. The new auxiliary spillway component is comprised of a reinforced concrete control structure that regulates releases through submerged tainter gates (STGs) into a lined spillway chute and stilling basin, before discharging into the American River.

The Joint Federal Project at Folsom Facility, as currently designed, will consist of six 23' X 33' STGs at invert elevation 368' combined with a concrete lined chute approximately 170' wide and 2,850' in length leading to a dissipation structure.

The JFP, as currently designed, provides a reduction in flood risk of one chance in 156, annually, and meets the local objective of safely passing at least the 200-year design flow without overtopping the downstream levees or exceeding the top of joint use storage. The current JFP design, in conjunction with releases from the existing dam, is capable of passing the Probable Maximum Flood (PMF).

Gate dimensions and invert elevations may be optimized during final design to maximize performance, reduce risk, and/or reduce costs. The optimization will seek to reduce costs while continuing to preserve Flood Damage Reduction Benefits, assure the safety of the public and expedite completion of the dam safety objective of withstanding the passage of the PMF.

REVIEW OF JFP PERFORMANCE OBJECTIVES

*Reclamation has reviewed the current JFP design and assessed the risk reduction effectiveness in accordance with the Policy on Dam Safety Decision Making in the Reclamation Manual. The Guidelines for Achieving Public Protection in Dam Safety Decision Making, dated June 15, 2003, were used for this decision making process. Based on this review, conclusions and recommendations communicated to the Corps in the Folsom Dam Joint Federal Project Short-Term Evaluation Decision Document dated March 28, 2007 (included in **Appendix G – Pertinent Correspondence** of this PAC report) that the project, subject to the identified key findings and recommendations, meets the project technical objectives.*

WORK DISTRIBUTION METHODOLOGY

The dam safety and flood damage reduction percentages guiding the work distribution are based on the proportion of single purpose construction costs to the sum of the two single purpose costs. Work distribution of the JFP was

determined to be proportional to the construction costs of standalone, separate, least-cost, single-purpose alternatives. The Dam Safety (DS) alternative (Fuseplug Auxiliary Spillway) and Flood Damage Reduction (FDR) alternative (6 STG Auxiliary Spillway) included all design elements necessary to meet the specified DS and FDR responsibilities and criteria consistent with the principles and guidelines for their respective purposes.

The work split will be implemented by allocating work packages to Reclamation and the Corps that, in the aggregate, meets the primary objectives of;

- Reclamation – Expedited Hydrologic Risk Reduction by safely passing the PMF*
- The Corps – Achieve the local Flood Damage Reduction goal by safely passing at least the 200 - year design flood.*

Each agency will seek funding and cost sharing/cost recovery from its own partners/customers on its own work package. Any required non-federal funding contributions and/or reimbursement will be from the respective agency's project beneficiaries. Costs of the Dam Safety work distribution will not be attributable to the Corps nor to the Corps' partners. Likewise, the costs of the Flood Damage Reduction distribution will not be attributable to Reclamation's Dam Safety Program or to cost recovery with the contracting entities for repayment, under the Safety of Dams Act and other applicable laws.

The following list identifies the cost split methodology mutually developed by the agencies and used to define the equitable agreed upon distribution of work.

- 1) Work to be split will involve only the defined JFP. Other features planned or underway at Folsom are either single-purpose dam safety (DS) or single-purpose flood damage reduction (FDR) and are not included. Reclamation and the Corps will implement their allocated work as a part of larger comprehensive Dam Safety or Flood Damage Reduction Program modifications to Folsom Dam under respective agency authorities.*
- 2) Both the FDR and DS programs will equitably share in the cost savings realized by collaboration and implementation of the JFP over separate DS and FDR single-purpose projects.*
- 3) Each least-cost, DS and FDR single purpose alternative must meet all documented agency policy and guidance.*
- 4) Each least-cost, DS and FDR single JFP costs should be adjusted proportional to the costs of the separate least-cost, single-purpose DS and FDR alternatives necessary to meet the specified DS and FDR objectives respectively. Estimates for least-cost, single-purpose alternatives must*

contain all costs that would be required for agency approval and implementation of the single-purpose project.

- 5) *Each least-cost, single-purpose alternative must meet all documented agency policy and guidance.*
- 6) *Each least-cost, single-purpose alternative should assume that the other single-purpose project has not been constructed and is not part of the base condition.*
- 7) *JFP work will be distributed proportional to the construction line item costs of the separate least-cost, single purpose DS and FDR alternatives necessary to meet the specified DS and FDR objectives respectively.*
- 8) *Construction line item estimates for each least-cost, DS and FDR single purpose alternatives must contain all design elements and estimates of cost that would be required for agency approval and implementation as a single purpose project and single-purpose alternative and the JFP must be based upon the same assumptions, methodologies, unit prices, etc. to make them comparable.*
- 9) *Once the work split is developed, the work each agency is to perform will conform as closely as possible to the agency's distribution and responsibilities. Each agency will fund and manage its assigned work packages recognizing there are both risks and opportunities associated with the management of those work packages.*
- 10) *Each agency will seek cost sharing/cost recovery from its own partners/customers on its own work packages. Any required non-federal funding contributions will be from the respective agency's project beneficiaries.*
- 11) *Reclamation and the Corps will confer and resolve any remaining differences in the split by ensuring consistent application of all estimating factors.*

APPLICATION OF METHODOLOGY

Reclamation and the Corps have equitably divided work based on the construction cost for the 6 Submerged Tainter Gate (6STG) JFP Spillway and a Fuseplug Auxiliary Spillway resulting in an approximate 20% work allocation to Reclamations Safety of Dams Program and 80% allocation to the Corps Flood Damage Reduction Program. The estimate is based on a feasibility level design and construction cost estimate at an effective price level of October 2006.

To accommodate variations in agency estimation methodologies, jointly developed construction cost estimates for each single-purpose alternative were prepared by an engineering consultant. These estimates were reviewed and accepted by both agencies as appropriate for use in determining the proportional work distribution based on equitable the agreed upon cost distribution formula. In determination of construction cost, costs for non contract and/or program costs were excluded from the estimate of overall construction costs to further eliminate potential inequities due to variations in agency program requirements. The costs excluded from the computation were; sunk costs incurred by both Reclamation and the Corps, planning, engineering & design (PE&D), construction supervision & administration (S&A), interest during construction, construction contingencies and other miscellaneous costs such as recreation mitigation and allowances for possible contract fees.

Work package distribution between Reclamation and the Corps was based upon this construction cost estimate with the addition of escalation of costs from notice to proceed to mid-point of construction. The cost formula used to determine percentage for work package distribution is as follows;

$$\text{FDR or DS Work Allocation} = \frac{\$ \text{ Single Purpose FDR or DS}}{(\$ \text{ Single Purpose FDR} + \$ \text{ Single Purpose DS})} * 6\text{STG}$$

$$\text{FDR Work Allocation} = \frac{\$ \text{ Single Purpose FDR}}{(\$ \text{ Single Purpose FDR} + \$ \text{ Single Purpose DS})} * \text{JFP}$$

$$\text{DS Work Allocation} = \frac{\$ \text{ Single Purpose DS}}{(\$ \text{ Single Purpose FDR} + \$ \text{ Single Purpose DS})} * \text{JFP}$$

The method established work package target costs based on a ratio of the single-purpose construction costs to the sum single-purpose construction costs. The resulting percentages were applied to the construction line item costs of the JFP to calculate the basic FDR and DS target construction costs. Working together, both agencies distributed construction line items into two work packages.

The construction line items for the JFP were distributed between the Corps and Reclamation using the following criteria.

- *The total costs of the work items should match as closely as possible the target costs for each work package.*
- *The Reclamation work package would include, to the extent possible, the construction of those portions of the 6 STG Element that coincide with emergency fuseplug auxiliary spillway features. The Corps work package would include the balance of the work, associated with flood damage reduction.*
- *The distribution of work items should minimize construction risk (e.g. complications from two operations being conducted at the same time at the same place) and increase construction efficiency.*
- *The packages should minimize problems of one agency interfacing with the previous work of the other agency.*
- *Construction risk should be balanced between work packages.*

SUMMARY OF WORK PACKAGES

Reclamation and the Corps have determined an optimal division of the work with Reclamation placing emphasis on work which will expeditiously implement interim and permanent hydrologic risk reduction and further expedite implementation, construction and completion of the JFP modification(s). Reclamation and the Corps have identified work packages distributed as follows:

Summary of Reclamation Work Packages

Responsible for excavation of the JFP Chute, Stilling Basin, and a portion of the Control Structure including;

- *Initial Site Preparation including roads and utilities*
- *Chute Excavation*
- *Stilling Basin Excavation*
- *Partial Control Structure Excavation*
- *Initial Control Structure Foundation Remediation*
- *Permitting for Reclamation Work Packages*
- *Physical Site Security*
- *Project NEPA/CEQA/Cultural Resources Commitments*

Summary of Corps Work Packages

Responsible for excavation of the remainder of the excavation of JFP Control Structure and Approach Channel excavation as well as the construction of the Chute, Stilling Basin, and Control Structure including;

- *Follow-up Site Preparation*
- *Stilling Basin Construction*
- *Chute Construction*
- *Remaining Control Structure Excavation*
- *Control Structure Construction*
- *Remaining Control Structure Foundation Remediation*
- *Approach Channel Excavation*
- *Permitting for the Corps Work Packages*
- *Site Restoration*

Feasibility level cost estimates have been completed by each agency for their respective work packages consistent with each agency's policies and guidelines. Reclamation and the Corps will implement their allocated work packages as a part of larger comprehensive Dam Safety or Flood Damage Reduction Program modifications to Folsom Dam under respective agency authorities. Each agency will report only the work and associated cost it is responsible for to meet budgetary and authorization purposes and exclude the portions not allocated to it in determining its total work and associated costs. Within this Modification Report, Reclamation is reporting the estimated costs of completing only the work package elements attributable to Reclamation not the estimated total cost of completing the JFP.

Each agency has assumed responsibility of its work package and will continue working cooperatively through completion of a final JFP designs and construction. Reclamation will implement construction of its JFP work packages in stages, with emphasis on completing design features common to the Dam Safety standalone Fuseplug Auxiliary Spillway, consistent with the Dam Safety Act as the Corps pursues required project authorization. Upon Corps authorization to construct the JFP, Reclamation will undertake the additional allocated work. Absent timely Corps authorization to construct the JFP, Reclamation will undertake the additional work necessary to complete the Dam Safety standalone Fuseplug Auxiliary Spillway.

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CHAPTER 7.0 IMPLEMENTATION

7.1 IMPLEMENTATION TOPICS

This chapter covers implementation considerations for the United States Army Corps of Engineers (Corps) Work Package portion of the auxiliary spillway with six submerged tainter gates (6 STG Element) and the raise of Folsom Dam (DR Element). It also introduces an Economic Reevaluation Study being conducted by the Corps.

Implementation topics include cost-sharing (apportionment) with non-Federal sponsors, cost comparison with Section 902 limits on project costs, and a construction schedule. As discussed in **Chapter 4**, the 6 STG Element would be constructed as part of the Folsom Modification Project. Only the Corps Work Package would be implemented under the Folsom Modification Project. The United States Department of the Interior, Bureau of Reclamation (Reclamation), Work Package is to be constructed under that agency's Safety of Dams Program. Implementation considerations for the Reclamation Work Package are being developed by Reclamation. The DR Element would be part of the Folsom Dam Raise Project together with the Other Features: a permanent bridge and ecosystem restoration. Implementation is discussed in the context of the projects because the projects are budgeted separately and will have separate Project Cooperation Agreements (PCA). **Table 7-1** relates the major elements of the Refined Authorized Projects (RAP) (Selected Plan and Other Features) to their respective authorities.

**TABLE 7-1
FEATURES, PURPOSE, AGENCY IMPLEMENTATION**

SELECTED PLAN ELEMENTS			
Item	Features	Purpose/Output	Agency/Authority or Program
6 STG Element	Auxiliary Spillway with Six Submerged Tainter Gates	<ul style="list-style-type: none"> • Flood Damage Reduction • Dam Safety 	Corps/ Folsom Modification Project (Corps Work Package)
			Reclamation/ Safety of Dams Program (Reclamation Work Package)
DR Element	<ul style="list-style-type: none"> • Raise Dam 3.5 Feet • Replace Three Emergency Spillway Tainter Gates • Construct Temporary Bridge 	Flood Damage Reduction	Corps/ Folsom Dam Raise Project
OTHER FEATURES			
Other Previously Authorized Features	Permanent Bridge Increment	Local Transportation	Corps/ Folsom Dam Raise Project
	<ul style="list-style-type: none"> • Bushy Lake and Woodlake Restoration Sites • Automated Temperature Shutters 	Ecosystem Restoration	
Key:		DR = dam raise	STG = submerged tainter gate

7.2 FOLSOM MODIFICATION PROJECT

7.2.1 6 STG Element Cost-Share

Costs of the Corps Work Package are cost-shared with the non-Federal sponsor using standard cost-share rules for flood damage reduction projects. No lands, easements, rights-of-way, or relocations are required for this work package. Three relocations are included in Reclamation's Work Package; accordingly, it is not the responsibility of the non-Federal sponsor for the flood damage reduction portion of the 6 STG Element, also referred to below as the Joint Federal Project, or JFP. The responsibility to provide all requirements for lands, easements, rights of way, relocations, and disposal areas (LERRD) is typically that of the Corps' non-Federal sponsor. Reclamation's performance of these work items does not affect or lessen the fiscal cost-sharing of the Corps' non-Federal sponsor. The non-Federal sponsor is still responsible for 35 percent of the cost of the project (in this case, the Corps Work Package). The sponsor is required to pay a cash contribution equal to 5 percent of the cost of the structural features.

Included in **Table 7-2** is the estimate of cost for the Corps Work Package of the 6 STG Element, apportioned to Federal and non-Federal categories. As can be seen, of the total cost of \$683.0 million, the Federal share is \$444.0 million and the non-Federal share is \$239.0 million.

TABLE 7-2
6 STG ELEMENT CORPS WORK PACKAGE COST APPORTIONMENT
FOR FLOOD DAMAGE REDUCTION (\$ MILLIONS)¹

MCACES ACCOUNT	Item	6 STG Element (Corps Work Package)		
		Federal	Non-Federal	Total ⁴
	First Costs			
1	Lands	0.0	0.0	0.0
2	Relocations	0.0	0.0	0.0
08, 11	Construction	538.6	0.0	568.6
6	Environmental Mitigation ²	0.4	0.0	0.4
18	Cultural Resources	0.0	0.0	0.0
30, 31	EDS&A	144.0	0.0	144.0
	Subtotal	683.0	0.0	683.0
	Less Cultural Resources	0.0	0.0	0.0
	Subtotal	683.0	0.0	683.0
	5 Percent Cash	(34.1)	34.1	0.0
	Subtotal	648.9	34.1	683.0
	Cash Adjustment	(204.9)	204.9	0.0
	Subtotal	444.0	239.0	683.0
	Percent³	65	35	100
	Add Cultural Resources	0.0	0.0	0.0
	Total – 6 STG Element⁴	444.0	239.0	683.0
Key:	EDS&A = engineering, design, supervision, and administration MCACES = microcomputer-aided cost engineering system STG = submerged tainter gate			

Notes:

1. First costs at October 2006 price levels.
2. Sunk costs for biological mitigation associated with completed construction of access and turnaround area. Air and water quality mitigation costs are included in construction.
3. Percentages are not exactly 65 – 35, but round to these numbers. Federal share slightly higher than 65 percent because of cultural resources.
4. Includes \$55.95 million in total sunk costs.

7.2.1.1 Operation, Maintenance, Repair, Replacement, and Rehabilitation Cost

When a Corps project is completed, it is normally turned over to the non-Federal sponsor, who is then responsible for the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the project. The 6 STG Element (and the DR Element), however, involve both improvements to existing facilities and implementation of new features on lands owned by the Federal Government and State of California. Consequently, no transfer of “ownership” would occur as a result of implementation of the auxiliary spillway and dam raise. However, for the RAP, the non-Federal sponsor would still be responsible for any increased maintenance costs of both the new and existing pertinent structures.

Operation of Folsom Dam with the auxiliary spillway and raise would be different from existing conditions. The Corps would revise the Water Control Manual for Folsom Dam based on the auxiliary spillway being completed to reflect a new flood control diagram and emergency spillway release diagram. Reclamation, in coordination with the California Department of Water Resources (DWR) Flood Operations Center, would continue to operate Folsom Dam and spillway in accordance with the revised operation manual. Because of the addition of the auxiliary spillway and dam raise, the non-Federal sponsor may need to enter into a new agreement with Reclamation to reflect changes to the overall operation of the Folsom facility, and to reflect any increased operating costs to meet flood control requirements. An OMRR&R agreement would specify tasks each agency would perform. If Reclamation, as operator of the Folsom Dam Industrial Complex, performs all or most of the work, the agreement would specify reimbursement to Reclamation by the non-Federal sponsor.

The non-Federal sponsor would be responsible for the OMRR&R of most of the 6 STG Element (and all OMRR&R associated with the DR Element). OMRR&R responsibilities of Reclamation and the non-Federal flood damage reduction sponsor do not follow the work packages, but are figured on the total, completed, JFP. The rationale used to divide the OMRR&R is that Reclamation OMRR&R responsibility should not exceed the OMRR&R required for a fuseplug spillway. This would be the amount of OMRR&R that Reclamation would have to perform if there were no flood damage reduction interest in an auxiliary spillway. Fuseplug spillway OMRR&R would consist of keeping vegetation growth away from the fuseplug, and keeping the channel clear of debris and vegetation. The annual OMRR&R cost of a fuseplug spillway is less than \$50,000 per year and thus falls under the cost estimate level of detail of the feasibility-level cost estimates of this evaluation. The significant JFP OMRR&R cost is for inspecting, testing, operating, maintaining and repairing the six submerged tainter gates. This cost is estimated to average about \$160,000 per year. This is a flood damage reduction cost and is the responsibility of the State of California and the Sacramento Area Flood Control Agency (SAFCA). This cost will be more accurately estimated through development of the OMRR&R agreement referred to above.

OMRR&R of environmental mitigation lands is a joint cost that is split between flood damage reduction and dam safety. The flood damage reduction non-Federal sponsor will be responsible for the flood damage reduction portion of this OMRR&R cost and will work with Reclamation to assign these OMRR&R responsibilities, similar to above.

7.2.2 Section 902 Limit of Folsom Modification Project

This section compares the Section 902 maximum project cost limit with the total project fully funded cost. The maximum project cost allowed by Section 902 of the Water Resources Development Act (WRDA) of 1986, as amended, includes the authorized cost (adjusted for inflation), the current cost of any studies, modifications, or actions authorized by the WRDA of 1986 or any later law, and 20 percent of the authorized cost (without adjustment for inflation). The fully funded estimate is the flood damage reduction project first cost inflated through the construction period at the current interest rate. If the fully funded cost exceeds the Section 902 limit, then new authorization would be required.

The Folsom Modification Project Section 902 limit is the flood damage reduction portion of the 6 STG Element (i.e., Corps Work Package portion of the 6 STG Element). On the basis of the estimated first cost of the Corps Work Package of \$683 million, updated to current price levels, the fully funded cost is about \$762.0 million. As shown in **Table 7-3**, the Section 902 limit of the Folsom Modification Project is \$245.6 million. Therefore, construction of the Corps Work Package would require a project reauthorization to increase the project cost.

TABLE 7-3
SECTION 902 COST LIMIT FOR 6 STG ELEMENT FLOOD DAMAGE
REDUCTION (\$ MILLIONS)

Computation Process	Cost
1. Authorized amount inflated through construction (fully funded)	
a. Project cost estimate ¹ at current price levels	683.0
b. Line a, inflated through construction	762.0
c. Ratio: Line b / Line a	1.1157
d. Authorized cost, at current price level	193.3
e. Authorized cost, inflated through construction (Line c x Line d)	215.6
2. Cost of modifications required by law	0
3. 20 percent of project cost in authorization (.20 x \$150 ²)	30.0
4. Maximum cost limited by Section 902 (sum of Lines 1e + 2 + 3)	245.6

Notes:

1. Authorized Folsom Dam Modifications Project consisting of the 10-main-dam-outlet plan described in the Corps 2003 American River Watershed, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study.
2. Authorized cost of Folsom Modification Project.

7.2.3 Report and Project Approvals

Since the cost of the Corps Work Package portion of the 6 STG Element exceeds the Folsom Modification Project authorized cost, reauthorization by Congress is required to increase the project cost. The DR Element is within the scope of the Folsom Dam Raise Project. No further authorization or other congressional action is required to proceed with the DR Element.

Since the 6 STG Element/JFP is within project scope and further authorized by Section 128 of the Energy and Water Resources Appropriations Act of 2006, only a project cost increase is needed. No *Chief of Engineers Report* will be prepared.

As mentioned, Reclamation prepared and circulated a *Draft Folsom Dam Safety and Flood Damage Reduction Environmental Impact Statement/Environmental Impact Report* (EIS/EIR), which became final in March 2007. The Corps intends to issue a Record of Decision on the Corps Work Package and the DR Element in May 2007.

Reclamation's contribution to the 6 STG Element would be through the Reclamation Safety of Dams Program. To proceed with its contribution to the 6 STG Element, Reclamation prepared information to support the Reclamation Work Package, including information to support the construction of an auxiliary spillway with six submerged tainter gates. After approval of a revised Folsom Modification Project, the project would be approved by the Office of Management and Budget. If no action is taken by Congress, approval is implied and Reclamation may proceed with implementation.

7.2.4 Local Support

As mentioned, the non-Federal sponsor for both the Folsom Modification and Folsom Dam Raise projects is the State of California, with SAFCA as a co-sponsor. The City of Folsom is responsible for the permanent bridge portion of the Folsom Dam Raise Project (see **Section 7.3.3.1**). Both the State of California and SAFCA continue to support these projects. Both agencies are aware of their sponsor responsibilities and are able to meet cost-sharing requirements. The non-Federal co-sponsors support the project, as evidenced by letters of intent from the State of California (5 December 2006) and SAFCA (5 October 2006). These letters are contained in **Appendix G - Pertinent Correspondence**.

7.2.5 Sponsor Financial Analysis and Ability to Pay

The State of California has sponsored many Federal projects and has sufficient resources and powers of taxation to fulfill its obligations of sponsorship.

7.2.6 Folsom Modification Project Cooperation Agreement

Review continues of PCAs between the Corps and other signatories required for implementation of the Corps Work Package of the 6 STG Element.

An existing PCA under the Folsom Modification Project was signed in March 2004. Analysis is currently occurring of issues such as whether this PCA can be amended, or whether nonstandard language would be added to achieve project implementation. The non-Federal signatory would be the State of California with SAFCA as a contributing sponsor.

7.2.7 6 STG Element Schedule

As mentioned, a number of approvals/reviews are required to implement the Selected Plan portion of the RAP. In addition, authorization of a new project cost for the Folsom Modification Project (6 STG Element of the Selected Plan) would be required. This would result

in a new 902 limit. Reclamation may begin construction of its work package before all Corps flood damage reduction approvals are in place. Reclamation may begin construction in September 2007. Almost 7 years would be required for construction of the 6 STG Element, as shown in **Table 7-4**. Construction of the DR Element would be phased to begin well after the beginning of construction of the 6 STG Element.

**TABLE 7-4
IMPLEMENTATION SCHEDULE OF 6 STG ELEMENT AND DR ELEMENT**

Task Name	Start Date	Finish Date
Project Approval Activities PAC & EIS/EIR Final Reports	In progress	June 2007
Folsom Modification & Related Activities¹ 6 STG Element Construction -Reclamation Work Package -Corps Work Package Folsom Dam Reoperation & Forecast-Based Release -Decision Document & EIS/EIR	September 2007 2010 January 2007	2010 2014 June 2008
Folsom Dam Raise² Folsom Bridge Construction Folsom Dam Raise Construction Ecosystem Restoration Construction	February 2007 2014 2016	January 2009 2016 2019
Key: DR = dam raise EIS/EIR = Environmental Impact Statement/Environmental Impact Report PAC = Post Authorization Change STG = submerged tainter gate		

Notes:

1. A more detailed schedule for activities related to the 6 STG Element is included in **Appendix C – Joint Federal Project Engineering Design Report**.
2. A more detailed schedule for activities related to the Folsom Dam Raise Project is included in **Appendix B – Folsom Dam Raise Project Engineering Design Report**.

7.2.8 Folsom Dam Reoperation

As mentioned, Reclamation’s interim operation agreement will end after completion of the Folsom Modification Project (6 STG Element/JFP). The Corps has begun a study that will lead to a decision and National Environmental Policy Act document on this permanent reoperation, and a revised Water Control Manual. The evaluation will include an analysis of alternative operation rules, with accompanying cost-benefit and environmental impact information. This study will also include an analysis of forecast-based releases from Folsom Dam. The cost of the study and the cost and economic benefits of reoperation are not included in the costs and benefits of the RAP.

7.3 FOLSOM DAM RAISE PROJECT

7.3.1 Dam Raise Project Features

The Folsom Dam Raise Project was authorized as a 7-foot dam raise with replacement of all eight gates on the service and emergency spillways, and operation to a top of flood control space at elevation 482 feet. This project was planned for construction after the Folsom Modification Project was in place. As described in **Chapter 4**, a 3.5-foot raise and replacement of the three emergency spillway tainter gates is a more efficient and technically feasible plan. As

mentioned, the 3.5-foot raise is a major part of the DR Element of the Selected Plan described in **Chapter 4**. The 3.5-foot dam raise is also the major design change for the authorized Folsom Dam Raise Project. The estimated cost for the 3.5-foot raise is \$115.3 million, or \$165.2 million, including the temporary bridge.

Since the 6 STG Element of the Selected Plan would provide passage of the Probable Maximum Flood (PMF), the DR Element would not include dam safety functions or benefits attributable to the Reclamation Safety of Dams Program. All costs associated with the 3.5-foot dam raise and emergency spillway gate replacement are assigned to flood damage reduction. Included in both the 7-foot and 3.5-foot dam raise plans is the cost of the temporary portion of the Folsom Dam Bridge that would be required to divert traffic that could not use Folsom Dam Road during construction. This cost is partially a cost-shared flood damage reduction cost and partially a cost that has been labeled dam safety in the Corps *2006 Folsom Dam Raise, Folsom Bridge Post Authorization Decision Document (PADD)*. Allocation assumptions for the temporary bridge will not be applied or otherwise transferred to the dam raise or other components of the DR Element of the Selected Plan.

As mentioned, the DR Element also includes Other Features: permanent increment of the Folsom Dam Bridge and ecosystem restoration. An *EIS/EIR* for that decision was also finalized in 2006 (Corps). Ecosystem restoration was last reported in the *2002 American River Watershed, California, Long-Term Study*. As described in **Chapter 4**, a 7-foot raise is not incrementally justified over the 3.5-foot raise. The 3.5-foot raise may be constructed under the Folsom Dam Raise authority because it is within the overall scope and is economically feasible.

7.3.2 DR Element Cost-Sharing

Table 7-5 shows cost apportionment for the DR Element of the Selected Plan. The temporary bridge is included in the calculation. The temporary bridge cost is considered a sunk cost because of existing commitments and contracts to construct the bridge that are independent of this evaluation. Including the temporary bridge, the DR Element cost is \$165.2 million. Of this, \$115.2 million is a Federal cost and \$50.0 million is a non-Federal cost.

Lands costs for the DR Element, estimated at about \$200,000, are for environmental mitigation. Land costs for fish and wildlife mitigation are identified as construction costs under Corps guidance (*CEWW-P, Cost Sharing Lands Associated with Fish and Wildlife Mitigation*, 19 September 2006), which states “ERRs are cost shared as construction elements.”

**TABLE 7-5
COST APPORTIONMENT OF DR ELEMENT FLOOD DAMAGE REDUCTION
(\$MILLIONS)¹**

MCACES Account	Item	DR Element		
		Federal	Non-Federal	Total ³
	First Costs			
1	Lands	0.2	0.0	0.2
2	Relocations	0.0	0.0	0.0
08, 11	Construction	73.6	0.0	73.6
6	Environmental Mitigation			
	EM Lands	0.6	0.0	0.6
	Site Improvements	2.4	0.0	2.4
18	Cultural Resources ²	0.8	0.0	0.8
30, 31	EDS&A	37.7	0.0	37.7
	Subtotal	115.3	0.0	115.3
	Less Cultural Resources	(0.8)	0.0	(0.8)
	Subtotal	114.5	0.0	114.5
	5 Percent Cash	(5.7)	5.7	0.0
	Subtotal	108.8	5.7	114.5
	Cash Adjustment	(34.4)	34.4	0.0
	Subtotal	74.4	40.1	114.5
	Percent	65	35	100
	Add Cultural Resources	0.8	0.0	0.8
	Subtotal	75.2	40.1	115.3
	Temporary Bridge	40.0	9.9	49.9 ⁴
	Total - DR Element	115.2	50.0	165.2
Key: DR = dam raise EDS&A = engineering, design, supervision, and administration EM = Environmental Mitigation MCACES = microcomputer-aided cost engineering system				

Notes:

1. First costs at October 2006 price levels.
2. Cultural resources recovery cost.
3. Includes sunk cost.
4. Includes a Corps-budgeted dam safety cost that is subject to Reclamation determination of which part, if any, may be subject to reimbursement by the Central Valley Project.

7.3.2.1 Operations, Maintenance, Repair, Replacement, and Rehabilitation Cost

As mentioned, the non-Federal sponsor is responsible for all additional OMRR&R incurred from the 3.5-foot raise and replacement of the three emergency spillway tainter gates. The additional OMRR&R includes periodic clearing of vegetation in proximity to walls, inspection of walls, and periodic coating of walls with protective sealant or paint. Since the three emergency spillway gates replace existing, older gates, no maintenance cost is associated with the gates. The new gates may reduce existing maintenance costs of the old gates. The annual OMRR&R cost is estimated at \$120,000. Special OMRR&R considerations at the Folsom Dam Industrial Complex are discussed above in **Section 7.2.1.1**.

7.3.3 Folsom Dam Raise Project Other Features

The authorized Folsom Dam Raise Project included several Other Features requiring separate consideration in relation to the RAP, as summarized below.

7.3.3.1 Folsom Bridge

Folsom Bridge, although part of the Folsom Dam Raise Project, is a distinct Other Feature being funded and constructed separately. Bridge description, costs, and costs distribution are fully presented in the Corps *Folsom Dam Raise, Folsom Bridge PADD*, dated September 2006. The total cost of a new, permanent Folsom Bridge is \$115.6 million. The numbers presented herein are first costs at October 2006 price levels. The numbers have been updated since the Corps *2006 Folsom Dam Raise, Folsom Bridge PADD*; those numbers are reported at October 2005 price levels. Of this cost, \$49.9 million corresponds to the cost funding for the temporary bridge and the remaining \$65.7 million balance is for the permanent increment. The temporary bridge cost represents the cost to divert traffic during construction that otherwise might use Folsom Dam Road to cross the dam. The permanent increment is the cost to make the bridge permanent; the permanent bridge has a traffic purpose, and is treated as a betterment. The temporary bridge and its cost are included in the DR Element of the RAP. The permanent bridge increment is a local betterment and is not cost-shared. The City of Folsom is responsible for the permanent bridge cost; however, a Federal contribution is authorized. This contribution is \$41.6 million.

Cost funding for the temporary bridge was distributed between flood damage reduction and dam safety based on the raise's contribution to passing the PMF, in accordance with the Corps *2002 Long-Term Study*. The funding split is 57 percent flood damage reduction and 43 percent dam safety. The Corps would fund that portion of the project assigned to dam safety through Federal appropriations. Reclamation would determine which of these costs, if any, may be subject to reimbursement by Central Valley Project water or power contractors. Such determination would be made in accordance with Reclamation law, policies, standards, directives, and contract obligations. Allocation assumptions for the temporary bridge will not be applied or otherwise transferred to the dam raise or other components of the DR Element of the Selected Plan.

The Folsom Bridge PCA is completed and signed. It establishes the flood damage reduction/dam safety cost split of 57/43 percent. This report does not affect the bridge financing, or other aspects of the bridge. As mentioned, the full cost of the bridge is added to the DR Element to determine the total project cost. The project cost subject to the Section 902 limit, however, excludes the permanent portion of Folsom Dam Bridge. The Folsom Dam Raise Project authorizing language did not specify the cost of the permanent bridge increment.

7.3.3.2 Ecosystem Restoration

The ecosystem restoration portion of the Folsom Dam Raise Project authorization includes riparian and other wetlands restoration of the Bushy Lake and Woodlake sites, and automated temperature control shutters at Folsom Dam. These features have not been revised since the *2002 Long-Term Study* (Corps, the Reclamation Board, and SAFCA). The cost

estimates for all three features have been revised to 2006 price levels. The cost estimate for the temperature control shutters has been further revised to include costs for items that were left out of the previous estimate. The ecosystem cost in the Corps 2002 *Chief of Engineers Report* is \$27 million. The change to current price levels and revisions to the cost estimate result in a total ecosystem restoration cost of \$59.8 million. The non-Federal sponsor for ecosystem restoration is SAFCA. The sponsor continues to support ecosystem restoration. Design efforts are continuing. A construction schedule has not been revised to date.

7.3.3.3 L.L. Anderson Dam

As described in **Chapter 3**, improvements to L.L. Anderson Dam for passage of the PMF are to be completed by Placer County Water Agency. Improvements are a without-project feature.

7.3.4 Section 902 Limit of Folsom Dam Raise Project

This section compares the Section 902 maximum project cost limit with the total Folsom Dam Raise Project fully funded cost. **Table 7-6** lists the items of the Folsom Dam Raise Project that have fully funded costs, the sum of which is to be compared to the Section 902 limit. Not included in the sum is the permanent bridge cost (the increment over the temporary bridge), which has no cost specified in the authorization language. The fully funded cost of the project (minus permanent bridge) is \$261.6 million. The Section 902 maximum cost limit calculation is shown in **Table 7-7**. The Section 902 limit is \$405.3 million. Therefore, since the project fully funded cost is less than the Section 902 limit, the DR Element would not require a project reauthorization.

**TABLE 7-6
FOLSOM DAM RAISE PROJECT FULLY FUNDED COSTS (\$ MILLIONS)**

Facility	Fully Funded Cost	Comments
Raise of Folsom Dam and Dikes	133.8	Includes replacement of three emergency spillway gates, L.L. Anderson sunk PED costs
Ecosystem Restoration	77.1	Bushy Lake, Woodlake, automated temperature shutters
Temporary Folsom Bridge	50.7	Permanent bridge has no authorized cost and is not included in Section 902 calculations
Total	261.6	
Key: PED = preconstruction, engineering, and design		

TABLE 7-7
SECTION 902 COST LIMIT FOR FOLSOM DAM RAISE PROJECT (\$ MILLIONS)

Computation Process	Cost
1. Authorized amount inflated through construction (fully funded)	
a. Project cost estimate at current price levels	225.0
b. Line a, inflated through construction	261.6
c. Ratio: Line b / Line a	1.1625
d. Authorized cost, at current price level	304.4
e. Authorized cost, inflated through construction (Line c x Line d)	353.8
2. Cost of modifications required by law	0
3. 20 percent of project cost in authorization (.20 x \$248.6)	51.5
4. Maximum cost limited by Section 902 (sum of Lines 1e + 2 + 3)	405.3

7.3.5 Report and Project Approvals

See Section 7.2.3 for discussion on report and project approvals.

7.3.6 Local Support

See Section 7.2.4 for discussion on local support.

7.3.7 Sponsor Financial Analysis and Ability to Pay

See Section 7.2.5 for statement about ability to pay.

7.3.8 Folsom Dam Raise Project Cooperation Agreement

The existing, signed PCA for the bridge is based on the Corps September 2006 *Folsom Dam Raise, Folsom Bridge PADD*. The City of Folsom is the non-Federal signatory. The State of California and SAFCA, as flood damage reduction sponsors, will contribute funds for the temporary bridge through the City of Folsom. The PCA was signed in November 2006.

No PCA exists for the Folsom Dam Raise Project. The non-Federal signatory would be the State of California, with SAFCA as a contributing sponsor.

Another potential PCA might be executed for ecosystem restoration work features. The non-Federal sponsor for ecosystem restoration would be SAFCA. A PCA may be executed independent of this *PAC Report* because the features have been previously authorized and have not changed other than a change to costs.

7.3.9 Folsom Dam Raise Project Schedule

As discussed previously, a number of approvals/reviews are required to implement the Selected Plan portion of the RAP. In addition, reauthorization of the Folsom Modification Project would be required. Construction of the DR Element would be phased to begin well after

the beginning of construction of the 6 STG Element. **Table 7-4** shows the construction schedule for the Folsom Dam Raise Project features and the rest of the RAP.

7.4 SUMMARY OF SELECTED PLAN AND OTHER FEATURES

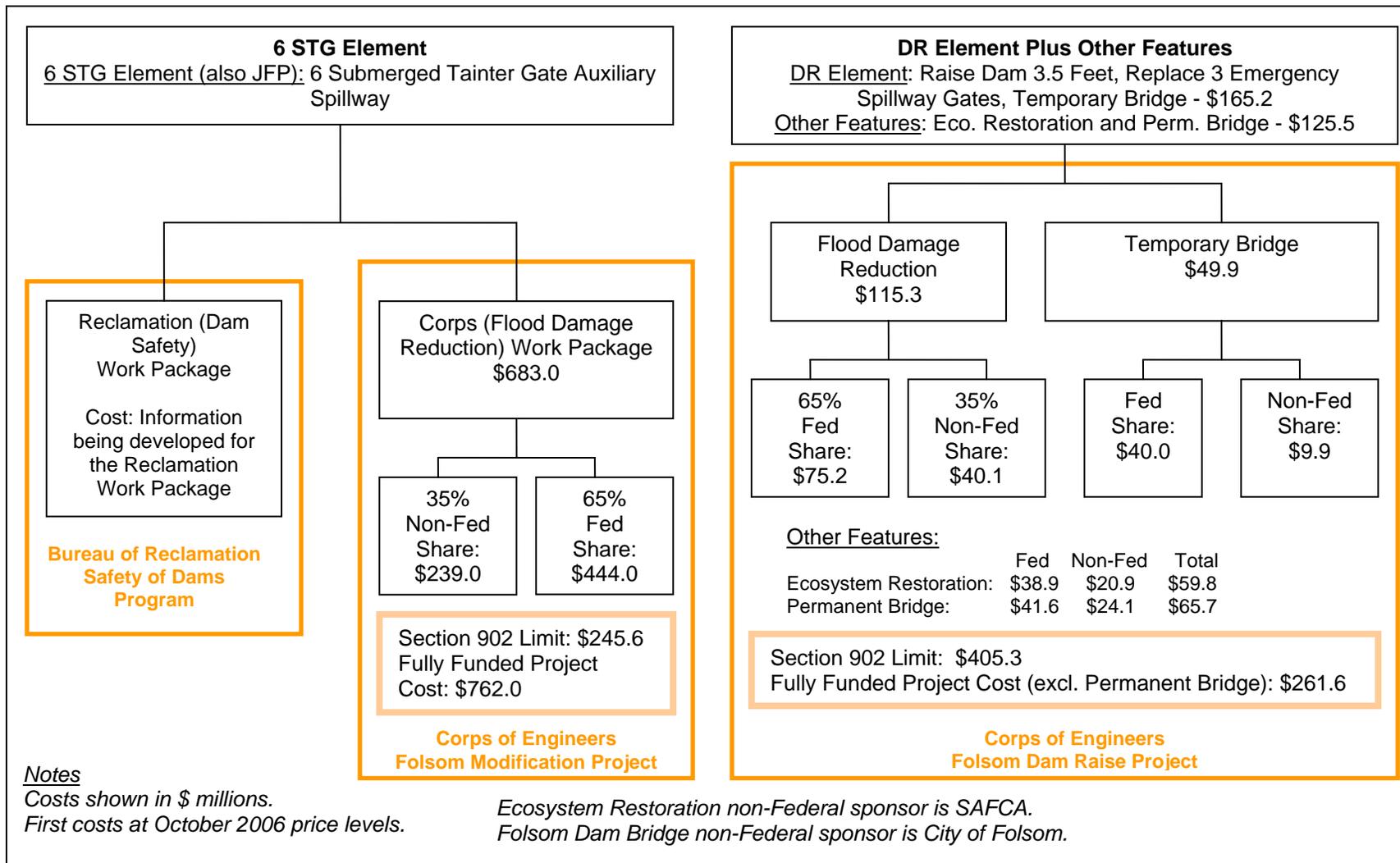
Table 7-8 summarizes cost-sharing of all the features of the Selected Plan and related Other Features of the current Folsom Dam Raise Project. The DR Element corresponds to the Folsom Dam Raise Project. These Other Features would add \$125.5 million to the total cost of the Selected Plan. The cost-sharing and authority structure of the Selected Plan elements and Other Features are diagrammed in **Figure 7-1**.

TABLE 7-8
SUMMARY OF COSTS FOR SELECTED PLAN, DAM RAISE PROJECT, AND OTHER FEATURES (\$ MILLIONS)¹

Program/Authority	Federal	Non-Federal	Total	Reclamation Safety of Dams	Total
6 STG Element					
Flood Damage Reduction	444.0	239.0	683.0	0.0	683.0
Safety of Dams	0.0	0.0	0.0	⁴	0.0
Subtotal	444.0	239.0	683.0	⁴	683.0
DR Element and Other Features					
Flood Damage Reduction					
3.5-foot Raise, 3 Emergency Gates	75.2	40.1	115.3	0.0	115.3
Temporary Bridge	40.0 ⁶	9.9	49.9	0.0	49.9
Subtotal Flood Damage Reduction	115.2	50.0	165.2	0.0	165.2
Other Features					
Ecosystem Restoration	38.9	20.9	59.8	0.0	59.8
Permanent Bridge Increment ⁵	41.6 ⁵	24.1 ⁵	65.7	0.0	65.7
Subtotal Other Features	80.5	45.0	125.5	0.0	125.5
Total DR Element + Other Features	195.7	95.0	290.7	0.0	290.7
Total Selected Plan²	559.2	289.0	848.2	⁴	848.2
Total Refined Authorized Projects³	639.7	334.0	973.7	⁴	973.7
Key: DR = dam raise STG = submerged tainter gate					

Notes:

1. First costs at October 2006 price levels.
2. Without Other Features.
3. With Other Features.
4. See information being developed by Reclamation for cost of the Reclamation (Dam Safety) Work Package.
5. Folsom Dam Bridge non-Federal Sponsor is City of Folsom. Permanent bridge is a local betterment, and therefore is not cost-shared. However, there is a Federal contribution of \$41.6 million towards the permanent bridge.
6. Includes \$21.5 million that is subject to Reclamation determination of which part, if any, may be subject to reimbursement by Central Valley Project.



**FIGURE 7-1
SUMMARY OF COSTS FOR THE REFINED AUTHORIZED PROJECTS ACCORDING TO ELEMENT**

7.5 ECONOMIC REEVALUATION

Projects related to the American River Watershed Project are undergoing a comprehensive economic reanalysis (see **Appendix E – Economics**) by the Corps. This Economic Reevaluation Study is revisiting economic without-project damages and benefits that would accrue from construction of the Selected Plan. This reevaluation is necessary to demonstrate continued Federal interest in the projects so that they may be implemented.

Although the current analysis included in this *PAC Report* is more than adequate for supporting conclusions in **Chapter 8**, a new analysis is needed to confirm Federal interest before funds are budgeted and obligated for construction. The reevaluation is needed because much of the current data is out of date: some Corps standards have changed, and data may no longer meet these standards. The analysis would also provide more definitive determination of project downstream impacts to the Sacramento River and Yolo Bypass.

The analysis will include revisions to without-project hydrology, geotechnical levee analysis, floodplain delineation, damageable property inventory, and potential economic damages. The economic analysis will include accounting for emergency evacuation and other flood-related costs. Benefits in three of the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, or P&G (WRC, 1983), system of accounts would be developed. The account categories included are national economic development (NED), other social effects (OSE), and regional economic development (RED). The environmental quality (EQ) account will not be included in the reevaluation. The analysis will include an assessment of conditions with the Common Features Project in place (the without-project condition of this current *PAC Report* evaluation), with-project conditions of the 6 STG Element, and the 6 STG Element plus 3.5-foot Folsom Dam raise.

The reevaluation project management plan and schedule have not yet been approved, but the current schedule is to complete the reevaluation by June 2007. Hydrologic analysis is underway and requires a limited amount of work.

CHAPTER 8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

Major conclusions of this *Post Authorization Change (PAC) Report* are as follows:

- The Folsom Modification Project, as originally formulated (10 main dam river outlets), is much more costly than last reported in the *2003 American River Watershed, California, Folsom Dam Modification Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study* (2003 LRR). Although an effective plan, it is not efficient compared to other engineering solutions, and has high construction risk. The Folsom Modification Project cost exceeds the authorized project cost (as defined by Section 902, Water Resources Development Act (WRDA) of 1986).
- Design studies have found that the Folsom Dam Raise Project (7-foot raise with a 482-foot elevation top of flood pool) is more costly than reported in the *Corps 2002 American River Watershed, California, Long-Term Study, Final Supplemental Plan Formulation Report/Environmental Impact Statement/Environmental Impact Report* (2002 Long-Term Study EIS/EIR), and, with the proposed design refinement to the Folsom Modification Project, is not as efficient compared to the other dam raise configurations studied.
- With or without flood damage reduction measures at Folsom Dam, the United States Department of the Interior, Bureau of Reclamation (Reclamation), intends to implement a project to lower structural (seismic and static) and hydrologic (passing the Probable Maximum Flood (PMF)) dam safety risk at Folsom Dam under its Safety of Dams Program. According to Reclamation studies and policy, an emergency fuseplug spillway would pass the PMF.
- The Refined Authorized Projects (RAP) in this *PAC Report* include a Selected Plan consisting of two major elements and two Other Features. The two major elements consist of (1) an auxiliary spillway with six submerged tainter gates (referred to as the 6 STG Element, also known as the Joint Federal Project (JFP)) and (2) raising Folsom Dam 3.5 feet with replacement of the dam's three emergency spillway tainter gates, referred to as the Dam Raise Element (DR Element). Also, two authorized Other Features are companion to the DR Element: a permanent bridge increment and the ecosystem restoration component of the Folsom Dam Raise Project. The RAP consists of the separate Folsom Modification Project and Folsom Dam Raise Project and should be implemented in the order that those projects were originally authorized: essentially the Folsom Modification Project first, then the Folsom Dam Raise Project.
- The 6 STG Element of the RAP would provide flood damage reduction performance similar to the authorized Folsom Modification Project, and would also pass the PMF. The 6 STG Element can be divided into two major components: a Corps Work Package and Reclamation Work Package. The work packages reflect the approximate cost associated with flood damage reduction and dam safety. Work packages are to be budgeted and implemented separately by each respective agency. The first cost of the

Corps Work Package is estimated at \$683.0 million. The estimated annual economic cost attributable to flood damage reduction for the Corps Work Package is \$37.9 million. The average annual equivalent benefits are \$89.9 million. The benefit-to-cost ratio is 2.4. Costs for dam safety are not included in economic costs for flood damage reduction.

- The DR Element, when added to the 6 STG Element, would provide levels of flood risk reduction similar to the combined function of the two authorized projects. The total estimated first cost of the DR Element, including Other Features, is \$290.7 million. This includes \$165.2 million for flood damage reduction facilities (dam raise, emergency gate replacement, and temporary bridge increment) and \$125.5 million for Other Features. Other Features include \$65.7 million for a permanent bridge increment and \$59.8 million for ecosystem restoration. The estimated average annual economic cost of the DR Element attributable to flood damage reduction is \$5.6 million. The incremental increased average annual equivalent benefits and benefit-to-cost ratio are \$17.2 million and 3.1, respectively.
- The total first cost of the Selected Plan is \$848.2 million. The total first cost of the RAP (including the Selected Plan and Other Features) is \$973.7 million. The total annual cost attributable to flood damage reduction is \$43.5 million. The average annual equivalent benefits are \$107.1 million. The benefit-to-cost ratio is 2.5. The non-Federal share of the total first cost is \$334.0 million. The Selected Plan portion of the RAP would result in a reduction of the flood risk in Sacramento from a 1 in 81 chance in any year, to a 1 in 185 chance in any year.
- The 6 STG Element of the Selected Plan is functionally equivalent to the Folsom Modification Project with an annual exceedence probability (AEP) of 1 in 156 and may be built in lieu of the original 10-main-dam-river-outlet plan. The 3.5-foot dam raise and replacement of the three emergency spillway tainter gates is also functionally equivalent to the flood damage reduction purpose of the authorized Folsom Dam Raise Project and has an AEP of 1 in 185. The AEP of the RAP is 1 in 185.
- The Selected Plan has a favorable benefit-to-cost ratio and is functionally equivalent to the originally authorized projects for flood damage reduction and passing the PMF. As described in previous studies, there is a clear Federal interest in the Other Features. Therefore, there remains a Federal interest in implementing the RAP.
- The 6 STG Element cost exceeds the authorized cost of the Folsom Modification Project. On approval of this *PAC Report*, the Corps would request a cost increase reauthorization by Congress for the Folsom Modification Project to implement the project.
- The RAP will be able to pass 100 percent of the PMF. Reclamation will address seismic and static dam risks at Folsom Dam.
- The Folsom Modification Project, as originally authorized, was an assumed without-project condition and a basis for the Folsom Dam Raise Project original authorization. Both of these projects experienced increases in costs during the design phase, calling into question the previous determination that the authorized 7-foot dam raise height was still viable. The 6 STG Element that is part of the refined Folsom Modification Project accomplishes flood damage reduction and the dam safety function that had originally been authorized as part of the Folsom Dam Raise Project, effectively moving that

function from one project to the other. Due to these refinements, the most viable dam raise heights (3.5 and 7 feet) originally investigated in the *2002 Long-Term Study EIS/EIR*, were considered in this *PAC Report* via alternatives C and D. The 3.5-foot raise was determined to be the dam raise height that maximized net benefits and provided flood damage reduction performance similar to the authorized 7-foot raise, and is included in the RAP. The 3-5 foot dam raise in this PAC Report is similar to the 3.5-foot dam raise that was evaluated in the Corps *2002 Long-Term Study EIS/EIR*. Environmental impacts associated with the current 3.5-foot dam raise are considered similar to those described in the *2002 Long-Term Study EIS/EIR*.

- The Energy and Water Development Appropriations Act of 2006 authorized reasonable modifications to the existing authorized activities, including an auxiliary spillway. Accordingly, no additional congressional authorization is necessary to implement the scope of the Corps portion of the RAP.
- The estimated flood damage reduction share of the 6 STG Element of \$762.0 million (fully funded) is greater than the authorized project cost of \$245.6 million, as provided by Section 902 of WRDA 1986. Therefore, reauthorization would be required to increase the authorized project cost. For the Folsom Dam Raise Project, the fully funded cost of \$261.6 million is less than the maximum authorized project cost of \$405.3 million. Therefore, the 3.5-foot raise, with replacement of the three emergency spillway tainter gates, needs no reauthorization.
- It is intended that the Folsom Dam Raise authorization remain active to support efforts to reduce the level of flood risk to Sacramento, to support implementation of ecosystem restoration contained in the authorized project, and to complete construction of Folsom Dam Bridge.
- The authorized maximum flood pool elevation of the Folsom Dam Project is elevation 466 feet. Traditionally, it has been the practice to use some of the storage space above elevation 466 for purposes of reducing the flood risk to Sacramento by limiting the outflow from Folsom to 160,000 cubic feet per second (cfs) or less when the pool elevation exceeded elevation 466. This practice was formally described and included in both the Folsom Modification Project and the Folsom Dam Raise Project. Both components of the Selected Plan will continue to rely on using storage above the authorized flood pool elevation of 466 for the purpose of reducing the flood risk to Sacramento and obtaining the performance described in this report.
- An authorized project element to modify the L.L. Anderson Dam spillway for dam safety is being addressed by Placer County Water Agency (PCWA) and is no longer necessary as part of the flood damage reduction and dam safety work by the Corps and Reclamation. In accordance with ER 1105-2-100, Appendix G, section 3,B,3, this feature should be deferred from the authorized Folsom Dam Raise Project.
- The Folsom Dam Raise Project, as authorized in the Energy and Water Appropriations Act for 2004, included development of an updated flood management plan. Opportunities to improve reservoir operations for flood damage reduction via forecast-based operations warrants further study by the Corps.

- The Corps should develop, as part of its Folsom Dam Reoperation Study, an updated Water Control Manual for Folsom Dam. The reoperation study should be completed in time for its application to the completed six submerged tainter gate auxiliary spillway.
- The local sponsors, the State of California and Sacramento Area Flood Control Agency (SAFCA), continue to support the RAP and are capable of carrying out their respective financial and institutional responsibilities. The City of Folsom is the local sponsor for the permanent bridge.
- Reclamation prepared the *2007 Final Folsom Dam Safety and Flood Damage Reduction Environmental Impact Statement/Environmental Impact Report* (2007 EIS/EIR), with cooperation from the Corps. The *2007 EIS/EIR* analyzed alternatives that address Reclamation dam safety objectives and the Corps' flood damage reduction objectives, as described in this *PAC Report*. The Corps intends to adopt Reclamation's *2007 EIS/EIR* to satisfy environmental compliance laws and regulations for the 6 STG and DR elements of the RAP. The nature of impacts associated with raising Folsom Dam facilities 3.5 feet are also evaluated in the Corps *2002 Long-Term Study EIS/EIR*.
- There has been no fundamental change in the types of impacts and required mitigation between the authorized projects and the RAP. Potentially significant adverse effects have been identified for geology and soils, traffic, water quality, fisheries, cultural resources, recreation and noise. Implementation of proposed mitigation measures, as described in the *2007 EIS/EIR*, would reduce these impacts to less than significant levels. An environmental commitment of mitigation, to be implemented prior to, or concurrent with, construction activities would be required to reduce potentially significant impacts for vegetation and wildlife, and special-status species.
- As determined in its work package, Reclamation would be responsible for environmental mitigation for impacts associated with the 6 STG Element. There is no environmental mitigation in the Corps Work Package. The non-Federal sponsors for flood damage reduction will not be responsible for lands, easements, rights-of-way, relocations, or disposal areas (LERRD) for Reclamation's Work Package; despite this, the non-Federal sponsor would share in the same cost amount as if the work packages had been adjusted to move LERRDs into the Corps Work Package. The non-Federal sponsor would be responsible for operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) associated with the 6 STG Element mitigation; this may require a subsequent agreement between the non-Federal partner(s) and Reclamation. The Corps, with the non-Federal partners, would be responsible for environmental mitigation associated with the DR Element.
- The RAP is consistent with, and able to contribute to, the Corps' 12 Actions for Change.
- The RAP would significantly contribute to reduction of the risk of flooding to the Sacramento area. Following implementation of the project, the estimated average annual flood damages would be reduced by 54 percent to \$198 million. Additional studies should be conducted to investigate ways to further reduce the risk of flooding to the area.

8.2 FEDERAL AND NON-FEDERAL RESPONSIBILITIES

To implement the Selected Plan, Federal and non-Federal obligations and requirements would be contained in Project Cooperation Agreements (PCA), one each for the Folsom Modification Project and Folsom Dam Raise Project.

8.2.1 Federal Responsibilities

The Corps and Reclamation would perform preconstruction engineering and design studies. Once the PCAs are signed and the non-Federal sponsors have provided cash contributions, LERRDs, and assurances, the Federal Government would construct the project.

The Corps and Reclamation would perform inspections of the project periodically to assess the adequacy of OMRR&R of the completed works.

8.2.2 Non-Federal Responsibilities

The non-Federal sponsor shall, prior to implementation, agree to perform items of local cooperation. Items of local cooperation are specific to the authorized purposes of the projects. The Folsom Modification Project is a flood damage reduction project. The Folsom Dam Raise Project is both a flood damage reduction and ecosystem restoration project. As such, distinct items of local cooperation apply to each of the two authorized projects.

It should be noted that American River Project was initiated prior to the Corps requirement for separate agreements for the design phase. However, a current PCA exists for the Folsom Modification Project; therefore, design phase activities have been cost-shared to date. After the recommendations of this *PAC Report* are approved, pending funding, the Corps, the State of California, and possibly SAFCA will enter into a new or updated PCA to share in the cost of construction. For the Folsom Dam Raise Project, after the recommendations of the *PAC Report* are approved, pending funding, design would proceed with Federal expense upfront. The Corps, the State of California, and possibly SAFCA, will enter into a PCA to share in the cost of construction, at which time the non-Federal share of the design phase costs would be recouped.

It is also important to note that items of local cooperation that address non-Federal responsibilities for OMRR&R will be revised. When a Corps project is completed, it is turned over to the non-Federal sponsor, which is then responsible for OMRR&R of the project. The Selected Plan, however, involves both improvements to existing facilities and implementation of new features on lands owned by the Federal Government and State of California. After construction, the auxiliary spillway would be physically operated and maintained by Reclamation as part of its Folsom Dam Industrial Complex. Thus, no transfer of ownership would occur as a result of implementation of the auxiliary spillway and dam raise. The non-Federal sponsor would be responsible for any increased maintenance costs of both the new and existing pertinent structures. As noted in the following items of local cooperation, items specific to OMRR&R will be revised as the specific methods of non-Federal responsibility for OMRR&R are determined.

8.2.2.1 Folsom Modification Project

Federal implementation of the 6 STG Element would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including, but not limited to, the following:

- a. Provide a minimum of 35 percent, but not to exceed 50 percent of total project costs as further specified below:
 - i. Provide, during the first year of construction, any funds necessary to pay the full non-Federal share (35 percent) of design costs. It should be noted that the non-Federal sponsors, under an existing PCA for the Folsom Modification Project, are sharing in the cost of design phase;
 - ii. Provide, during construction, a contribution of funds equal to 5 percent of total project costs;
 - iii. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project; and
 - iv. Provide, during construction, any additional funds necessary to make its total contribution equal to at least 35 percent of total project costs.
- b. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;
- c. Not less than once each year, inform affected interests of the extent of protection afforded by the project;
- d. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;
- e. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 United States Code (USC) 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within 1 year after the date of signing a project cooperation agreement, and to implement such plan not later than 1 year after completion of construction of the project;
- f. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking

- other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the project;
- g. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;
 - h. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law (PL) 91-646, as amended (42 USC 4601-4655), and the Uniform Regulations contained in 49 Code of Federal Regulations (CFR) Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;
 - i. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government (because the 6 STG auxiliary spillway is intended to ultimately be physically operated and maintained by Reclamation as part of the Folsom Dam Industrial Complex, this item will be revised as the specific non-Federal method of accomplishing and paying for the OMRR&R responsibility is determined);
 - j. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, replacing, or rehabilitating the project;
 - k. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;
 - l. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR Section 33.20;

- m. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, PL 88-352 (42 USC 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements, including, but not limited to, 40 USC 3141- 3148 and 40 USC 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 USC 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 USC 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 USC 276c et seq.);
- n. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), PL 96-510, as amended (42 USC 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;
- o. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;
- p. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and
- q. Comply with Section 221 of PL 91-611, Flood Control Act of 1970, as amended (42 USC 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, PL 99-662, as amended (33 USC 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

8.2.2.2 Folsom Dam Raise Project

Federal implementation of features associated with the Folsom Dam Raise Project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to the following:

- a. Provide a minimum of 35 percent, but not to exceed 50 percent of total project costs as further specified below:
 - i. Provide, during the first year of construction, any funds necessary to pay the full non-Federal share (35 percent) of design costs allocated by the Government to flood damage reduction;
 - ii. Provide, during construction, a contribution of funds equal to 5 percent of total flood damage reduction costs;
 - iii. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the flood damage reduction features; and
 - iv. Provide, during construction, any additional funds necessary to make its total contribution for flood damage reduction equal to at least 35 percent of total flood damage reduction costs.
- b. Provide 35 percent of total ecosystem restoration costs as further specified below:
 - i. Provide, during the first year of construction, any funds necessary to pay the full non-Federal share of design costs (35 percent) allocated by the Government to ecosystem restoration;
 - ii. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the ecosystem restoration features; and
 - iii. Provide, during construction, any additional funds necessary to make its total contribution for ecosystem restoration equal to 35 percent of total ecosystem restoration costs.

- c. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;
- d. Not less than once each year, inform affected interests of the extent of protection afforded by the flood damage reduction features;
- e. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;
- f. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 USC 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within one year after the date of signing a project cooperation agreement, and to implement such plan not later than one year after completion of construction of the flood damage reduction features;
- g. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the flood damage reduction features;
- h. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the flood damage reduction features afford, reduce the outputs produced by the ecosystem restoration features, hinder operation and maintenance of the project, or interfere with the project's proper function;
- i. Shall not use the ecosystem restoration features or lands, easements, and rights-of-way required for such features as a wetlands bank or mitigation credit for any another project;
- j. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended (42 USC 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;
- k. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible

with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government (because the DR Element is intended to ultimately be physically operated and maintained by Reclamation as part of the Folsom Dam Industrial Complex, this item will be revised as the specific non-Federal method of accomplishing and paying for the OMRR&R responsibility is determined);

- l. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;
- m. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;
- n. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR Section 33.20;
- o. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, PL 88-352 (42 USC 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements, including, but not limited to, 40 USC 3141- 3148 and 40 USC 3701 – 3708 (revising, codifying, and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 USC 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 USC 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 USC 276c et seq.);
- p. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the CERCLA, PL 96-510, as amended (42 USC 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written

direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

- q. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;
- r. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and
- s. Comply with Section 221 of PL 91-611, Flood Control Act of 1970, as amended (42 USC 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, PL 99-662, as amended (33 USC 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

8.3 RECOMMENDATIONS

Based on the findings presented in this report and supporting documents, I recommend approval of the Refined Authorized Projects as the plan that responds to the project authorizations in the Water Resources Development Act of 1999, and the Energy and Water Development Appropriations Acts for 2004 and 2006. This recommendation includes the following:

- **Folsom Modification Project.** In accordance with project authorizations in the Water Resources Development Act of 1999 and the Energy and Water Development Appropriations Act for 2006, approval of the Six Submerged Tainter Gate Element, and the concept of dividing the Six Submerged Tainter Gate Element into two work packages that will be constructed by the Corps and Reclamation separately; approval and forwarding to Congress the request for an increased new authorized cost for the Folsom Modification Project; and use of this document to support the Project Cooperation Agreement(s) to implement those project features identified to be implemented by the Corps subject to Congressional approval of a project cost increase for the Folsom Modification Project.
- **Folsom Dam Raise Project.** In accordance with project authorization in the Energy and Water Development Appropriations Acts for 2004 and 2006, approval of this document for use to support the Project Cooperation Agreement(s) to implement those project features identified to be implemented by the Corps; implement as planned the separable

ecosystem restoration project features; and continue implementation of the permanent Folsom Bridge Project.

I also recommend additional studies to investigate further reduction of the residual risk from flooding to the greater Sacramento metropolitan area, which may be undertaken as part of or coordinated with any future comprehensive investigation of the Sacramento River basin, or a portion thereof.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program, nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Assistant Secretary of the Army (Civil Works) as proposals for implementation funding and for an increase in the cost for the Folsom Modification Project. However, prior to transmittal, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Ronald N. Light
Colonel,
Corps of Engineers
District Commander

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