

Chapter 2

Project Description and Project Alternatives

2.1 Alternatives Development and Screening Process

2.1.1 Alternatives Formulation

The California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) require that environmental documents identify and analyze a reasonable range of feasible alternatives that could meet the project objectives to varying degrees. In addition, CEQA focuses on alternatives that would avoid or substantially lessen any of the significant effects of the project. NEPA and CEQA also require that a no-project/no-action alternative be analyzed. The Folsom Dam Safety/Flood Damage Reduction (DS/FDR) EIS/EIR evaluates 5 action alternatives and a No Action/No Project Alternative.

2.1.2 Alternatives Identification

The range of action alternatives that are assessed in this EIS/EIR were developed from a series of engineering measures addressing both Reclamation's Safety of Dams objectives of hydrologic, seismic, and static risk reduction; and the Corps flood damage reduction objectives. The features of the alternatives were compiled from the documents listed below. These features were presented at public scoping meetings intended to solicit comments and additional alternative details. Appendix A contains a public scoping report summarizing input received during the scoping period for the EIS/EIR.

- American River Watershed Project Final Supplemental EIS/EIR Part I Main Report. Corps, March 1996.
- American River Watershed Project Final Supplemental EIS/EIR Part II Final Supplemental EIS/EIR. Corps, March 1996.
- American River Watershed Long-Term Study Final Supplemental Plan Formulation Report. Corps, February 2002.
- Preliminary Borrow Materials Report for Corrective Action Study. Reclamation, August 2004.
- Folsom Facility – Safety of Dams Requirements and Concepts. Reclamation, February 2005.

- Folsom Dam – Draft Safety of Dams Corrective Action Study Scoping Report. Reclamation, October 2005.
- Folsom Dam Raise and Auxiliary Spillway Project Alternative Solution Study (PASS I). Reclamation and Corps. October 2005.
- Folsom Dam Raise and Auxiliary Spillway Project Alternative Solution Study (PASS II). Reclamation and Corps, February 8, 2006.
- Folsom Dam Modifications Limited Reevaluation Report. Corps, 2003.
- Folsom Dam Modifications Environmental Assessment. Corps, 2005
- Environmental Site Assessment Folsom Dam Modification. Corps, 2005.
- Draft American River Watershed Project Folsom Dam Raise, Folsom Bridge Environmental Impact Statement/Environmental Impact Report. Corps, 2006.

2.1.3 Scoping of Alternative Measures and Pre-Screening Process

Teams comprised of Reclamation and Corps engineers and environmental planners participated in a series of engineering scoping meetings to identify, develop, refine, screen, and describe measures that would achieve Reclamation's dam safety and Corps' flood damage reduction objectives. A significant portion of the efforts centered on independent identification of stand-alone dam safety and flood damage reduction alternatives that would serve as a functionally equivalent project to the Corps authorized Folsom Dam Modification and Folsom Dam Raise projects. Additional efforts were focused on developing alternatives to meet both the dam safety and the flood damage reduction objectives.

The alternative development process commenced with the initial identification of a range of stand-alone engineering measures, followed by their further refinement and the identification of alternatives that met both objectives. Each measure was evaluated for its engineering effectiveness and relative environmental benefits and effects. The result of the initial evaluation of engineering measures was the identification of specific measures to be addressed as part of a subsequent feasibility phase. The feasibility phase was used to define the proposed project/action by combining measures into comprehensive alternatives.

Conceptual design measures identified during initial engineering scoping efforts were reduced to those determined by engineering and environmental staff with specific dam safety expertise and environmental planning skills to have the greatest potential to provide practical, implementable, cost effective, and least environmentally damaging aspects of achieving the required project objectives. Because scoping resulted in the identification of a wide range of conceptual

measures with multiple design variations, some measures were eliminated that essentially accomplished the same objective of more effective measures. This resulted in a manageable array of representative measures being selected for more detailed evaluation relative to addressing project objectives. Section 2.2.4 provides descriptive details of the measures addressed in this EIS/EIR.

The hydrologic, seismic, static, and flood control measures evaluated by Reclamation and Corps engineering and planning staff included alternatives that jointly addressed both the dam safety and flood damage requirements, as well as stand-alone alternatives that addressed either specific dam safety or flood damage requirements at the Folsom Facility. A comprehensive list of potential alternatives considered during initial screening, along with a brief comment on why the measure was dropped from further consideration, is presented in the following section.

Reclamation is preparing a Modification Report, which would outline a recommended joint alternative to meet dam safety and flood damage reduction objectives as well as specific, stand-alone dam safety alternative recommendations. There are several potential structural and non-structural measures associated with modifications to the Folsom Facility that have been identified in previous studies which have the potential to benefit flood damage reduction and/or dam safety.

The Corps is preparing a Post Authorization Change (PAC) Report that describes recommended alternatives to address Flood Damage Reduction needs as well as proposed changes to the existing Folsom Dam Modification and Folsom Dam Raise Project authorizations. To help identify recommended changes to the Corp's existing authorizations, the PAC compares four action alternative plans that address the study objectives and constraints for completeness, effectiveness, efficiency and acceptability.

The alternative plans presented in the respective Modification and PAC Reports are encompassed within the alternatives analysis of this EIS/EIR. The scope of this EIS/EIR includes the integration of the majority of the information on the alternatives from both Reclamations' and the Corps' Modification Report and the PAC. The alternatives in this document are joint alternatives which address Reclamations' stand-alone dam safety and security alternatives, as well as the Corps' potential flood damage reduction measures.

2.1.4 Dam Safety and Flood Damage Reduction Measures Evaluated as Part of Alternatives Development

Reclamation and the Corps initiated a comprehensive value planning process in September of 2005, referred to as the Project Alternatives Solutions Study (PASS). The PASS process identified and evaluated a large number of potential measures that would meet the objectives of both agencies responsibilities for the Folsom Facility.

Tables 2-1 through 2-7 summarize the dam safety and flood damage reduction measures evaluated for incorporation into an action alternative. The general rationale for elimination of a measure from further detailed evaluation is summarized in the tables. The measures were evaluated as part of the PASS process. The rationale for elimination is discussed within the PASS documents listed in Section 2.1.2.

The purpose of the PASS process was to identify potential alternatives for a common project that provided minimum 1/200 year flood protection and addressed hydrologic risk reduction for the Folsom Facility. The PASS process consisted of three separate phases: (1) A cursory examination of possible alternatives; (2) completion of PASS I, reported in October 2005; and, (3) identification of five potential alternatives. Following a detailed examination of the most probable PASS I alternatives during the PASS I evaluation, select stand-alone dam safety and flood damage reduction alternatives were evaluated for applicability to jointly address dam safety and flood damage reduction. In this additional scoping process, stand-alone alternatives were combined and/or reformulated to create an initial array of joint alternatives.

Measure No.	Measure Description	Retained for Further Evaluation?	Primary Reason for Elimination of Measure¹
Facility Alternatives			
1	Restrict Reservoir Elevation	No	P&N, IF, Not effective
2	Remove Dam and Reservoir	No	P&N, IF, EI
3	Relocate the population	No	IF, EF, Too expensive and not practical
4	Build New Upstream/Down Stream Dam under Corps Authorized Projects	No	IF, P&N, EI, Beyond the scoping study, not authorized under Dam Safety Program or Corps authorized projects
5	Enlarging the Levees Downstream	No	IF, P&N, EI, Beyond the scoping study
Embankment Alternatives			
	Reinforced Earthfill Wall Raise		
6	Geogrids and soil	No	TF
7	Concrete facings w/ steel straps	No	TF
Structural Wall Alternatives			
8	Pre-cast Wall	Yes	
9	Concrete Wall (T-wall) ¹	Yes	
10	Jersey Barrier with Earth Raise	No	TF, Earth raise alone is a better alternative
11	Sheet Piles (concrete or steel)	No	TF, IF, Restricts recreation and maintenance access, unsightly, obstructs views, subject to graffiti
12	Earth Raise and Concrete Wall	Yes	

Table 2-1
List of Potential Flood Protection and Hydrologic Risk Reduction Measures for Concrete Dam & Embankment Dams/Dikes

Measure No.	Measure Description	Retained for Further Evaluation?	Primary Reason for Elimination of Measure¹
Crest Raise Alternatives			
13	Soil Cement Raise	No	TF
14	Earth Raise	Yes	
15	Rolled compressed concrete (RCC) Raise	No	Earth raises equally effective at less cost
16	Asphalt Concrete	No	Asphalt cement is more expensive than other materials
Concrete Dam Outlet Modification Alternatives			
17	Enlarge/Replace Existing Gates	Yes	
18	Enlarge Existing Spillway	Yes	
19	Enlarge Existing Outlets/Construct New Outlets	Yes	
New Outlet Alternatives			
20	New Auxiliary Spillway	Yes	
21	New Tunnel	Yes	

TF - Technical Infeasibility

EF - Economic Infeasibility

EI - Environmental Impact

IF - Institutional Infeasibility

P&N - Inability to meet Purpose & Need

¹ Source for determination: Folsom Dam Raise and Auxiliary Spillway Project Alternative Solution Study (PASS I). Reclamation and Corps. October 2005.

Table 2-2
List of Potential Static Risk Reduction Measures for Embankment Dams/Dikes

Measure No.	Measure Description	Retained for Further Evaluation?	Primary Reason for Elimination of Measure¹
1	Downstream (D/S) Overlay	Yes	
2	Cutoff Wall (crest)	No	TF, May damage embankments
3	Vertical Filter	Yes	
4	Vertical Geo membrane	No	TF, Difficult to construct, difficult to verify long-term performance
5	Geo membrane U/S Face	No	May work well on small dikes that typically do not store water
6	Asphalt Up Stream (U/S) Barrier	No	More expensive than other measures
7	Slurry Wall D/S	No	TF, Not a good design
8	Slurry Wall U/S	No	TF
9	Filter Cutoff Combo. (Slurry Wall & Overlay)	No	TF, EI
10	Install Drain on D/S side with outfalls	Yes	
11	Excavate and Overlay	Yes	
12	Horizontal Drains	No	TF, may cause harm to embankment and seepage conditions

TF - Technical Infeasibility

EF - Economic Infeasibility

EI - Environmental Impact

IF - Institutional Infeasibility

P&N - Inability to meet Purpose & Need

¹ Source for determination: Folsom Dam Raise and Auxiliary Spillway Project Alternative Solution Study (PASS I). Reclamation and Corps. October 2005.

Table 2-3
List of Potential MIAD Seismic Risk Reduction Measures

Measure No.	Measure Description	Retained for Further Evaluation?	Primary Reason for Elimination of Measure¹
1	Downstream Overlay	Yes	
2	Stone Columns	No	TF, Difficult to verify, low confidence
3	Compaction Grouting	No	TF, Difficult to verify, low confidence
4	Compaction Piles	No	TF, Difficult to verify, low confidence
5	Trench Walls	No	TF, Might not cutoff seepage
6	Slurry Walls	No	TF, Might not cutoff seepage
7	Excavate and Replace Foundation	Yes	
8	Permanent Freezing	No	TF, Unproven technique, O&M problems
9	Soil Vitrification	No	TF, Unproven technique
10	New Earth Dam Downstream	No	EI, TF, Similar to Overlay
11	New RCC Dam Downstream	No	TF
12	Replace the Dam in Place	No	EI, TF, Requires cofferdam, effects Res. Operation
13	Replace the Dam in Place with RCC Dam	No	EI, TF, Requires cofferdam, effects Res. Operation
14	Jet Grouting	Yes	
15	Blast Compaction	No	EI, TF, Difficult to verify, low confidence
16	Continuously Dewater	No	TF
17	Reservoir Restriction	No	IF, P&N, Not practical
18	More Downstream Berm	No	EI, TF, Difficult to quantify increase in strength
19	Dynamic Compaction	No	TF, Depth prohibitive
20	Increase Drainage with stone columns	No	TF
21	Wick Drains	No	TF
22	Rockfill Dam Downstream	No	EI, TF, Doesn't adequately address concern
23	Increase Release Capacity	No	EI, TF, IF, P&N, Downstream conditions restrict this (safe channel capacity)
24	Series of Concrete walls in fdn. perpendicular to the crest	No	TF
25	Overlay with RCC foundation	No	TF, similar to others

TF - Technical Infeasibility

EI - Environmental Impact

EF - Economic Infeasibility

IF - Institutional Infeasibility

P&N - Inability to meet Purpose & Need

¹ Source for determination: Folsom Dam Raise and Auxiliary Spillway Project Alternative Solution Study (PASS I). Reclamation and Corps. October 2005.

Table 2-4
List of Concrete Dam Foundation Wedge Sliding Seismic Risk Reduction Measures

Measure No.	Measure Description	Retained for Further Evaluation?	Primary Reason for Elimination of Measure¹
1	Anchor-Bar Halo	No	TF, EF, May not be necessary, depend on No.2, too expensive for level of risk
2	Instrument the contact (uplift piezometers)	Yes	
3	Drain water loading the wedge	Yes	
4	Adit installed shear keys	No	TF, EF, May not be necessary, depend on No.2, too expensive for level of risk
5	Post-tensioned anchors	No	TF, EF, May not be necessary, depend on No.2, too expensive for level of risk
6	Caisson crossing joint (shear pin)	No	TF, EF, May not be necessary, depend on No.2, too expensive for level of risk
7	Add weight	No	TF, EF, May not be necessary, depend on No.2, too expensive for level of risk
8	Excavate and drift block	No	TF, EF, May not be necessary, depend on No.2, too expensive for level of risk

TF - Technical Infeasibility

EF - Economic Infeasibility

IF - Institutional Infeasibility

P&N - Inability to meet Purpose & Need

¹ Source for determination: Folsom Dam Raise and Auxiliary Spillway Project Alternative Solution Study (PASS I). Reclamation and Corps. October 2005.

Table 2-5
List of Concrete Dam Foundation Contact Risk Reduction Measures

Measure No.	Measure Description	Retained for Further Evaluation?	Primary Reason for Elimination of Measure¹
1	Post-tensioned anchors	Yes	
2	U/S, D/S Shear Keys	Yes	
3	Toe Block	Yes	
4	Caissons (steel fiber reinforced look at alternative types of reinforcement)	No	TF
5	Downstream Buttress	Yes	
6	Add weight upstream (cantilevered)	No	TF, Not practical.
7	Drainage and monitoring (in conjunction with another alternative)	Yes	
8	Revisit uplift assumptions	No	TF
9	Tie-down at downstream toe (caissons or post tensioned anchors)	No	TF
10	Construction joint Shear Keys	Yes	

TF - Technical Infeasibility

EF - Economic Infeasibility

IF - Institutional Infeasibility

P&N - Inability to meet Purpose & Need

¹ Source for determination: Folsom Dam Raise and Auxiliary Spillway Project Alternative Solution Study (PASS I). Reclamation and Corps. October 2005.

Table 2-6
List of Concrete Dam Potential Sliding Along Lift Lines Risk Reduction Measures

Measure No.	Measure Description	Retained for Further Evaluation?	Primary Reason for Elimination of Measure¹
1	Post-tensioned anchors	Yes	
2	Post-tensioned anchors (composite fiber reinforced)	No	TF
3	Caissons (steel fiber reinforced look at alternative types of reinforcement)	No	TF, Not practical at non-overflow section (may work for overflow sections)
4	Counterfort upper throat of the dam	No	TF, EF, Not practical
5	Put weight on top of dam (this would be isolated during a seismic event)	No	TF, Not practical.

TF - Technical Infeasibility

EF - Economic Infeasibility

IF - Institutional Infeasibility

P&N - Inability to meet Purpose & Need

¹ Source for determination: Folsom Dam Raise and Auxiliary Spillway Project Alternative Solution Study (PASS I). Reclamation and Corps. October 2005.

Table 2-7
List of Concrete Dam Potential Gate and Piers Improvement Measures

Measure No.	Measure Description	Retained for Further Evaluation?	Reason for Elimination of A Measure¹
Gates			
1	Additional steel plates to flanges of gate arm structural members and/or replace gate arm beams with new members	Yes	
2	Additional bracing	Yes	
3	Box in lower structural members (increase section modulus)	No	EF, Much more costly than Measure No. 1
4	Steel Wrap at Pier ends to mitigate shear failure near trunnion	Yes	
Piers			
1	Struts across the top of gate openings between piers	Yes	
2	Steel plates for external shear reinforcement	No	TF
3	Steel reinforcing bars and/or post tensioned anchors for pier base stabilization	No	TF
4	Use the bridge as the strut to stiffen piers	Yes	
5	Provide additional internal moment reinforcing with drilled steel columns	No	TF

TF - Technical Infeasibility

EF - Economic Infeasibility

IF - Institutional Infeasibility

P&N - Inability to meet Purpose & Need

¹ Source for determination: Folsom Dam Raise and Auxiliary Spillway Project Alternative Solution Study (PASS I). Reclamation and Corps. October 2005.

2.1.5 Alternatives Screening Criteria

Viable measures retained at the completion of the initial PASS process were combined to create preliminary alternatives for further evaluation and screening. Both NEPA and CEQA contain guidance regarding screening to determine which alternatives should be carried forward for detailed analysis. The screening criteria applied to determine which alternatives should move forward are described in the text below. The screening criteria are based on NEPA and CEQA guidance as well as Reclamation guidelines for screening.

- Reclamation (2000)¹ explains, “Examples of reasons for elimination are: (1) failure of the alternative to meet the requirements of the purpose of and need for the action, (2) the alternative cannot be technically implemented, (3) the alternative is prohibitively greater in cost or in environmental impacts than the other alternatives, or (4) the alternative cannot be reasonably implemented.”
- CEQA §15126.6 (c) states, “Among the factors that may be used to eliminate alternatives from detailed consideration in an EIR are: (i) failure to meet most of the basic project objectives, (ii) infeasibility, or (iii) inability to avoid significant environmental effects.”

Using this guidance, the alternatives were judged based on the following list of screening criteria.

- Ability to meet purpose and need/project objectives: the degree to which an alternative meets elements of the purpose and need/project objectives.
- Technical feasibility: the engineering and technical feasibility of an alternative.
- Institutional feasibility: the ability of an alternative to be implemented within a reasonable timeframe, considering political, regulatory, permitting, and public acceptability constraints.
- Economic feasibility: the ability of an alternative to be funded, given the constraints of the state and federal budgets.
- Environmental impacts: the magnitude of potential environmental effects of an alternative, including biological, physical (air quality, water supply, geology and soils, groundwater, water quality, and visual resources), and social effects.

A last consideration for screening was identification of measures that would be functionally equivalent to the objectives of the Corps authorized Folsom Dam Modification and Folsom Dam Raise projects.

¹ Draft, not approved as formal guidance.

2.1.6 Alternatives Eliminated as Part of Pre-Screening Process

Several groups of alternatives were eliminated from detailed analysis in this EIS/EIR primarily due to their not meeting basic purpose and need requirements. These alternatives include siting of the Folsom Facility at a new location, restriction of operations of the Folsom Facility, and removal of the Folsom Facility.

2.1.6.1 Siting of a New Folsom Facility

The preliminary identification and screening of measures to consider for alternatives to include in the EIS/EIR did not include evaluation of alternative locations for the Folsom Facility, as otherwise required under Section 15126.6(f) (2) of the State CEQA Guidelines. Based on the importance of the Folsom Facility in supplying water and power to the Central Valley Project, and the fact that the project objectives and statement of purpose and need are very particular to the Folsom Facility, the concept of planning and implementing a replacement facility at an alternative location in order to address the risks posed with the Folsom DS/FDR was considered infeasible and inappropriate. Given the function, size, location, and regional nature of the Folsom Facility, it is not feasible to consider that a new replacement facility could be constructed elsewhere in a timely manner (i.e., by 2014, which is the completion timeframe for the currently proposed project), notwithstanding the fact that the construction of such a replacement facility would very likely have extensive significant environmental impacts of its own. Although development of the Auburn Dam was suggested as an alternative in the Scoping Process for the Folsom DS/FDR EIS/EIR, completion of that project would not occur anywhere near the timeframe proposed for the Folsom DS/FDR project and development of that facility would not address the risk issues particular to the Folsom Facility. Based on the reasons presented above, an alternative location scenario was not carried forth into the EIS/EIR analysis.

2.1.6.2 Restriction of Reservoir Operations

Restriction of reservoir operations (e.g., restricting the reservoir pool to a lower elevation) was considered but eliminated because it would not reduce dam safety or flood control risk. Evaluation of dam safety seismic, static, and hydrologic risks indicates that the risks remain approximately the same regardless of reservoir surface elevation. Because the basic flood control issue is the inability to safely release the reservoir pool prior to a major storm, the flood damage reduction risk would also remain unacceptably high regardless of reservoir pool elevation.

2.1.6.3 Removal of Folsom Facility

The removal of the Folsom Facility was considered but eliminated as a potential alternative due to the importance of Folsom to water supply, hydropower, and as recreation facility for the region. At present, no studies have been initiated on how the water and power provided by the Folsom Facility could be replaced if the Folsom were to be removed. Although CalFed is evaluating new water storage projects,

these project assume that the Folsom Facility would remain in place and meeting its water supply obligations. The loss of Folsom would significant adversely impact the region’s economy and therefore is not being considered as an option to the Folsom Dam Safety and Flood Damage Reduction issues.

2.1.7 Folsom Dam Safety and Flood Damage Reduction Alternatives

The primary outcome of the PASS process was the identification of alternatives that combined dam safety and flood damage reduction measures into overall actions. The initial grouping of alternatives is presented in Table 2-8.

Table 2-8 List of Project Alternatives Addressed in PASS I Evaluations			
Alternative Name	Alternative Description	Retained for Further Evaluation?	Reason for Elimination of Alternative
Bravo	Interim 500-ft wide fuseplug Auxiliary Spillway (phase 1) to be replaced by 5-gated spillway (phase 2). Replace 8 existing spillway gates on Main Concrete Dam, 5.5-ft raise of Main Concrete Dam and all earthen embankments.	Yes	5.5-ft raise eliminated as technically not necessary; remaining portions of alternative incorporated into DS/FDR alternatives
Delta	Four-gated Auxiliary Spillway. Replace 8 existing spillway gates on Main Concrete Dam, 6.5-ft raise of Main Concrete Dam and all earthen embankments.	Yes	6.5-ft raise eliminated as technically not necessary; remaining portions of alternative incorporated into DS/FDR alternatives; evaluation of the six-gated spillway proved to have superior flood control aspects.
Echo	Six-gated Auxiliary Spillway. Replace 8 existing gates on Main Concrete Dam, 5.5-ft raise of Main Concrete Dam and all earthen embankments,	Yes	5.5-ft raise eliminated as technically not necessary; remaining portions of alternative incorporated into DS/FDR alternatives
Zulu	Permanent 400-ft wide fuseplug Auxiliary Spillway. Upper tier outlet modifications on Main Concrete Dam, replace 8 existing spillway gates, new outlets 5 and 10 and enlarging outlets 6 through 9.3-ft raise of Main Concrete Dam and all earthen embankments.	Yes	9.3-ft raise and installation of new outlets eliminated as technically not necessary; remaining portions of alternative incorporated into DS/FDR alternatives
Juno	Permanent 550-ft wide fuseplug Auxiliary Spillway. Upper tier outlet modifications, new outlets 5 and 10 and enlargement of outlets 6 through 9, enlarging existing outlets 2 and 3, constructing 2 new outlets under the existing emergency spillway flip bucket. 1.5-ft raise of Main Concrete Dam of all earthen embankments.	Yes	1.5-ft raise and installation of new outlets eliminated as technical not necessary; portions of alternative incorporated into DS/FDR alternatives

During further evaluations termed PASS II and PASS II Optimization, further engineering evaluation and optimization of highly probable joint alternatives was accomplished. In parallel, further engineering evaluations of stand-alone dam safety

and flood damage reduction alternatives also occurred. PASS II reported the results in April 2006 of a gated spillway and raise combination according to very specific criteria established by a joint agency Oversight Management Group. A tertiary effort, as directed by the Oversight Management Group, was to focus on maximizing the spillway potential and minimizing the height of any raise necessary to meet flood damage reduction objectives. The PASS II Optimization effort further refined the gated spillway alternative to the current description of the Joint Federal Project Auxiliary Spillway, as defined in Section 1.4 and 2.6.

Within the comprehensive range of alternatives presented in this EIS/EIR, additional consideration was made for the development of and potential implementation of stand-alone alternatives in conjunction with a joint alternative, for dam safety, as well as potential additional flood damage reduction alternatives. The flood damage reduction alternative would serve as functional equivalents to the Corps authorized Folsom Dam Modification and Folsom Dam Raise projects. Alternatives 2, 3, and 4 presented in Table 2-9 formed the basis of the Corp's functional equivalency determination.

The range of probable PASS I alternatives that were refined in parallel with the PASS II evaluation in preparation of this EIS/EIR, in order to identify a comprehensive range of dam safety and flood damage reduction alternatives consisting of probable joint alternatives in combination with probable stand-alone alternatives for further environmental impact analysis, are analyzed within this EIS/EIR, and presented in Table 2-10.

2.2 Project Alternatives

2.2.1 Introduction to Folsom DS/FDR Alternatives

From the various engineering measures determined to best address the screening criteria relative to each Folsom Facility structure, five comprehensive action alternatives were developed. These alternatives incorporate, as a package, the measures necessary to modify the existing Folsom Facility features that are shown in the Project Base Map, Figure 1-1. Overall, it was determined that the five action alternatives would, to varying degrees, meet the purpose and need/project objectives, and are technically, institutionally, and economically feasible. The basic features of the five action alternatives are shown in Figures 2-1 through 2-5. The characteristics of all the alternatives are summarized in Table 2-10 and described in greater detail in Section 2.2.3 through Section 2.2.8 (the No Action/No Project Alternative description is Section 2.2.2). The corrective actions were developed on a structure-by-structure basis; therefore, the project features are described in the same manner. A more detailed description of each engineering measure can be found in Section 2.2.4.

Table 2-9
List of Corps Project Alternatives Addressed in American River Long-Term Study Supplemental EIS (2002)

Alternative Name	Alternative Description	Retained for Further Evaluation?	Reason for Elimination of Alternative
1 No Action	No action to improve dam safety or flood protection beyond existing constructed authorized projects	Yes	Required for analysis to serve as baseline for action alternatives
2 3.5-ft Dam Raise/478-ft Flood Pool Elevation	Strengthening of Main Concrete Dam, lowering of main and existing Auxiliary Spillway crests, replacement of 8 spillway gates, modification of spillway bridge piers, replacement of spillway bridge, extension of stilling basin, and 3.5-ft concrete crest wall on all earthen embankments.	Yes	Elements retained to reflect functionally equivalent measures to potential DS/FDR actions
3 7-ft Dam Raise/482-ft Flood Pool Elevation	Strengthening and raising of Main Concrete Dam, lowering of main and existing Auxiliary Spillway crests, replacement of 8 spillway gates, modification of spillway bridge piers, replacement of spillway bridge, extension of stilling basin, combined 3.5-ft earthen raise and 3.5-ft concrete crest wall on all earthen embankments.	Yes	Elements retained to reflect functionally equivalent measures to potential DS/FDR actions
4 12-ft Dam Raise/487-ft Flood	Strengthening and raising of Main Concrete Dam, lowering of main and existing Auxiliary Spillway crests, replacement of 8 spillway gates, modification of spillway bridge piers, replacement of spillway bridge, extension of stilling basin, combined 8.5-ft earthen raise and 3.5-ft concrete crest wall on all earthen embankments.	Yes	12-ft raise eliminated as technically not necessary; remaining portions retained to reflect functionally equivalent measures to potential DS/FDR actions.
5 Stepped Release to 160,000	No structural modifications. Stepped release from 115,000 to 145,000 cfs, and then stepped to 160,000 cfs emergency release.	No	Does not address Safety of Dams concerns
6 Stepped Release to 160,000 and New Outlets at Folsom Dam	A new outlet to Folsom Dam to increase the early release from 115,000 cfs to 145,000. Release up to 160,000 same as Alternative 5	No	Does not address Safety of Dams concerns
7 Stepped Release to 180,000 cfs	No structural modifications. Stepped release from 115,000 to 145,000 cfs, with emergency release stepped to 180,000 cfs.	No	Does not address Safety of Dams concerns
8 Stepped Release to 160,000 cfs and 7-ft Dam Raise/482-ft Flood Pool Elevation	Combines features of Alternative 3 with features of Alternative 5	Yes	Portions of alternative incorporated into Folsom DS/FDR alternatives per discussion for Alternatives 3 and 5 above

**Table 2-10
Summary of Folsom DS/FDR EIS/EIR Alternatives**

<i>Project Alternatives</i>	<i>Alternative 1</i>	<i>Alternative 2</i>	<i>Alternative 3</i>	<i>Alternative 4</i>	<i>Alternative 5</i>	
Main Alternative Features Dam Safety & Flood Damage Reduction	Fuseplug Auxiliary Spillway with No Dam Raise/Embankment Crest Protection	Fuseplug Auxiliary Spillway with Underlying Tunnel, 4-ft Dam/ Embankment Raise	JFP Gated Auxiliary Spillway (6STG) with Potential 3.5-ft Parapet Wall Raise	Gated Auxiliary Spillway (4STG) with 7-ft Dam/ Embankment Raise	No Auxiliary Spillway, 17-ft Dam/ Embankment Raise	
All alternatives include the main alternative features above plus seismic and static design elements at Main Concrete Dam and earthen embankment dams/dikes as outlined below						
Principle Spillway vs. Raise tradeoffs in relation to PMF/FDR and relative outlet elevation	Maximum PMF capacity w/o raise element, minimal FDR benefit, highest outlet elevation	Raise required for full PMF capacity plus full FDR benefit with lowest outlet elevation	No required raise element, Maximum PMF capacity w/ full FDR benefit, lower outlet elevation, potential raise as incrementally justified for FDR only	Required raise and gate modification elements to pass PMF w/ full FDR benefit with smaller gated spillway, higher outlet elevation	Raise required to fully contain PMF w/o aux spillway.	
Existing Main Concrete Dam						
Main Concrete Dam	Concrete Monoliths	No Dam Raise	No Dam raise - Existing parapet wall (3.5 ft) sufficient with minor modifications to 4.0 ft	No Dam raise - Existing parapet wall (3.5 ft) sufficient with minor modifications	Dam monolith raise - non-overflow sections of dam to 7 ft	Dam monolith raise – non-overflow sections of dam to 17 ft
		Post-tensioned anchors, shear key elements, and/or toe blocks	Post-tensioned anchors, shear key elements, and/or toe blocks	Post-tensioned anchors, shear key elements, and/or toe blocks	Post-tensioned anchors, shear key elements, and/or toe blocks	Post-tensioned anchors, shear key elements, and/or toe blocks
		Foundation drain enhancements	Foundation drain enhancements	Foundation drain enhancements	Foundation drain enhancements	Foundation drain enhancements
	Existing Spillway	Spillway pier reinforcement comprised of bracing, post tensioned anchors and/or pier wraps	Spillway pier reinforcement comprised of bracing, post tensioned anchors and/or pier wraps	Spillway pier reinforcement comprised of bracing, post tensioned anchors and/or pier wraps	Spillway pier reinforcement comprised of bracing, post tensioned anchors and/or pier wraps	Spillway pier reinforcement comprised of bracing, post tensioned anchors and/or pier wraps
		No spillway bridge improvements	No spillway bridge improvements	Potentially modify/replace existing spillway bridge	Replace existing spillway bridge	Replace existing spillway bridge
		Additional bracing or replacement of structural members to spillway gates	Additional bracing or replacement of structural members to spillway gates	Potentially modify as in Alts 1 or 2 or replace 3 emergency gates as incrementally justified for FDR	Replace all spillway gates as incrementally justified for FDR	Replace all spillway gates as incrementally justified for FDR
	Existing Stilling Basin	No modifications	No modifications	Extend the Stilling Basin 50-75 ft as incrementally justified for FDR	Extend the Stilling Basin 50-75 ft as incrementally justified for FDR	No modifications

Table 2-10 (continued)						
Summary of Folsom DS/FDR EIS/EIR Alternatives						
Project Alternatives		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
New Auxiliary Spillway						
New Auxiliary Spillway	Auxiliary Spillway	Maximum width PMF fuseplug spillway w/partially-lined chute	Smaller width PMF fuseplug spillway w/partially- or completely-lined chute	Joint (PMF/Flood control) 6 STG Auxiliary Spillway w/fully-lined chute, stilling basin, and approach channel	Smaller Gated Auxiliary 4 STG spillway w/fully-lined chute, stilling basin, and approach channel	None
	Control Structure	520-ft wide fuseplug	350- to 400-ft wide fuseplug	6 submerged tainter gates, plus potential redundant water supply outlet connection	4 submerged tainter gates, plus possible redundant water supply outlet connection	None
	Tunnel	No Tunnel	Tunnel w/3 submerged tainter gates	No Tunnel	No Tunnel	No Tunnel
Existing Embankment Dams/Dikes						
Embankments raise height with incorporation of various seismic and static elements. Increased raise heights assumes increased impacts		None to minimal to accommodate crest protection. No FDR benefit	Low to Moderate to accommodate required for achieving PMF, FDR, freeboard, crest strengthening	Low to Moderate to accommodate required freeboard, crest resurfacing and potential incremental flood surcharge as incrementally justified	Moderate to High to accommodate required PMF, FDR, freeboard, crest resurfacing and freeboard potential incremental flood surcharge as incrementally justified	High to primarily accommodate required incremental flood surcharge and freeboard due to no increase in outlet capacity Requires separately authorized outlet modifications to achieve full FDR
Left Wing Dam	<4 ft earthen raise for crest protection	0.5-ft earthen, 3.5-ft parapet concrete wall	Potential 3.5-ft parapet concrete wall	3.5-ft parapet wall and 3.5-ft earthen raise	17-ft earthen raise	
	None	Toe drains	None	Toe drains	Toe drains	
	None	None	Training wall between LWD and spillway	Training wall between LWD and spillway	None	
	Crest filters in upper portion of dam and along contact with concrete dam	Half-height filters	Crest filters in upper portion of dam and along contact with concrete dam	Full-height filters	Full-height filters	

Chapter 2
Project Description and Project Alternatives

Table 2-10 (continued) Summary of Folsom DR/FDR EIS/EIR Alternatives					
Project Alternatives	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Right Wing Dam	<4 ft earthen raise for crest protection	0.5-ft earthen, 3.5-ft parapet concrete wall	Potential 3.5-ft parapet concrete wall	3.5-ft parapet wall and 3.5-ft earthen raise	17-ft earthen raise
	None	Toe drains	None	Toe drains	Toe drains
	Crest filters in upper portion of dam and along contact with concrete dam	Half-height filters	Crest filters in upper portion of dam and along contact with concrete dam	Full-height filters	Full-height filters
Mormon Island Auxiliary Dam	<4-ft earthen raise for crest protection	4-ft earthen raise	Potential 3.5-ft parapet concrete wall	7-ft earthen raise	17-ft earthen raise
	Toe drains	Toe drains	Toe drains	Toe drains	Toe drains
	Full-height filters	Full-height filters	Full-height filters	Full-height filters	Full-height filters
	Jet grouting downstream foundation	Excavation & replacement of downstream foundation	Jet grouting downstream foundation	Jet grouting downstream foundation	Excavation & replacement of downstream foundation
	Downstream overlay	Downstream overlay	Downstream overlay	Downstream overlay	Downstream overlay
Dikes 1,2 3,7, & 8	No activity	4-ft earthen raise	Potential 3.5-ft parapet concrete wall	7-ft earthen raise	17-ft earthen raise
		Toe drains	None	Toe drains	Toe drains
		No Filter	Full-height filter at Dike 7. Replace filter material removed at Dikes 1-3, 8 for parapet wall construction	Full-height filters	Full-height filters
Dikes 4, 5 & 6	<4 ft earthen raise for crest protection	4-ft earthen raise	Potential 3.5-ft parapet concrete wall	7-ft earthen raise	17-ft earthen raise
	Toe drains	Toe drains	Toe drains	Toe drains	Toe drains
	Full-height filters	Half-height filters	Full-height filters	Full-height filters	Full-height filters

Table 2-10 (continued)					
Summary of Folsom DR/FDR EIS/EIR Alternatives					
Project Alternatives	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Miscellaneous and Overarching Features					
Non-Federal Property Protection	No Action	New embankment protection	New embankment protection	New embankment protection	New embankment protection
		Acquisition of real estate rights (easements or fee title)	Acquisition of real estate rights (easement or fee title)	Acquisition of real estate rights (easement or fee title)	Acquisition of real estate rights (easement or fee title)
Borrow Sites	Auxiliary Spillway Beal's Point	Auxiliary Spillway Tunnel excavation Beal's Point	Auxiliary Spillway Beal's Point	Auxiliary Spillway Beal's Point Granite Bay	Beal's Point Folsom Point D1/D2 L1/L2 Granite Bay
Contractor Use Area – Staging, Material Processing, Concrete Batch Plant	Main Concrete Dam - Concrete Folsom Point - Processing Beal's Point - Processing MIAD - Jet Grout Plant	Main Concrete Dam - Concrete Folsom Point - Processing Beal's Point - Processing Granite Bay - Staging MIAD – Staging	Main Concrete Dam - Concrete Folsom Point - Processing Beal's Point - Processing Granite Bay - Staging MIAD - Jet Grout Plant	Main Concrete Dam - Concrete Folsom Point - Processing Beal's Point - Processing Granite Bay - Processing MIAD - Jet Grout Plant	Main Concrete Dam - Concrete Folsom Point - Processing L1/L2 - Processing Beal's Point - Processing Mooney Ridge - Processing Granite Bay - Processing MIAD – Staging
Disposal Sites	Dike 7 MIAD D1/D2 Folsom Point LWD Beal's Point	Dike 7 MIAD D1/D2 Folsom Point LWD Beal's Point	Dike 7 MIAD D1/D2 Folsom Point LWD Beal's Point	Dike 7 MIAD D1/D2 Folsom Point LWD Beal's Point	Dike 7 MIAD Beal's Point Granite Bay Folsom Point
Other Project Features	Utility relocations	Utility relocations	Utility relocations	Utility relocations	Utility relocations
	Security Upgrades	Security Upgrades	Security Upgrades	No security features associated with the FDR alternatives	No security features associated with the FDR alternatives
	Road relocations	Road relocations	Road relocations	Road relocations	Road relocations
	Haul road construction	Haul road construction	Haul road construction	Haul road construction	Haul road construction
	Excavation blasting	Excavation blasting	Excavation blasting; Underwater blasting and dredging	Excavation blasting; underwater blasting and dredging	Excavation blasting; underwater blasting and dredging

this page intentionally left blank.

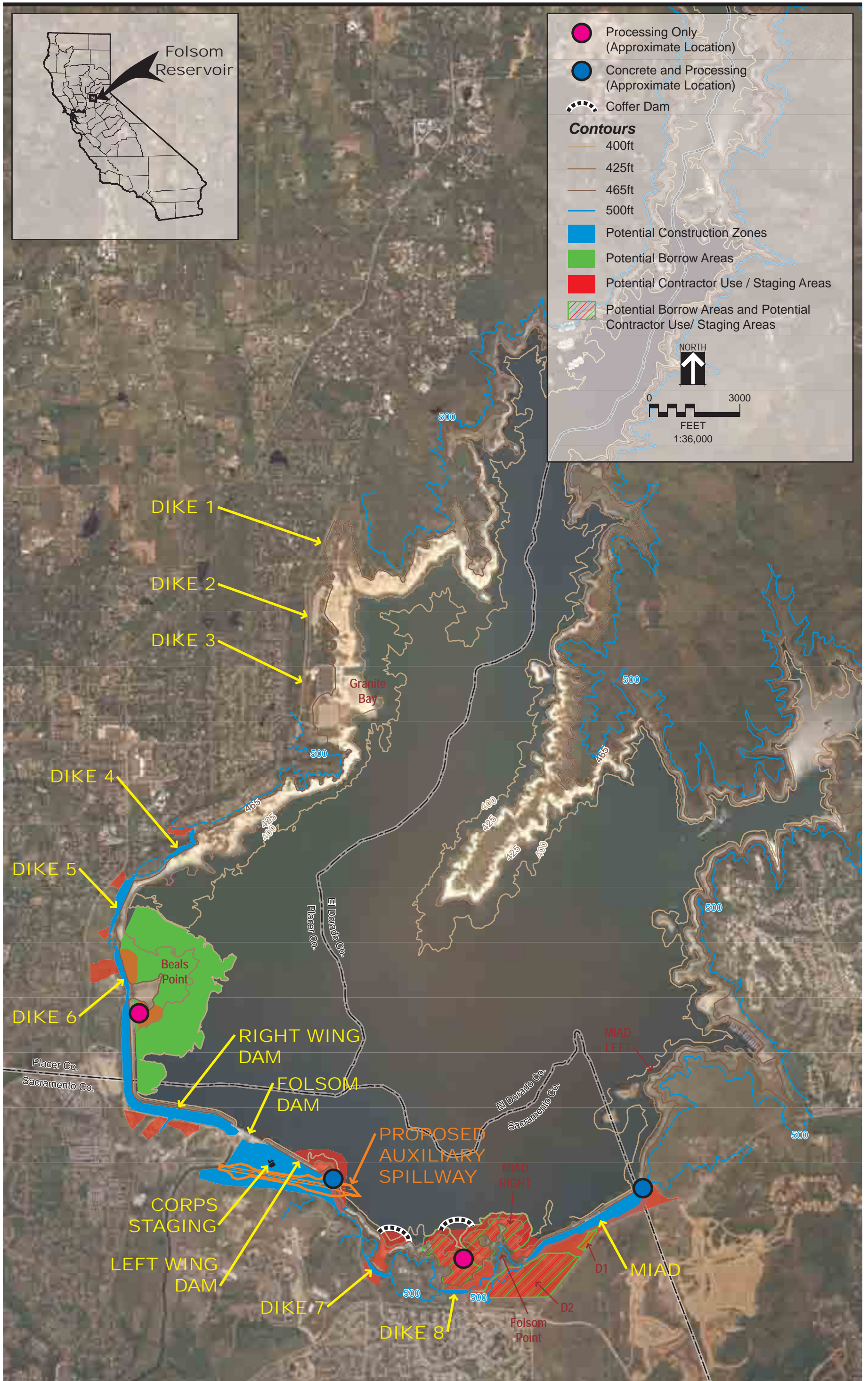


Figure 2-1
 Folsom DS/FDR EIS/EIR
 Alternative 1

This page is left intentionally blank

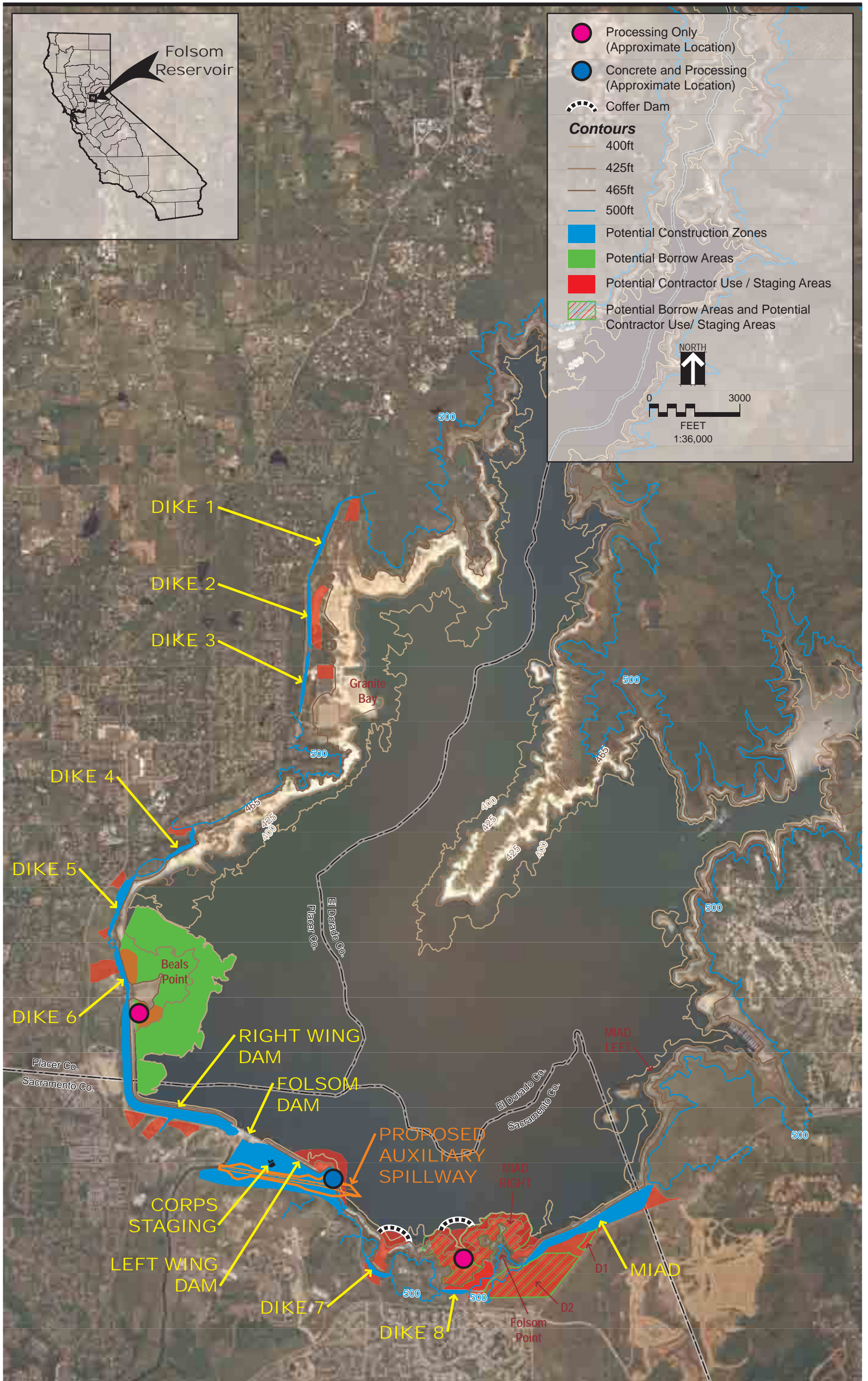


Figure 2-2
 Folsom DS/FDR EIS/EIR
 Alternative 2

This page is left intentionally blank