DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION, CORPS OF ENGINEERS
1455 MARKET STREET
SAN FRANCISCO, CALIFORNIA 94103-1399

REPLY TO
ATTENTION OF

6 Dec 2012

CESPD-PDC

MEMORDANDUM FOR Commander, Sacramento District US Army Corps of Engineers,

Subject: Review Plan Approval For America River Watershed – Folsom Dam Water Contorl Manual Review Plan

1. The attached Review Plan for the America River Watershed – Folsom Dam Water Contorl Manual dated 14 November, 2012 has been prepared in accordance with EC 1165-2-209. The Review Plan has been coordinated internally within the District Support Team and with the Risk Management Center. The Risk Management Center will serve as the Review Management Office.

2. The Review Plan does include independent external peer review.

3. I hereby approve this Review Plan, which is subject to change as circumstances require, consistent with study development under the Project Management Business Process. Subsequent revisions to this Review Plan or its execution will require new written approval from this office.

4. For any additional information or assistance, contact Karen Berresford, District Support Team Lead, (415) 503-6557, Karen.G.Berresford@usace.army.mil.

Encl

MICHAEL C.WEHR, P.E.
BG, USA
Commanding

REVIEW PLAN

American River Watershed Project
Folsom Dam Water Control Manual (WCM) Update

U.S. Army Corps of Engineers
Sacramento District

14 November 2012

MSC Approval Date: PENDING
Last Revision Date: --

US Army Corps
of Engineers ®

REVIEW PLAN

American River Watershed Project
Folsom Dam Water Control Manual (WCM) Update

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1. PURPOSE AND REQUIREMENTS

a. Purpose

This Review Plan (RP), which is a component of the Project Management Plan (PMP), defines the scope and level of quality management activities for the Folsom Dam Water Control Manual (WCM) Update project (project) and all associated documents. The successful completion of the WCM Update will result in an updated Water Control Manual for Folsom Dam and Reservoir, supported by an Engineering Report (ER), as well as all required environmental compliance documentation and economic analysis demonstrating Federal interest in the selected flood risk management operations plan.

b. References

(1) EC 1165-2-209, Civil Works Review Policy, 31 Jan 2010
(2) ER 1110-2-1400, Engineering and Design Reservoir/Water Control Centers, 30 Sep 1993
(3) EM 1110-2-3600, Management of Water Control Systems, 30 Nov 1987
(4) ER 1110-2-240, Water Control Management, 8 Oct 1982
(5) ER 1110-2-241, Use of Storage Allocated for Flood Control and Navigation at Non-Corps Projects, 24 May 1990
(6) ER 1110-2-8156, Preparation of Water Control Manuals, 31 Aug 1995
(7) Project Management Plan for Flood Management Operations Study for Folsom Dam, 2012
(8) ER 1110-1-12, Engineering and Design Quality Management, 21 Jul 2006
(9) EC 1105-2-412, Assuring Quality of Planning Models, 31 Mar 2011
(10) ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 Aug 1999
(11) ER 1110-1-12, Quality Management, 30 Sep 2006
(12) EM 1110-1-1005, Engineering and Design Control and Topographic Surveying, 1 Jan 2007
(13) CESPD-R-2-8, Guidance on the Preparation of Deviations from Approved Water Control Plans, 1 Aug 1999
(14) Folsom Dam and Reservoir, American River, California, Water Control Manual, Dec 1987
(15) CESPD R 1110-1-8, South Pacific Division Quality Management Plan, 14 Dec 1998
(16) CESPD R 1110-1-8, Attachment C, Quality Management of Planning Products, 20 Sep 2004
(17) CESPK-DE, Quality Management Plan for Sacramento District, February 2004

c. Requirements

This RP was developed in accordance with Engineering Circular 1165-2-209 (EC 209), dated 31 Jan 2010, which establishes an accountable, comprehensive, life-cycle review strategy for Civil Works products by providing a seamless process for review of all Civil Works projects from initial planning through design, construction, and operation, maintenance, repair, replacement and rehabilitation (OMRR&R). EC 209 does not explicitly address Water Control Manual updates, but is expected to apply given the cost, complexity and potential controversy associated with the WCM Update for Folsom Dam.

EC 209 outlines four general levels of review: District Quality Control/Quality Assurance (DQC), Agency Technical Review (ATR), Independent External Peer Review (IEPR), and Policy and Legal Compliance Review. The requirements and proposed scope of each of these levels of review for the Folsom Dam WCM Update are described in later sections of this Review Plan.

2. REVIEW MANAGEMENT ORGANIZATION (RMO) COORDINATION

The Review Management Organization (RMO) is responsible for managing the overall peer review effort described in this Review Plan. The RMO responsible for this project will be the USACE Risk Management Center (RMC).

Selection of an Agency Technical Review (ATR) lead will be managed through RMO.

The Independent External Peer Review (IEPR) effort will be managed through the DST.

3. PROJECT INFORMATION

a. Project Description

Folsom Dam and Reservoir are located downstream from the confluence of the north and south forks of the American River, near Folsom, California, about 20 miles northeast of Sacramento, California. 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 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 482.84 feet NAVD (480.5 feet NGVD) above mean seal level (msl). Folsom Reservoir's normal operating pool (Gross Pool) is 966,000 acre-feet (ac-ft) with a surface area of 11,140 acres at a reservoir water surface elevation of 468.34 feet (466.0 NGVD) (Reclamation, Folsom Lake Area and Capacity Tables, 2005). According to the 1987 Water Control Manual, the current maximum allowable water surface elevation (MWSE) of the reservoir pool behind Folsom Dam is 477.74 feet (475.4 feet NGVD), with 5.1 feet of freeboard.

Purpose

A study will be used to develop, evaluate, and recommend changes to the flood management operation of Folsom Dam and Reservoir. The study results will be described in the Manual Update in order to reduce flood risk to the Sacramento area by utilizing its existing and authorized physical features, specifically after completion of the new auxiliary spillway, and through an improved understanding of the American River watershed upstream of Folsom Dam.

SPK will analyze a number of flood risk management operational rule alternatives and the effect of those alternatives on Folsom Dam and Reservoir's other authorized purposes (water supply, power generation, fish and wildlife protection, water quality, recreation, and navigation). The Study results will be described in the Manual Update. The findings of the analysis will be used to define the dam's new flood operation plan, intended to meet the specific flood risk management objectives in a manner that conserves as much water as possible and maximizes all project functions to the extent practicable.

Background

In response to the recognition of the significant flood threat to the Sacramento area, the initial American River Watershed Investigation Feasibility Report (and accompanying EIS/EIR) was completed by the Corps in December 1991. 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 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.

The Sacramento Area Flood Control Agency (SAFCA) studied ways to incrementally reduce flood risk while other studies for a basin-wide solution were being performed. During these studies, it was recognized that existing upstream reservoirs (French Meadows, Hell Hole, and Union Valley) provided some flood management benefits, even though these reservoirs had no dedicated space for flood management. It was determined that a combined volume of 200,000 ac-ft within the three reservoirs could effectively be utilized as incidental storage for flood management purposes.

As such, SAFCA and Reclamation entered into a contract in 1995 which implemented this operation. The Water Resources Development Act of 1996 (WRDA 96) directed the Secretary of the Interior to enter into an agreement with SAFCA to extend the operation agreement "until such time as a comprehensive Flood Risk Management plan for the American River watershed has been implemented".

The Water Resources Development Act of 1999 (WRDA 99) authorized the Folsom Modification project and provided additional direction on reoperation. Congress directed that "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 operation range of 400,000-670,000 acre-feet to 400,000-600,000 acre-feet" [WRDA 99 SEC. 101. (a)(6)(B)] and that the updated flood management plan "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" [WRDA 99 SEC. 101. (a)(6)(E)].

In the Energy and Water Development Appropriations Act (EWDAA) of 2006, Congress directed USACE and Reclamation to collaborate to maximize flood risk management and address dam safety at Folsom Dam. The 2006 EWDAA also directed USACE and Reclamation to consider reasonable modifications to the existing authorized activities, which included an auxiliary spillway. As a result of this collaboration, the Folsom Dam Raise project, along with the Folsom Modifications Project, was reevaluated and the results were described in the Post Authorization Change Report (PACR) for the American River Watershed Project dated March 2007.

This report resulted in the recommendation of a six submerged tainter gate auxiliary spillway, known as the Joint Federal Project (JFP), to be constructed jointly by USACE and Reclamation to achieve both flood management and dam safety objectives.

The JFP is under construction and scheduled to be completed in 2017; the WCM update must be completed by that time to support the flood management capabilities provided by the release capabilities of the new auxiliary spillway. The WCM update will also develop new operational rules to meet dam safety and flood management objectives and comply with federal authorizations and directives.

As the WCM is updated, new technologies will be utilized to assess various components of the new water control plan. Those components include; reflecting operational capabilities of improved weather forecasts; implementation of basin wetness and upstream storage credit parameter(s); development of a risk and uncertainty process for assessing operational uncertainty in project regulation; and utilization of rainfall runoff models to develop inflow hydrographs for determining probabilistic inflows for assessing flood damage reduction determinations of proposed operation sets. These technologies will be developed in full coordination with the Hydrologic Engineering Center (HEC), and the National Weather Service (NWS) as well as USACE project partners (Reclamation, Department of Water Resources, and Sacramento Area Flood Control Agency).

Because Folsom Dam and Reservoir was constructed with Federal Funds provided for flood control and navigation, USACE has authority to prescribe flood control at Folsom Dam and Reservoir in accordance with regulations contained in 33 C.F.R. §208.11 pursuant to the Flood Control Act of 1944. Pub. L. 78-534 §7. Since Congress has already directed the reservoir storage volume to be dedicated to flood control, and it is thought to be sufficient to meet local flood risk reduction objectives, no additional authority is being sought via the WCM update. However, in the absence of a Chief's Report, the WCM update will need to produce a Post-Authorization Change Report that demonstrates the federal interest in the updated flood operations plan, in compliance with ER 1105-2-100.

b. Products to be Developed

The primary products developed by this project include: (1) an updated Water Control Manual for Folsom Dam including a new Water Control Diagram (WCD) and Emergency Spillway Release Diagram (ESRD); (2) an Engineering Report that summarizes the WCM development procedures and decisions; (3) a PACR that demonstrates the federal interest in the updated WCM; and (4) appropriate NEPA/CEQA documentation. Secondary products to be developed by this project are reservoir operations models that may subsequently be used by US Bureau of Reclamation staff to guide revised flood operations established by the new WCD and ESRD, and will be used by Corps water management staff to subsequently oversee the revised operations.

The update to the Folsom Dam and Reservoir WCM is being prepared in accordance with instructions contained in EM 1110-3600, ER 1110-2-240, and ER 1110-2-241, to update the WCM that was published in December 1987. Updates to the WCM will bring information in the manual up to date in order to comply with ER 1110-2-8156.

An Engineering Report will be prepared that will serve as the basis for the update to the WCM, to include revisions to the WCD and ESRD, and its technical basis; including supporting hydrologic, risk and effects analyses, and the evaluation of alternative operations plans. The Engineering Report will be accompanied by a PACR, and all needed NEPA/CEQA compliance documentation.. These documents and supplemental technical documentation are expected to undergo all levels of technical review described in this review plan, and serve as the basis for policy and legal compliance review.

c. Factors Affecting the Scope and Level of Review

Quality control for the WCM Update will be achieved through District Quality Control (DQC), Agency Technical Review (ATR) and a modified Type II Independent External Peer Review (IEPR).

Because this is a flood risk management action, a Type II IEPR will be assessed as part of the Manual Update. However, enen though there will be no decision document produced as part of this effort, there are value added benefits of certain features of a Type I IEPR that will be incorporated into the IEPR assessment for the Manual Update. Further explanation of the levels of review, and the IEPR decision, is provided in the following sections of this review plan.

The factors affecting risk-informed decisions to determine the appropriate scope and level of review are summarized as follows:

Questions to Determine Project Scope	Project: Folsom Dam WCM Update
Will parts of the project be challenging?	Developing a flood management plan and balancing all other authorized project purposes is considered challenging from a technical, resource, and implementation perspective.
What are the likely project risks and the magnitude of the risks?	The WCM update has the potential for partner, stakeholder and public controversy, which will be mitigated through a carefully planned, coordinated, and implemented public involvement program between USACE and its project partners.
Will the project have a significant threat on human life and safety?	Yes. Though, a goal of the WCM update is to improve flood risk reduction and is expected to reduce threats to life and improve public safety.
Will the project involve significant public dispute?	The WCM update has a potential for public (stakeholder, resource agency biological opinions, mitigation cost) dispute.
Will the information in the document be based on novel methods, present complex challenges for interpretation, contain precedent-setting methods or models, or present conclusions that are likely to change prevailing practices?	The WCM update will be based on novel methods, present complex challenges for interpretation, contain precedent-setting methods or models, and present conclusions that are likely to change prevailing practices.
Will the project have significant interagency interest?	A variety of local, State, and Federal agencies will be included as part of the coordination process to develop the WCM update.
Will the project have significant economic environmental or social effects on the nation?	The WCM update may have significant economic and environmental effects. An environmental effects analysis will be conducted as part of the WCM update.
Will the project contain influential scientific information or be a highly influential scientific assessment?	It is anticipated that the WCM update will include influential scientific information (e.g. incorporation of forecasting) and data and information developed from extensive hydraulic and hydrologic data management and modeling.

d. In-Kind Contributions

It is anticipated that all products and analyses provided by non-Federal sponsors as in-kind services are subject to USACE DQC, ATR, and IEPR.

4. DISTRICT QUALITY CONTROL (DQC)

District Quality Control (DQC) is an internal review process of basic science and engineering work products focused on fulfilling the project quality requirements defined in the Project Management Plan (PMP). The Sacramento District will manage the DQC process for this project.

Documentation of DQC activities is required and should be in accordance with the Quality Manual of the District and the home Major Subordinate Command (MSC) - see 1.b (18) and 1.b (16), respectively. Per EC 1165-2-209, Paragraph 8d, for each ATR event, the ATR team will examine relevant DQC records and provide written comment in the ATR report as to the apparent adequacy of the DQC effort.

a. Products to Undergo DQC

Major products to undergo DQC include the draft WCM update, the draft Engineering Report and associated EIS/EIR; the Final Engineering Report and associated EIS/EIR.

Internal peer review of Planning and Environmental products will be carried out by SPK Planning Division staff with appropriate expertise in the study subject prior to each scheduled formal ATR. Ultimately, the Section Chiefs of the Planning Division will be responsible for the technical relevance and appropriateness of the product contents as well as compliance with USACE policy requirements.

Both the WCM update and the associated Engineering Report will undergo a seamless internal review and QA/QC process, which will include a thorough review of the Reservoir Operation Sets (ROS) with HEC-ResSim that are designed to update the WCM.

The internal review and QA/QC for these documents will focus on the following:

- Hydrologic Modeling: Internal DQC of the period of record hydrology (1922-2006); synthetic hydrology (43 exceedence events); a seasonal frequency and critical duration analysis, as well as any other hydrology work completed.
- Hydraulic Modeling: All HEC-RAS and FLO2D outputs will be internally reviewed under the guidelines listed within the Hydraulics Quality Control Plan by a Senior Engineer and back-checked by the Hydraulic Analysis Section Chief.
- Reservoir Modeling: DQC will be performed to assess and compare inflow/outflow relationships and pool elevations. Assuring the modeling output data clearly reflects operational guidelines, release schedule, operating instructions, and computational requirements of the WCD and ESRD. To assess initial states and modeling assumptions about the physical and operational constraints of each model; and to assess the structure and prioritization of operational rule sets developed for each zone.
- Other Modeling: Internal review of any and all output data produced from Engineering or Planning type models such as CalSim, HEC-ResSim, HEC-FIA, HEC-FDA and other models being utilized to assess potential impacts of any particular ROS might have to beneficial uses of Folsom Dam and Reservoir will also be done seamlessly throughout this analysis.

The process for achieving QA/QC of engineering products within the district is described in greater detail in the project's Quality Control Plan (QCP), which is included as an addendum to this Review Plan.

b. Documentation of DQC.

District QC of all study efforts and products, including contract work, will be performed. Coordination of DQC, including documentation and certification, will be the responsibility of technical leads on the (Project Development Team (PDT).

The PDT and DQC members will use DrChecks to document the DQC process. The lead planner or project manager will facilitate the creation of a project portfolio in the system to allow access by all PDT and DQC members. An electronic version of the document, appendices, and any significant and relevant public comments shall be posted in Microsoft Office compatible format and maintained in a USACE SharePoint site prior to the start of the comment period.

The PDT leads will send DQC members individual documents and appendices as necessary, and maintain the documentation, including comments and responses, within the SharePoint site. The PDT leads will gather all responses and the DQC lead will post a revised electronic version of the report and appendices with comments incorporated for use during back-checking of the comments.

The PDT members will contact DQC team members directly, as needed, to seek clarification of a comment's intent or provide clarification of information in the report. DQC team members are also encouraged to contact PDT members via face-to face, email, or phone to seek clarification. DrChecks will only be used for comments and responses on critical questions; it is not required in order to post questions needed for clarification. However, a summary of discussions may be provided in DrChecks.

5. AGENCY TECHNICAL REVIEW (ATR)

ATR is mandatory for all engineering products (including supporting data, analyses, environmental compliance documents, etc.). The objective of ATR is to ensure consistency with established criteria, guidance, procedures, and policy. The ATR team will assess whether the analyses presented are technically correct and comply with published USACE guidance, and that the document explains the analyses and results in a reasonably clear manner for the public and decision makers.

For the Folsom Dam Water Control Manual Update, the ATR will be managed within USACE and will be conducted by a qualified team that is not involved in the day-to-day production of the project and its resultant products. The proposed ATR lead for this project will have expertise in water management and reservoir operations. The ATR lead is responsible for providing information necessary for setting up the review, communicating with the PDT, providing a summary of critical review comments, collecting grammatical and editorial comments from the ATR team, ensuring that the ATR team has adequate funding to perform the review, facilitating the resolution of the comments, and certifying that the ATR has been conducted and resolved in accordance with policy.

ATR will be conducted for project planning, environmental compliance, economics, hydrology and reservoir operations, hydraulic design, and cost engineering; reviews of more specific disciplines may be identified if necessary.

a. Products to Undergo ATR.

Products to undergo ATR include the draft WCM update, the draft Engineering Report and associated EIS/EIR; and the Final Engineering Report and associated EIS/EIR.

b. Required ATR Team Expertise.

ATR teams will be comprised of senior USACE personnel and may be supplemented by outside experts as appropriate.

ATR Team Members/Disciplines	Expertise Required
ATR Lead	The ATR lead should be a senior professional with extensive experience in water management and conducting ATR. The lead should also have the necessary skills and experience to lead a virtual team through the ATR process. The ATR lead may also serve as a reviewer for a specific discipline (such as planning, economics, environmental resources, risk analysis, etc).
Planning CalSim II	Team member will be experienced with the civil works process, reservoir projects, current flood damage reduction planning and policy guidance, and planning in a collaborative environment.
Economics HEC FDA SWP Power CalSim II SWAP IMPLAN OMWEM	Team member will be experienced in civil works and related flood risk reduction projects, and have a thorough understanding of HEC-FDA, CalSim II and other economic modeling tools as necessary. Additionally, the team member will have knowledge in water and power economics in

LT_Gen ARHEM	California.
Environmental Resources Delta Simulation Model II Reclamation Temperature Reclamation Fish Mortality	Team Member will have extensive experience in compliance requirements for NEPA, CEQA, the Endangered Species Act, and the Clean Water Act, as well as other pertinent environmental laws and regulations. Strong understanding of flood management operations at dams and how they relate to other project purposes of a multi-purpose dam, such as water supply, recreation, and power generation. In addition, the reviewer should be familiar with environmental resources in the Lower American River watershed, and to a lesser degree, resources in the Sacramento/San Joaquin River watersheds, including the Delta.
Hydrology HEC-HMS	Team member will be experienced with hydrological analysis techniques for dam operation studies, including annual and seasonal duration frequency analyses (per Bulletin 17B methodology), computation of unregulated flows, distribution of flow throughout a reservoir network, and critical duration determination. An understanding of rainfall-runoff modeling for both planning studies and real-time operations with incorporation of forecasts is also required.
Hydrologic Engineering HEC-HMS HEC-ResSim	Team member will have a thorough understanding of the field of reservoir operations and modeling, water and power generation and distribution in the western United States. The team member will have an understanding of computer modeling techniques that will be used for this project (HEC-ResSim, CalSim II). Additionally, the team member must have some knowledge of the application of NWS-RFC forecast technologies and their application in flood control operations.
Reservoir Operations HEC ResSim CalSim II	Team member will be experienced with the operational requirements of Folsom Dam, from both a flood management and water supply perspective. Additionally, the team member must have in-depth knowledge of NWS-RFC forecast technologies and their application in flood control operations.
Risk Analysis	Team member will have experience with HEC-led strategies for analyzing risk and uncertainty.

c. Documentation of ATR.

DrChecks review software will be used to document all ATR comments, responses and associated resolutions accomplished throughout the review process. Comments should be limited to those that are required to ensure adequacy of the product. The four key parts of a quality review comment will normally include:

(1) The review concern – identify the product's information deficiency or incorrect application of policy, guidance, or procedures;
(2) The basis for the concern – cite the appropriate law, policy, guidance, or procedure that has not be properly followed;
(3) The significance of the concern – indicate the importance of the concern with regard to its potential impact on the plan selection, recommended plan components, efficiency (cost), effectiveness (function/outputs), implementation responsibilities, safety, Federal interest, or public acceptability; and
(4) The probable specific action needed to resolve the concern – identify the action(s) that the reporting officers must take to resolve the concern.

In some situations, especially addressing incomplete or unclear information, comments may seek clarification in order to then assess whether further specific concerns may exist.

The ATR documentation in DrChecks will include the text of each ATR concern, the PDT response, a brief summary of the pertinent points in any discussion, including any vertical team coordination (the vertical team includes the district, DST, MSC, and HQUSACE), and the agreed upon resolution.

If an ATR concern cannot be satisfactorily resolved between the ATR team and the PDT, it will be elevated to the vertical team for further resolution in accordance with the policy issue resolution process described in either ER 1110-1-12 or ER 1105-2-100, Appendix H, as appropriate. Unresolved concerns can be closed in DrChecks with a notation that the concern has been elevated to the vertical team for resolution.

At the conclusion of each ATR effort, the ATR team will prepare a Review Report summarizing the review. Review Reports will be considered an integral part of the ATR documentation and shall:

- Identify the document(s) reviewed and the purpose of the review;
- Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;
- Include the charge to the reviewers;
- Describe the nature of their review and their findings and conclusions;
- Identify and summarize each unresolved issue (if any); and
- Include a verbatim copy of each reviewer's comments (either with or without specific attributions), or represent the views of the group as a whole, including any disparate and dissenting views.

ATR may be certified when all ATR concerns are either resolved or referred to the vertical team for resolution and the ATR documentation is complete. The ATR Lead will prepare a Statement of Technical Review certifying that the issues raised by the ATR team have been resolved (or elevated to the vertical team). A Statement of Technical Review should be completed, based on work reviewed to date, for the AFB, draft report, and final report. A sample Statement of Technical Review is included in Attachment 2.

6. INDEPENDENT EXTERNAL PEER REVIEW (IEPR)

IEPR may be required for specific Engineering Reports and technical work under certain circumstances. IEPR is the most independent level of review, and is applied in cases that meet certain criteria where the risk and magnitude of the proposed project are such that a critical examination by a qualified team outside of USACE is warranted. A risk-informed decision, as described in EC 1165-2-209, is made as to whether IEPR is appropriate.

There are two types of IEPR:

- Type I IEPR. Type I IEPR reviews are managed outside the USACE and are conducted on project studies. Type I IEPR panels assess the adequacy and acceptability of the economic and environmental assumptions and projections, project evaluation data, economic analysis, environmental analyses, engineering analyses, formulation of alternative plans, methods for integrating risk and uncertainty, models used in the evaluation of environmental impacts of proposed projects, and biological opinions of the project study. Type I IEPR will cover the entire

Engineering Report or action and will address all underlying engineering, economics, and environmental work, not just one aspect of the study. For Engineering Reports where a Type II IEPR (Safety Assurance Review) is anticipated during project implementation, safety assurance shall also be addressed during the Type I IEPR per EC 1165-2-209.

- Type II IEPR. Type II IEPR, or Safety Assurance Reviews (SAR), are managed outside the USACE and are conducted on design and construction activities for hurricane, storm, and flood risk management projects or other projects where existing and potential hazards pose a significant threat to human life. Type II IEPR panels will conduct reviews of the design and construction activities prior to initiation of physical construction and, until construction activities are completed, periodically thereafter on a regular schedule. The reviews shall consider the adequacy, appropriateness, and acceptability of the design and construction activities in assuring public health safety and welfare.

a. Decision on IEPR.

Changes to water control manuals are not in itself a cause for Type I IEPR. However, to be thorough in its review, components of a Type I IEPR will be added to the review process for the Manual Update because of its complexity, along with precedent-setting development and application of software models that will be used to change prevailing reservoir operation practices. This project has the potential to be controversial and may have significant agency and public interest. Since this is a flood risk management action, the importance of the life safety component of the Type II IEPR will be addressed within a complete and formal Type II review. What is proposed is that the Type II IEPR panel will be given the added Type I charge to review "the entire Engineering Report or action and will address all underlying engineering, economics, and environmental work, not just on aspect of the study" Incorporating the Type I SAR requirements into the Type II IEPR process should result in increased overall project efficiency without compromising the intent or integrity of either type of review. This is largely due to the fact that unlike many USACE projects, the independent expertise needed to conduct a Type I IEPR includes all the disciplines needed to conduct a Type II IEPR as well.

EC 1165-2-209 states thresholds that trigger an IEPR: "In cases where there are public safety concerns, a high level of complexity, novel or precedent-setting approaches; where the project is controversial, has significant interagency interest, has a total project cost greater than $45 million, or has significant economic, environmental and social effects to the nation, IEPR will be conducted."

The disciplines and expertise required of the IEPR team are listed in the table below.

b. Products to Undergo IEPR.

Products to undergo IEPR include the draft WCM update, the draft Engineering Report, and all associated environmental documents (EIS/EIR).

c. IEPR Panel Expertise.

IEPR panels will consist of independent, recognized experts from outside of the USACE in the appropriate disciplines, representing a balance of areas of expertise suitable for the review being conducted.

IEPR Team Members/Disciplines	Expertise Required
Planning CalSim II	Team member will be experienced with the civil works process, reservoir operations, current flood damage reduction planning and policy guidance, and planning in a collaborative environment.

Economics HEC FDA SWP Power CalSim II SWAP IMPLAN OMWEM LT_Gen ARHEM	Team member will be experienced in civil works and related flood risk reduction projects, and have a thorough understanding of HEC-FDA, CalSim II and other economic modeling tools as necessary. Additionally, the team member will have knowledge in water and power economics in California.
Environmental Resources Delta Simulation Model II Reclamation Temperature Reclamation Fish Mortality	Team Member will have extensive experience in compliance requirements for NEPA, CEQA, the Endangered Species Act, and the Clean Water Act, as well as other pertinent environmental laws and regulations. Strong understanding of flood management operations at dams and how they relate to other project purposes of a multi-purpose dam, such as water supply, recreation, and power generation. In addition, the reviewer should be familiar with environmental resources in the Lower American River watershed, and to a lesser degree, resources in the Sacramento/San Joaquin River watersheds, including the Delta.
Hydrology HEC-HMS	Team member will be experienced with hydrological analysis techniques for dam operations studies, including annual and seasonal duration frequency analyses (per Bulletin 17B methodology), computation of unregulated flows, distribution of flow throughout a reservoir network, and critical duration determination. An understanding of rainfall-runoff modeling for both planning studies and real-time operations with incorporation of forecasts is also required.
Hydrologic Engineering HEC-HMS HEC-ResSim	Team member will have a thorough understanding of the field of reservoir operations and modeling, water and power generation and distribution in the western United States. The team member will have an understanding of computer modeling techniques that will be used for this project (HEC-ResSim, CalSim II). Additionally, the team member must have knowledge of the application of NWS forecast technologies and their application in flood control operations.
Reservoir Operations HEC ResSim CalSim II	Team member will be experienced with reservoir operations, from both a flood management and water supply perspective. Additionally, the team member must have knowledge of the application of NWS forecast technologies and their application in flood management operations.

d. IEPR Documentation of.

The IEPR panel will be selected and managed by an Outside Eligible Organization (OEO) per EC 1165-2-209; Appendix D. Panel comments will be compiled by the OEO and should address the adequacy and acceptability of the economic, engineering and environmental methods, models, and analyses used. IEPR comments should generally include the same four key parts as described for ATR comments in Section 3.c of this Review Plan.

The OEO will prepare a final Review Report that will accompany the publication of the final Engineering Report and shall:

- Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;
- Include the charge to the reviewers;
- Describe the nature of their review and their findings and conclusions; and

- Include a verbatim copy of each reviewer's comments (either with or without specific attributions), or represent the views of the group as a whole, including any disparate and dissenting views.

The final Review Report will be submitted by the OEO no later than 60 days following the close of the public comment period for the draft documents. USACE shall consider all recommendations contained in the Review Report and prepare a written response for all recommendations adopted or not adopted. The final documents will summarize the Review Report and USACE response. The Review Report and USACE response will be made available to the public, including through electronic means on the internet.

7. POLICY AND LEGAL COMPLIANCE REVIEW

Value Engineering (VE) identifies the function(s) of a product or service; identifies monetary value for that function; and provides the necessary function reliability at the lowest overall cost. Because the Manual update is documentation of an internal business process and is neither a project nor a decision document, a VE study is not required for the Manual Update.

The Engineering Report will be reviewed throughout the study process for its compliance with law and policy. Guidance for policy and legal compliance reviews is addressed in Appendix H, ER 1105-2-100. These reviews culminate in determinations that the recommendations in the reports and the supporting analyses and coordination comply with law and policy, and warrant approval or further recommendation to higher authority by the home MSC Commander.

Approval authority for WCM updates has been delegated to the MSC level by ER 1110-2-1400, which also established Water Control Centers (WCC's) at the MSC level throughout USACE. WCC's have been delegated a high degree of responsibility and authority with respect to all phases of water control management, including WCM review and approval. However, revised WCM's containing changes to the water control plan (i.e. WCD and ESRD), must be sent to HQUSACE for review and comment prior to MSC approval.

Policy and legal compliance review on this project will be achieved through a series of draft Engineering Report submittals to the DST and subsequent requests for HQUSACE review and comment. Three sequential reviews over the course of the project are planned in order to assure policy compliance before the WCM and associated Engineering Report are finalized and approved. Each of these policy and legal compliance reviews will occur after ATR of the same products. The final policy and legal compliance review is planned to occur after IEPR comments have been received.

8. COST ENGINEERING DIRECTORY OF EXPERTISE (DX) REVIEW AND CERTIFICATION

Not Applicable. No cost estimates for additional project features are expected to be developed as part of this project.

9. MODEL CERTIFICATION AND APPROVAL

a. Planning and Economic Models.

EC 1105-2-412 mandates the use of certified or approved models for all planning activities to ensure the models are technically and theoretically sound, compliant with USACE policy, computationally accurate, and based on reasonable assumptions.

The following planning and economic models will be used in the development of the engineering report:

Model Name and Version	Brief Description and Application of the Model
The California Water Resources Simulation Model applied to the SWP-CVP system (CalSim II)	CalSim II simulates operations of the SWP, CVP, and other facilities in the Central Valley and approximates changes in river flows and exports from the Delta. The principal results of interest for this phase of evaluation are changes to: (1) Sacramento River flows, (2) exports and south Delta flows, and (3) reservoir storage conditions associated with the assumed operation of the BDCP simulated scenarios.
Delta Simulation Model II (DSM2)	DSM2 is a one-dimensional hydrodynamic and water quality simulation model used to simulate hydrodynamics, water quality, and particle tracking. It describes the existing conditions in the Delta, as well as performs simulations for the assessment of incremental environmental impacts caused by facilities and operations. DSM2 uses flow data generated from CalSim II outputs and is simulated on a 15-minute time step to address the changing tidal dynamics of the Delta system.
Reclamation Monthly Temperature Model - Sacramento River Basin (Reclamation Temperature)	This model predicts the effects of operations on water temperatures in the Sacramento, Feather, Stanislaus, and American river basins and upstream reservoirs. The model simulates monthly reservoir and stream temperatures used for evaluating the effects of SWP and CVP operations on mean monthly water temperatures in the basin based on hydrologic and climatic input data. The model uses CalSim II output to simulate mean monthly vertical temperature profiles and release temperatures for six major reservoirs (Trinity, Whiskeytown, Shasta, Oroville, Folsom, and New Melones); four downstream regulating reservoirs (Lewiston, Keswick, Natoma, and Goodwin); and four main river systems (Sacramento, Feather, American, and Stanislaus).
Reclamation Fish Mortality Model	This model applies to early life stages of Chinook Salmon. The model uses average monthly temperatures predicted by Reclamation's temperature model to estimates mortality of Chinook Salmon pre-spawned eggs, incubated embryos, and alevins.
IMPLAN	IMPLAN develops input-output estimates of the economic impacts of various activities. For water resources planning, IMPLAN estimates the income and employment effects upon local communities from water project construction and the regional effects of water transfers. Key modeling inputs for IMPLAN include output from the recreation economics analysis, CVPM, LCPSIM, and LCRBWQM.
Reclamation Long Term-GEN (LT_GEN)	LT-GEN is a CVP power model that estimates the CVP power generation, capacity, and project use based on the operations defined by a CalSim II simulation. The LT-GEN Model computes monthly power generation, capacity, and project use (pumping plant demand) for each CVP power facility for each month of the CalSim II simulation. Monthly estimates of power generation and loads for CVP facilities; simplified factors used to separate peak and non-peak generation and load; estimate of net-revenue based on price forecasts
State Water Project Power Model (SWP POWER)	SWP Power is an SWP power model that estimates the SWP power generation, capacity, and project use based on the operations

	defined by a CalSim II simulation. The SWP Power Model computes monthly power generation, capacity, and project use (pumping plant demand) for each SWP power facility for each month of the CalSim II simulation. Monthly estimates of power generation and loads for SWP facilities; simplified factors used to separate peak and non-peak generation and load; estimate of net-revenue based on price forecasts
SWAP	Agricultural Water Supply economic model
Least Cost Planning Simulation Model (LCPSIM)	Urban economics model to determine least cost solution for supply/demand balance for the South Bay and South Coast regions.
Other Municipal Water Economics Model (OMWEM)	Urban water supply valuation for other urban areas utilizing assumptions associated with availability of surface and groundwater supplies
American River Hydrologic-Economics Model (ARHEM) v.1.0	A water supply economics model of Lower American River M&I water users. The outputs from this model will include changes in average annual deliveries and cost. This model is currently under development.
SWAP (v5.0) (Statewide Agricultural Planning Model)	Agricultural production economic model for the Central Valley and some areas outside of the Central Valley; analysis uses a one or multiple set of sample years; considers availability of surface and groundwater supplies
HEC-FDA 1.2.5a (Hydrologic Engineering Center- Flood Damage Analysis)	Flood risk management economics model that integrates hydrologic engineering and economic analysis. USACE Certified

The PDT, district, and division will determine the appropriate level of model certification or one-time use approval for these models. Once an acceptable approach has been identified, this Review Plan will be updated to reflect that approach, including model review costs and schedule.

As the model accepted by the community of water purveyors, water rights, and contract holders, CalSim II is the system model that is used for most interregional and statewide analyses of SWP/CVP water allocations in California and will be used in this analysis to evaluate the effects of flood operation rules on the beneficial uses of water supply provided by Folsom Dam and Reservoir. There is no other model currently available that provides the necessary coverage for evaluating changes to water allocation in the CVP/SWP system.

Currently, CalSim II; DSM2; Reclamation Monthly Temperature Model - Sacramento River Basin; Reclamation Fish Mortality Model; IMPLAN; Reclamation Long Term-GEN; SWP POWER; and SWAP are all models commonly used by water resource management agencies in California, such as Reclamation and DWR, in the planning of proposed changes to water resources management operations, particularly in relation to CVP and SWP issues. As such, the use and output of these models is familiar to the resource agencies (i.e., USFWS, NMFS, CDFG, etc…) and stakeholders involved in this study.

The other models listed above were developed to accept CalSim II model outputs and translate those outputs into parameter valuations of other pertinent resources, such as power generation, water quality, fisheries habitat condition, and economic effects to M&I and agricultural water supply uses.

b. Engineering Models.

The review and approval of engineering models are addressed in ER 1110-2-1150. The responsible use of well-known and proven USACE-developed and commercial engineering software will continue and the professional practice of documenting the application of the software and modeling results will be followed.

As part of the USACE Scientific and Engineering Technology (SET) Initiative, many engineering models have been identified as preferred or acceptable for use on USACE studies and these models should be used whenever appropriate. The selection and application of the model and the input and output data is still the responsibility of the users and will be subject to DQC, ATR, and IEPR.

The following engineering models will be used in the process of the water control manual update. Data and information developed from each of these models will be thoroughly reviewed via Reclamation, Department of Water Resources, and SAFCA and will each go through USACE's DQC, ATR, and IEPR process as defined within this Review Plan.

Model Name and Version	Brief Description of the Model and How It Will Be Applied in the Study	Approval Status
HEC-ResSim (Reservoir System Simulation)	HEC-ResSim is the successor to the "HEC-5, Simulation of Flood Control and Conservation Systems" program (HEC, 1998). ResSim is a computational program used; to simulate reservoir operation, for data storage and management capabilities, and for graphics and reporting facilities. The program will be used to model proposed operation schemes to evaluate each scheme and determine how best to operate Folsom Dam in the interest of all of its operational requirements.	HEC-ResSim is an HH&C CoP Preferred Model
HEC-RAS (River Analysis System)	HEC-RAS is the Hydrologic Engineering Center's River Analysis System that performs one-dimensional steady flow, unsteady flow, sediment transport/mobile bed computations, and water temperature modeling. HEC-RAS will be used to assess and compare water surface profiles created by each reservoir operation set against other previously compiled water surface profiles of current studies within the American River Watershed.	HEC-ResSim is an HH&C CoP Preferred Model

10. REVIEW SCHEDULES AND COSTS

a. ATR Schedule and Cost.

The estimated schedule for ATR is as follows:

Product or Decision	Scheduled Review Time	Suspense
ATR team identified	3 weeks	Sep '13
Submit admin draft for ATR, Office of Counsel and Sponsor review	6 weeks	Oct '13, June '15, Sep '15
PDT back check and comment response to ATR, Office of Counsel and Sponsor review	4 weeks	Nov '13, July '15, Oct '15
ATR back check and close out of comment responses	2 weeks	Dec '13, July '15, Oct '15
Engineering Report update/Commander's	1 week	Dec '16

Concurrence (SIGNATURE)		

The estimated cost for the ATR effort is $100,000. The ATR budget includes participation of the ATR lead in milestone conferences to address the ATR process and any significant and/or unresolved ATR concerns.

b. IEPR Schedule and Cost.

The IEPR panel review of documents should be scheduled for no less than 15 weeks from the OEO contract Notice to Proceed to the submittal of the final Review Report by the OEO. The cost to contract the IEPR panel is funded with 100% federally appropriated funds, but must be budgeted as part of the project cost. The cost for the DST to facilitate the IEPR and for the PDT to respond to the IEPR recommendations will vary and is cost shared amongst USACE and its project partners.

The estimated schedule for IEPR is as follows:

Product or Decision	Scheduled Review Time	Suspense
SPD/HQ review of Draft Engineering Report and WCM	9 weeks	Feb ’14, Oct ’15, Dec ‘15
Initiate seamless IEPR Receipt of interim IEPR report Receipt of final IEPR report	60 weeks 8 weeks 2 weeks	Sep ‘15 Nov ‘15 May ‘16
Final Engineering Report and WCM	n/a	Dec ‘16

IEPR will be a federally funded project cost, currently estimated to be $500,000. In-house costs associated with obtaining the IEPR panel contract, as well as responding to IEPR comments, will be cost shared expenses. It is not anticipated that the public, including scientific or professional societies, will be asked to nominate potential external peer reviewers.

The budget for IEPR includes participation of an IEPR panel member and/or OEO representative at the Civil Works Review Board meeting (CWRB) where comments and responses will be discussed.

11. PUBLIC PARTICIPATION

The public and agencies will have opportunities to participate in this study, as part of the public scoping process required by the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA). Public scoping meetings will be held to solicit public and agency input on the proposed Federal action. In addition, a stakeholder assessment plan has been developed to engage stakeholders and agencies most directly affected by this study. The public scoping and stakeholder assessment will be used to refine a public involvement plan being developed for this effort and to be implemented during the course of the study.

Public review of the draft EIS/EIR will occur after concurrence that the document is ready for public release. Public review of the draft report will begin approximately one month after the completion of the ATR process and policy guidance memo. The review period will last a minimum of 45 days, as required by NEPA. One or more public workshops will be held during the public and agency review period. Comments received during the public comment period for the draft report will be provided to the IEPR team prior to completion of the final Review Report and to the ATR team before review of the final Engineering Report and associated EIS/EIR.

Upon completion of the review period, comments will be consolidated in a matrix and addressed, as appropriate. A comment resolution meeting will take place if needed. A summary of the comments and resolutions will be included in the draft Final EIS/EIR. The draft Final EIS/EIR will go through ATR along with the final Engineering Report and Economic Analysis. The PDT will then submit the Final EIS/EIR for formal State and Agency review concurrently with a 30-day public review.

12. REVIEW PLAN APPROVAL AND UPDATES

The South Pacific Division (SPD) Commander is responsible for approving this Review Plan. The Commander's approval reflects vertical team input (involving district, MSC, DST, and HQUSACE members) as to the appropriate scope and level of review for the Engineering Report. Like the PMP, the Review Plan is a living document and may change as the study progresses. The Sacramento District is responsible for keeping the Review Plan up to date. Minor changes to the review plan since the last MSC Commander approval are documented in Attachment 3. Significant changes to the Review Plan (such as changes to the scope and/or level of review) should be re-approved by the MSC Commander following the process used for initially approving the plan. The latest version of the Review Plan, along with the Commanders' approval memorandum, should be posted on the Home District's webpage. The latest Review Plan should also be provided to the RMO and home MSC.

13. REVIEW PLAN POINTS OF CONTACT

Public questions and/or comments on this review plan can be directed to the following points of contact:

Sacramento District Planning Division Point of Contact: Mr. Arturo Ceballos, 916-557-5297
Sacramento District Engineering Division Point of Contact: Mr. Kyle Keer, 916-557-7105
MSC (South Pacific Division) and DST Point of Contact: Ms. Karen Berresford, 415-503-6557

ATTACHMENT 1: TEAM ROSTERS

Team	Name	Discipline	Phone	Email
PDT	Angela De Paoli	Project Manager	(916) 557-6782	Angela.L.DePaoli@usace.army.mil
PDT	Scott Parker	Planning	(916) 557-7258	W.Scott.Parker@usace.army.mil
PDT	Arturo Ceballos	Planning Lead	(916) 557-5297	Arturo.Ceballos@usace.army.mil
PDT	Dan Artho	Environmental Analysis	(916) 557-7723	Daniel.F.Artho@usace.army.mil
PDT	Lisa Eckert	Environmental Analysis	(916) 557-6688	Lisa.E.Eckert@usace.army.mil
PDT	Kyle Keer (TL)	Reservoir Operations	(916) 557-7105	Kyle.J.Keer@usace.army.mil
PDT	Dean McLeod	Economics	(916) 557-7436	Dean.M.McLeod@usace.army.mil
PDT	Brian Walker	Hydrology	(916) 557-7376	Brian.Walker@usace.army.mil
PDT	Brad Moore	Risk Analysis	(916) 557-7114	Brad.M.Moore@usace.army.mil
DQC	Wayne Johnson	Reservoir Operations	(916) 557-7139	Wayne.L.Johnson@usace.army.mil
DQC	Lisa Clay	Office of Counsel	(916) 557-5295	Lisa.H.Clay@usace.army.mil
DQC	Marty Eisenman	Technical Writer	(916) 557-7125	Marty.H.Eisenman@usace.army.mil
ATR	TBD	ATR Lead		
ATR	TBD	Planning		
ATR	TBD	Economics		
ATR	TBD	Environmental Resources		
ATR	TBD	Hydrology		
ATR	TBD	Hydrologic Engineering		
ATR	TBD	Reservoir Operations		
ATR	TBD	Risk Analysis		
ATR	TBD	Planning		
ATR	TBD	Economics		
ATR	TBD	Environmental Resources		
ATR	TBD	Hydrology		
ATR	TBD	Hydrologic Engineering		
ATR	TBD	Reservoir Operations		
DST	Karen Berresford	District Support Team Lead	(415) 503-6557	Karen.G.Berresford@usace.army.mil
RMO	TBD	Risk Management Center		

ATTACHMENT 2: COMPLETION OF AGENCY TECHNICAL REVIEW

COMPLETION OF AGENCY TECHNICAL REVIEW

The Agency Technical Review (ATR) has been completed for the Folsom Dam Water Control Manual Update. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-209. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing U.S. Army Corps of Engineers policy. The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be appropriate and effective. All comments resulting from the ATR have been resolved and the comments have been closed in DrChecks[sm].

TBD Agency Technical Review Lead IWR-HEC	Date
Angela De Paoli Project Manager CESPK-PM	Date
Karen Berresford District Support Team Lead CESPD	Date

CERTIFICATION OF AGENCY TECHNICAL REVIEW

All concerns resulting from the Agency Technical Review of this project have been fully resolved.

Rick Poeppelman Chief, Engineering Division CESPK-ED	Date
Alicia Kirchner Chief, Planning Division CESPK-PD	Date

ATTACHMENT 3: REVIEW PLAN REVISIONS

Revision Date	Description of Change	Page / Paragraph Number

ATTACHMENT 4: ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations

°F	degrees Fahrenheit
2003 LRR	Folsom Dam Modification Project Final Limited Reevaluation Report
400 Fixed	400 Fixed Flood Control Diagram
400/600 Variable	Variable 400/600 Flood Control Diagram
400/670 Variable	Variable 400/670 Flood Control Diagram
500/800 Variable	Variable 500/800 Flood Control Diagram
1944 FCA	Flood Control Act of 1944
1991 Feasibility Report	American River Watershed Investigation Feasibility Report of 1991
1996 SIR	1996 American River Watershed, California, Supplemental Information Report
1999 WRDA	Water Resources Development Act of 1999

A.

AAHU	annual average habitat unit
AAR	after action review
A/E	architecture and engineering
AEP	annual exceedence probability
af	acre-foot, acre-feet,
AFB	alternatives formulation briefing
AFRP	Anadromous Fish Restoration Program
AHPS	Advance Hydrologic Prediction System
ALT670	Interim Reoperation of Folsom Dam and Reservoir to a Maximum of 670,000 acre-feet of flood control space
ALT800	Interim Reoperation of Folsom Dam and Reservoir to a Maximum of 800,000 acre-feet of flood control space
APE	area of potential effects
AQAP	air quality attainment plan
AR	American River
ARBDA	American River Basin Development Act
AROG	American River Operations Group

ARWEC	American River Watershed Education Center
ARWI	American River Watershed Investigation
ARWP	American River Watershed Project
ASA(CW)	Assistant Secretary of the Army, Civil Works
ATR	U.S. Army Corps of Engineers Agency Technical Review
ATRT	U.S. Army Corps of Engineers Agency Technical Review Team

B

(b)(2) water	dedicated and managed water from implementation of Central Valley Improvement Act Section 3406(b)(2)
BA	biological assessment
Bay-Delta	San Francisco Bay - Sacramento – San Joaquin River Delta Estuary
BCA	benefit-cost analysis
BDCP	Bay Delta Conservation Plan
BMP	best management practice
BO	biological opinion

C

CAAQS	California Ambient Air Quality Standards
CALFED	California Federal Bay-Delta Program
CAP	Continuing Authorities Program
CAR	coordination act report
CARB	California Air Resources Board
CCAA	California Clean Air Act
CDC	Climate Data Center
CDFG	California Department of Fish and Game; see also DFG
CEFMS	Corps of Engineer Financial Management System
CE/ICA	cost effectiveness/incremental cost analysis
Center	Center for Collaborative Policy
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensations, and Liability Act
CESA	California Endangered Species Act

CESPD	Corps of Engineers South Pacific Division
CESPD-ET-P	Corps of Engineers South Pacific Division, Planning Division; see also SPD
CESPK	Corps of Engineers Sacramento District; see also District
CESPK-ED-D	Engineering Division—Design Branch
CESPK-ED-E	Engineering Division—Environmental Engineering Branch
CESPK-ED-G	Engineering Division—Geotechnical Engineering Branch
CESPK-ED-H	Engineering Division—Hydraulics and Hydrology Branch
CESPK-ED-S	Engineering Division—Engineering Support Branch
CESPK-PD-R	Planning Division—Environmental Resources Branch
CESPK-PD-W	Planning Division—Water Resources Branch
CESPK-PM-C	Project Management Division—Civil Works Branch
CESPK-RD	Regulatory Division
CESPK-RE	Real Estate Division
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIP	capital improvement program
CMR	Command Management Review
CNP	conditional non-exceedence probability (Note: consider CNE for conditional non-exceedence
CNRFC	California Nevada River Forecast Center
CO	carbon monoxide
COA	coordinated operations agreement
Common Features	American River Common Features Project
Corps	U.S. Army Corps of Engineers
CSPA	California Sport-Fishing Protection Alliance
CVFPB	Central Valley Flood Protection Board
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVP-OCAP	Central Valley Project Operations Criteria and Plan
CWA	Clean Water Act

D

D-893	State Water Resources Control Board Decision 893
D-1485	State Water Resources Control Board Decision 1485
D-1594	State Water Resources Control Board Decision 1594
D-1641	State Water Resources Control Board Decision 1641
DDR	design documentation report
DEIS/EIR	draft environmental impact statement / environmental impact report
Delta	Sacramento-San Joaquin River Delta Estuary
DFG	California Department of Fish and Game; see also CDFG
District	Corps Sacramento District; see also CESPK
DPR	California Department of Parks and Recreation
DODAA	Department of Defense Appropriations Act
DQC	District Quality Control (Corps)
DR	dam raise
DrChecks	Design Review and Checking System
DST	District Support Team
DWR	California Department of Water Resources
DX	Department of Expertise

E

EA	environmental assessment
EBMUD	East Bay Municipal Utility District
EBRPD	East Bay Regional Parks District
EC	Engineering Circular
Econ	economics
ED	U.S. Army Corps of Engineers, Sacramento District, Engineering Division
EDF	Environmental Defense Fund
EDR	engineering documentation report
EDS&A	Engineering, Design, Supervision, and Administration
E/I Ratio	ratio of Delta exports to water inflow to the Delta, expressed by percentage

EID	El Dorado Irrigation District
EIR	environmental impact report
EIS	environmental impact statement
elevation xxx	elevation in feet above mean sea level
EM	Engineering Manual
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPR	external peer review
EQ	environmental quality
ERDC	Engineer Research and Development Center (Corps Lab)
ESA	Endangered Species Act; environmental site assessment
ESRD	emergency spillway release diagram
ESU	evolutionarily significant unit
EWDAA	Energy and Water Development Appropriations Act

F

FACA	Federal Advisory Committee Act
FAQ	Frequently asked questions
FCA	Flood Control Act
FCAA	Federal Clean Air Act
FCD	flood control diagram
FCSA	feasibility cost sharing agreement
FDA	flood damage assessment
FDR	flood damage reduction
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIO	forecast informed operations
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FLSRA	Folsom Lake State Recreation Area
FMS	flow management standard

Folsom Reop	Interim Reoperation of Folsom Dam and Reservoir
FONSI	finding of no significant impact
FOR	Friends of the River
FPMS	Flood Plain Management Services Program
FRM	Flood Risk Management
FSG	Formulation Strategy Group
FWCAR	U.S. Fish and Wildlife Service Coordination Act Report
FWS	U.S. Fish and Wildlife Service
FY	fiscal year

G

G	goal
GIS	geographic information system
GRR	general reevaluation report

H

HDR	HDR Engineering, Inc.
HEC	Hydrologic Engineering Center
HEMP	Hydrologic Engineering Management Plan
HEP	Habitat Evaluation Procedure
H&H	hydrology and hydraulics
HMT	hydrometeorological test bed
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HR	U.S. House of Representatives
HTRW	hazardous, toxic, and radiological waste
HU	habitat unit

I

IDP	Individual Development Plan (Training Plan)
IEPR	U.S. Army Corps of Engineers Independent External Peer Review
Interim Agreement	1995 Contract for operation of Folsom Dam and Reservoir
Interior	U.S. Department of the Interior

IPR	in-process review
IRC	issue resolution conference
IS	initial study
ISC	Interagency Security Committee
ITR	Independent Technical Review
IWR	Institute for Water Resources (Corps Lab)

J

JFP	Folsom Dam Joint Federal Project

K

kV	kilovolts
kW	kilowatt

L

LAR	lower American River
LEDPA	least environmentally damaging preferred alternative
LERRD	lands, easements, rights-of-way, relocations, and disposal areas
Long-term Study	American River Watershed, California Long-Term Study
LOP	level of protection
LOS	level of service
LPP	locally preferred plan
LRR	limited reevaluation report
LWD	left wing dam

M

M&I	municipal and industrial
MCACES	microcomputer-aided cost engineering system
mgd	million gallons per day
MIAD	Mormon Island Auxiliary Dam
MND	mitigated negative declaration
MOA	memorandum of agreement
MOU	memorandum of understanding

MSC	Major Subordinate Command
msl	mean sea level
mva	mega-volt amps or million volt amps
MW	megawatt

N

NAAQS	National Ambient Air Quality Standards
National Register	National Register of Historic Places
NAVD88	North American Vertical Datum of 1988
NCI	National Critical Infrastructure
NCPA	Northern California Power Agency
NED	National Economic Development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NFIP	National Flood Insurance Program
NGO	non-governmental organization
NGVD29	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service; see also NOAA Fisheries Service
NOA	naturally occurring asbestos
NOAA Fisheries Service	National Oceanographic and Atmospheric Administration National Marine Fisheries Service
NOI	Notice of Intent
NOP	Notice of Preparation
NOx	nitrogen oxides
NRCS	Natural Resources Conservation Service
NRDC	Natural Resources Defense Council
NTP	Notice to Proceed
NWS	National Weather Service

O

O&M	Operations and maintenance

OC	Oversight Committee
OCAP	Central Valley Project Operations Criteria and Plan
OEO	Outside Eligible Organization
OMG	Oversight Management Group
OMRR&R	operation and maintenance, repair, replacement and rehabilitation
Ops Group	CALFED Operations Coordination Group
OS	opportunity statement
OSE	other social effects

P

PACR	Post Authorization Change Report
PAO	Public Affairs Office
Partner	For the Flood Management Operations Study for Folsom Dam, the Corps' partner is the Bureau of Reclamation
PADD	Post Authorization Decision Document
PASS	Project Alternative Solutions Study
PCA	Project Cooperation Agreement
PCWA	Placer County Water Agency
PCX	Planning Centers Of Expertise
PD	U.S. Army Corps of Engineers Sacramento District, Planning Division
PDT	Project Delivery Team
PED	preconstruction, engineering, and design
PG&E	Pacific Gas and Electric Company
PGM	project guidance memorandum
PIA	Prison Industry Authority
PL	Public Law
PM	project manager
PM10	particulate matter of 10 micons or less in diameter
PMF	probable maximum flood
PMG	Project Management Group
PMP	Project Management Plan

PMS	probable maximum storm
POC	point of contact
PPA	project partnership agreement
ppm	parts per million
PPMD	U.S. Army Corps of Engineers, Sacramento District, Programs and Project Management Divisions
PRB	Project Review Board
Principles and Guidelines (P&G)	principles and guidelines; Federal Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies
PRP	Peer Review Plan
PROMIS	project management information system
Proposed Action	2004 Interim Reoperation Plan
PS	problem statement
psu	practical salinity unit

Q

QA	quality assurance
QC	quality control
QCP	quality control plan
QMP	quality management plan
QPF	quantitative precipitation forecasts

R

RAP	Refined Authorized Project
RCMP	River Corridor Management Plan
RD	Reclamation District
RDF	reservoir design flood
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Reclamation Board	State of California Reclamation Board
RED	regional economic development
RIT	U.S. Army Corps of Engineers Regional Integration Teams
RM	resource manager
RMO	Review Management Organization

ROD	record of decision
ROE	right of entry
ROS	reservoir operation set
RP	review plan
RPA	Reasonable and Prudent Action
rpm	revolutions per minute
RTS	Regional Technical Specialist
R&U	risk and uncertainty
RWQCB	Regional Water Quality Control Board
RWR	right wing dam

S

SACCR	schedule and cost change request
SACOG	Sacramento Area Council of Governments
SAFCA	Sacramento Area Flood Control Agency
SARA	Save the American River Association
SJRA	San Joaquin River Agreement
SJWD	San Juan Water District
SHPO	State of California Historic Preservation Office; State of California Historic Preservation Officer
SIP	State Implementation Plan
SIR	supplemental information report
SMAQMD	Sacramento Metropolitan Air Quality Management District
SMUD	Sacramento Municipal Utility District
SOW	scope of work (for contractors)
SOS	scope of service
SPA	U.S. Army Corps of Engineers Albuquerque District
SPD	U.S. Army Corps of Engineers South Pacific District; see also CESPD
SPF	standard project flood
SPK	U.S. Army Corps of Engineers Sacramento District
SPL	U.S. Army Corps of Engineers Los Angeles District
SPN	U.S. Army Corps of Engineers San Francisco District

Sponsors	Local entity entering into feasibility cost sharing agreement with the Corps to share the cost of the feasibility phase of a project or study. For the Flood Management Operations Study for Folsom Dam, sponsors are DWR (CVPFB) and SAFCA.
SRA	State Recreation Area
STG	submerged tainter gate
Stakeholder	Entity or individual with a stake or interest in the outcome of a project or study
Study	Flood Management Operations Study for Folsom Dam
SWP	State Water Project
SWRCB	State Water Resources Control Board

T

TAC	Traffic Advisory Committee
TAF	thousand acre-feet
TNM	Traffic Noise Model
TRSS	Technical Review Strategy Session (Corps)

U

UAIC	United Auburn Indian Community of the Auburn Rancheria
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USEPA	U.S. Environmental Protection Agency, see also EPA
USFWS	U.S. Fish and Wildlife Service

V

VE	Value Engineering
VEST	value engineering study

W

WAPA	Western Area Power Administration; also known as Western
Water Forum	Sacramento Water Forum
WBS	work breakdown structure
WCD	Water Control Diagram
WCM	Water Control Manual
Western	Western Area Power Administration; also known as WAPA
WFA	Water Forum Agreement

WRCB	Water Resources Control Board
WRDA	Water Resources Development Act
WRDA 07	Water Resources Development Act of 2007
WRDA 08	Water Resources Development Act of 2008
WRDA 96	Water Resources Development Act of 1996
WRDA 99	Water Resources Development Act of 1999
WSE	water surface elevation

X

X2	distance upstream, in kilometers, from the Golden Gate Bridge to the tidally averaged near-bed, 2-psu isohaline

Y

Z

ATTACHMENT 5: GLOSSARY OF TERMS

Glossary of Terms

1% flood	Preferred terminology of the U.S. Army Corps of Engineers (Corps). Flood having a 1% probability of being equaled or exceeded in any given year. (See *recurrence intervals* and *probabilities of occurrence.*) *(Note: The Corps does not refer to this as the 100-year flood.)*
100-year event	A flood having a 1% annual probability of occurring. The term *100-year* is a measure of the size of the flood, not how often it occurs. (See *recurrence intervals* and *probabilities of occurrence*.) *(Note: This is not a term commonly used by the Corps._*
100-year flood	Flood having a 1% probability of occurring in any given year. (See *recurrence intervals* and *probabilities of occurrence.*) *(Note: This is not a term commonly used by the Corps._*
1986 Corps Flood Control Diagram	Chart A-8 as published in the December 1987, Folsom Dam and Lake Water Control Manual.
200-year event	A flood having a 0.5% chance of occurring in any given year.
400 Fixed	A Folsom Dam and Reservoir operational scenario under which the maximum storage space available for flood control during the flood season (i.e., October 1 through May 31) in Folsom Lake is 400,000 acre feet.
400/600 Variable	Variable 400/600 Flood Control Diagram – A Folsom Dam and Reservoir operational scenario under which the maximum storage space available for flood control during the flood season (i.e., October 1 through May 31) varies between 400,000 and 600,000 acre-feet.
400/670 Variable	Variable 400/670 Flood Control Diagram - An alternative analyzed in Sacramento Area Flood Control Agency's (SAFCA) 1994 Interim Reoperation of Folsom Dam and Reservoir Environmental Impact Report/Environmental Assessment (EIR/EA) under which the maximum storage space available for flood control during the flood season (i.e., October 1 through May 31) in Folsom Lake varied between 400,000 and 670,000 acre-feet. This alternative (the preferred alternative of the EIR/EA) was adopted and changed the maximum flood space requirement at Folsom Reservoir from the prior fixed 400,000 acre-feet to a variable maximum flood space of 400,000 to 670,000 acre-feet, based on the day of the year and the reservoir storage space available in the French Meadows, Hell Hole, and Union Valley Reservoirs.
500/800 Variable	Variable 500/800 Flood Control Diagram – An alternative analyzed in Sacramento Area Flood Control Agency's (SAFCA) 1994 Interim Reoperation of Folsom Dam and Reservoir Environmental Impact Report/Environmental Assessment (EIR/EA) under which the maximum storage space available for flood control during the flood season (i.e., October 1 through May 31) in Folsom Lake varied between 500,000 and 800,000 acre-feet.

A.

acre-foot (AF)	The volume of water needed to cover an acre of land (about the size of a football field) to a depth of one foot; equivalent to 43,560 cubic feet, or 325,851 gallons.
advanced release	A calculated increase in reservoir discharges greater than currently measured inflows, made with the objective of creating a specific volume, to be made available for storage in advance of some pre determined forecasted inflow.
American River Common Features Project (Common Features)	American River Common Features Projects: Authorized in the Water Resources Development Act of 1996, levee improvements along American River downstream of Folsom Dam and portions of the Sacramento River for flood risk management for the Sacramento community on the north and south sides of the American River and to the Natomas Basin.

American River Basin Development Act (ARBDA) (Public Law 81-356, Oct 14, 1949)	Reauthorized the American River Basin development as part of the Central Valley Project to include a multi-purpose Folsom Dam with a capacity of 1,000,000 acre-feet. The Act also authorized construction of Nimbus Dam and Lake Natoma as a regulation reservoir for the Folsom Powerplant.
American River Operations Group (AROG)	Folsom Dam and Reservoir is operated by the U.S. Bureau of Reclamation to meet Central Valley Project-wide multi-purpose beneficial uses, while taking into consideration advisory input received from the AROG.
American River Parkway Plan of 2008	Adopted by the County of Sacramento and the State of California, the American River Parkway Plan provides a policy guide for land use decisions affecting the American River Parkway. Specifically, the plan addresses the preservation, use, development and administration of the Parkway.
annual exceedence probability (AEP)	With respect to flood risk, the AEP is the probability that damages due to a levee failure will occur in any given year considering the full range of possible annual flood events.
average recurrence interval	The average number of years between floods of a certain size is the recurrence interval. The actual number of years between floods of any given size can vary greatly because of the variability of the climate. (See *recurrence interval.*)

B.

(b)(2) water	The 800,000 acre feet of Central Valley Project (CVP) water dedicated to implement the fish, wildlife, and habitat restoration purposes required by the CVP Improvement Act (CVPIA) and to assist the State of California in its efforts to protect the waters of the San Francisco Bay and the Sacramento-San Joaquin Delta Estuary. (See *B-2 Water Account.*)
B-2 Water Account	The 800,000 acre feet of Central Valley Project (CVP) water dedicated to implement the fish, wildlife, and habitat restoration purposes required by the CVP Improvement Act (CVPIA) and to assist the State of California in its efforts to protect the waters of the San Francisco Bay and the Sacramento-San Joaquin Delta Estuary. (See *(b)(2) water.*)
base flood	Federal Emergency Management Agency term used to define the flood having a 1% chance of being exceeded in a given year. Base flood elevations are typically shown on flood insurance rate maps. (See *100-year flood*.)
basin	1. Refers to a natural hydrological feature generally defined as the area drained by a river system. 2. A basin functions the same way as a dam, but usually does not require an embankment to impound water. Basins are dug into the ground and store water at or below grade. Basins have outlet pipes that release flows at a predefined rate. Any flows that enter the basin at a rate in excess of the outlet pipe's capacity are temporarily stored in the basin.
bed	The bottom of a body of water such as a stream.
beneficial uses	Uses of water necessary for the survival or well-being of human, plants, and wildlife. These uses of water serve to promote tangible and intangible economic, social, and environmental goals. Beneficial uses of the waters of the state that may be protected against include, but are not limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves. Beneficial uses are equivalent to "designated uses" under federal law.
benefit-cost analysis (BCA)	An analytical technique that compares the cost of a project with the benefits to be derived from it. Expressed as a ratio of benefits to costs. For projects with ratios greater than 1.0, the U.S. Army Corps of Engineers deems the project "cost-effective." Projects are not optimized based on BCA but are based on highest net benefits (see *net benefit*). The determination of costs and benefits to be included in the analysis can be a contentious issue, particularly for public goods and the monetization of natural resources.

biological assessment (BA)	A document prepared for the Section 7 of the Endangered Species Act process to determine whether a proposed major construction activity under the authority of a federal action agency is likely to adversely affect listed species, proposed species, or designated critical habitat.
biological opinion (BO)	A document that is the product of formal consultation under Section 7 of the Endangered Species Act, stating the opinion of the U.S. Fish and Wildlife Service, or NOAA Fisheries, on whether a federal action would be likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

C.

CALFED Bay-Delta Accord	An agreement signed between California state and federal agencies with management responsibilities over the Sacramento-San Joaquin River Delta Estuary (Delta). Signed in December 1994, under the Clinton administration, the accord was in an attempt to work toward a resolution of water use in California.
California Endangered Species Act (CESA)	Originally adopted in 1970, the Act requires the California Department of Fish and Game to inventory all threatened fish and wildlife, develop criteria for rare and endangered species and report to the Governor and Legislature every 2 years on the status of those species. In 1984, the Act was amended to more closely resemble the federal Endangered Species Act. One of the Act's many requirements include that all government agencies undertaking activity that alters the bed, channel, or bank of any stream, creek, or river obtain a Section 1601 Streambed Alteration Permit from the California Department of Fish and Game. Species protected under CESA are not necessarily protected under the federal Endangered Species Act (ESA) and visa versa.
California Environmental Quality Act (CEQA)	First enacted in 1970 to provide long-term environmental protection, the CEQA is the foundation of environmental law and policy in California. CEQA encourages the protection of all aspects of the environment by requiring State and local agencies to prepare multidisciplinary environmental impact reports. Any project that requires the discretionary approval of a State or local legislative body must comply with CEQA requirements.
cavitation	The formation of vapor- or gas-filled cavities in liquids. In engineering terminology, the term is used to describe the formation of vapor-filled cavities in the interior or on the solid boundaries created by a localized pressure reduction produced by the dynamic action of a liquid system without change in ambient temperature. Cavitation in the engineering sense is characterized by an explosive growth and occurs at suitable combinations of low pressure and high speed in pipelines; in hydraulic machines such as turbines, pumps, and propellers; on submerged hydrofoils; behind blunt submerged bodies; and in the cores of vortical structures. This type of cavitation restricts the speed at which hydraulic machines may be operated and, when severe, lowers efficiency, produces noise and vibrations, and causes rapid erosion of the boundary surfaces, even though these surfaces consist of concrete, cast iron, bronze, or other hard and normally durable material.
Central Valley Project (CVP) [California]	A multipurpose water project developed mainly by the U.S. Bureau of Reclamation (Reclamation). The state and federal portions of the CVP encompass a number of dams, reservoirs, pumping facilities, canals, and aqueducts providing protection from saltwater intrusion into the San Francisco Bay-Sacramento-San Joaquin River Delta Estuary (Bay-Delta) region, irrigation water for San Joaquin Valley farms, and municipal and industrial water for some of California's most populated urban areas. Construction of the CVP was approved by California voters in a 1933 referendum of the California Central Valley Project Act. Because of the effects of the Great Depression, the State was unable to construct the project at that time. Subsequently, portions of the CVP were authorized and constructed by the federal government. Other portions were later constructed by California after the Depression as part of the State Water Project (SWP), as authorized under the 1960 Burns-Porter Act.

Central Valley Project Improvement Act (CVPIA)	The CVPIA was enacted in 1992. Its purposes are: • Protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California • Address impacts of the Central Valley Project (CVP) on fish, wildlife and associated habitats, and improve the operational flexibility of the CVP • Increase water-related benefits provided by the CVP to the State of California through expanded use of voluntary water transfers and improved water conservation • Contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary • Achieve a reasonable balance among competing demands for use of CVP water, including the requirements of fish and wildlife, agricultural, municipal and industrial and power contractors
Code of Federal Regulations (CFR)	The annual compilation of all current regulations that have been issued in final form by any federal regulatory agency. The publication is organized by subject titles.
concrete gravity dam	A concrete gravity dam secures stability through being of such a size and shape that it resists overturning, sliding and crushing at its toe. The dam will not overturn provided that the moment around the turning point, caused by the water pressure is smaller than the moment caused by the weight of the dam. This is the case if the resultant force of water pressure and weight falls within the base of the dam. When situated on a suitable site, gravity dams can prove to be a better alternative to other types of dams. When built on a carefully studied foundation, the gravity dam probably represents the best developed example of dam building.
conditional non-exceedence	An index of the likelihood that a specified target will not be exceeded, given the occurrence of a hydrometeorological event. For example, the conditional non-exceedence probability of a proposed 15.00 foot high levee might be p=0.75 for the 0.002-probability event. This means that if the plan is implemented, the probability equals 0.75 that the stage will not exceed 15.00 ft, given the occurrence of a 0.2-percent chance event.
confluence	The act of flowing together; the meeting or junction of two or more streams or rivers; also, the place where streams meet.
conservation storage	The space below the maximum allowable flood control pool. In this case, “maximum allowable flood control pool” refers to the bottom of the dedicated flood space. (The conservation storage varies as it is computed on a daily basis.)
Coordinated Operations Agreement	A 1986 agreement between the U.S. Bureau of Reclamation and the California Department of Water Resources to coordinate the operation of the Central Valley Project and the State Water Project.
cost-sharing	The appointment of the cost of the U.S. Army Corps of Engineers’ water resources studies and projects that is shared between federal and nonfederal entities as defined by laws and administrative provisions such as the Water Resources Development Act of 1986.
cost-sharing sponsor	For the Flood Management Operations Study for Folsom Dam, the non-federal cost-sharing sponsor is the State of California, Central Valley Flood Protection Board (CVFPB). The term “cost-sharing sponsor” is often used synonymously with “cost-sharing partner”, where, for this Study, the cost-sharing partners are the Corps and the CVFPB. Sacramento Area Flood Control Agency is the local sponsor per its agreement with the State of California.

Creditable Flood Control Transfer Space	The exchange of space between a downstream flood control reservoir and any space that might be available within reservoirs upstream. Specifically: • Folsom is a multiple purpose reservoir with a fraction of its total volume dedicated solely to capturing flood runoff for flood damage reduction purposes. • There are three reservoirs upstream of Folsom Reservoir (Union Valley, French Meadows and Hell Hole) that, although they do not have prescribed flood control operations, they have empty space within them that does provide additional flood control benefits to areas and communities downstream of Folsom Dam. • Creditable flood control transfer space is an operational process which assesses storage in Folsom Reservoir as well as the three reservoirs upstream of Folsom noted above. Creditable flood control transfer space takes advantage of available space in the upstream reservoirs; and calls for adjustments in the flood control storage within Folsom's Reservoir to provide a balanced flood risk management program.
crest	• The top of a dam, dike, or spillway, which water must reach before passing over the structure; in international usage it refers to the crown of an overflow section of a dam. • The summit or highest point of a wave. • The highest elevation reached by floodwaters flowing in a channel as in crest stage or flood stage.
crest elevation (crest of dam, top of dam, dam crest)	The elevation of the uppermost surface of a dam, usually a road or walkway, excluding any parapet wall, railing, curb, etc. The crown of the roadway or the level of the walkway that crosses the dam. On embankment dams, the crest is the top of the embankment, not including camber, crown, or roadway surface.
crest of dam	See *crest elevation*.
cubic foot per second (cfs)	Rate of water discharge representing a volume of 1 cubic foot passing a given point during 1 second. One cubic foot of water equals about 7½ gallons.

D.

D-893	A decision made by the State Water Resources Control Board (SWRCB) and adopted in 1958 that established minimum flows in the lower American River, at its confluence with the Sacramento River.
D-1641	A decision made by the State Water Resources Control Board (SWRCB), adopted in 1999, and revised in 2000, amending certain terms and conditions of the water rights of the State Water Project and the Central Valley Project.
dam crest	See *crest elevation*.
Dams	A structure of earth, rock, or concrete designed to form a basin and hold water back to make a pond, lake, or reservoir. A barrier built, usually across a watercourse, for impounding or diverting the flow of water.
design flood	A hypothetical flood of a given magnitude associated with a particular exceedence or non-exceedence frequency, selected for use as a criteria in the design of a specific flood control project; representing the largest flood that a given project would be designed to pass. A suite of hypothetical floods representing a range of specific likelihood of occurrences (i.e., a 50%, 2%, 1% 0.5% chance event) or a specified probability.
discharge (flow)	The rate of flow of water measured in terms of volume over time (i.e., the amount of water moving past a point). *Discharge* and *flow* are interchangeable terms. (See *flow.*)

E.

effective warning time	The available time that a community has from receiving a flood warning to when the flood reaches them.

emergency action plan	A predetermined plan of action to be taken to reduce the potential for property damages and loss of lives in an area affected by a dam break or excessive spillway discharges.
Emergency Relief Appropriation Act of 1935	Funded initial features of the Central Valley Project, includes improving navigation, regulation of the flows of the San Joaquin and Sacramento Rivers, control of floods, provision for delivery of stored waters thereof, reclamation of arid and semiarid lands and lands of Indian reservations, and other beneficial uses, and for the generation and sale of electric energy as a means of financially aiding and assisting such undertakings and to permit the full utilization of the works constructed.
Emergency Spillway Release Diagram (ESRD)	The ESRD consists of a family of curves (i.e., diagrams) that relate reservoir inflow, outflow, and storage. The diagram is constructed following procedures outlined in the U.S. Army Corps of Engineers Engineering Manual 1110-2-3600. The ESRD indicates the minimum permissible release that can be made without endangering the structure and without releasing quantities in excess of natural runoff.
encroachment	When a reservoirs pool elevation resides above its computed maximum allowable [conservation] storage
Endangered Species Act of 1973, as amended (ESA)	An Act passed by Congress in 1973 and intended to protect species and subspecies of plants and animals that are of "aesthetic, ecological, educational, historical, recreational and scientific value." It also protects the listed species' "critical habitat," the geographic area occupied by, or essential to, the protected species. The U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) share authority to list endangered species, determine critical habitat and develop recovery plans for listed species.
environmental assessment (EA)	A concise public document that records analyses of the environmental effects of a proposed federal action and provides sufficient evidence to determine the level of significance of the effects. An EA can be a precursor to an environmental impact statement.
environmental impact statement (EIS)	A detailed written statement, required by Section 102(2)(c) of the National Environmental Policy Act, documenting the environmental effects of a proposed action, adverse effects that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance of long-term productivity, and any irreversible and irretrievable commitment of resources.
Export/Inflow Ratio (E/I Ratio)	Export/Inflow Ratio is the ratio of Sacramento-San Joaquin River Delta Estuary (Delta) exports to water inflow to the Delta expressed by percentage.

F.

F1	Corps Planning Milestone: The date the district receives federal feasibility phase study funds.
F2	Corps Planning Milestone: A public meeting/workshop to obtain input and public opinions and to fulfill scoping requirements of the National Environmental Policy Act.
F3	Corps Planning Milestone: The Feasibility Scoping Meeting is conducted with Headquarters, U.S. Army Corps of Engineers to address potential changes in the Project Management Plan. It will establish without project conditions and screen preliminary plans.
F4	Corps Planning Milestone: The Alternative Review Conference is held to evaluate the final plans, reach a consensus that the evaluations are adequate to select a plan, and prepare Alternatives Formation Briefing (AFB) issues.
F4A	Corps Planning Milestone: Alternatives Formation Briefings is for policy compliance review of the proposed plan with Headquarters, U.S. Army Corps of Engineers to identify actions required to prepare and release the draft report.
F5	Corps Planning Milestone: Initiation of field-level coordination of the draft report with concurrent submittal to Headquarters, U.S. Army Corps of Engineers through Corps of Engineers South Pacific Division for policy compliance review.
F6	Corps Planning Milestone: Date of the final public meeting.

F7	Corps Planning Milestone: Policy compliance review of the draft report with Headquarters, U.S. Army Corps of Engineers to identify actions required to complete the final report.
F8	Corps Planning Milestone: Date of submittal of final report package to Corps of Engineers South Pacific Division, Planning Division, including technical and legal certifications, compliance memorandum, and other required documentation.
F9	Corps Planning Milestone: Date of issuance of the U.S. Army Corps of Engineers Division Commander's Public Notice. Congressional notification occurs two days prior. The report and supporting documentation are forwarded to Headquarters, U.S. Army Corps of Engineers. This milestone is used as the completion of the feasibility report in the Command Management Review.
federally-authorized	Actions that conform to federal standards and codes or that are initiated by Federal legislation.
first responder	A water source (such as Folsom Reservoir) that is considered to be the first choice when near-term water quality issues require additional water to be released; determination is based on water quality and/or proximity of the water source
flash flood	A fast, dangerous flow of water resulting from tropical storms, dam failures, or excessive rain and/or snowmelt; the flooding of an area that can occur in a matter of minutes or hours.
flood	Relatively high river or creek flows that overtop natural or artificial banks and submerge normally dry areas.
Flood Control Act (FCA) of 1944 (Public Law. 78-534)	Originally authorized in 1944 as a 355,000 acre-feet flood control unit, Folsom Dam was reauthorized in 1949 as a 1,000,000 acre-feet multiple-purpose facility. See American River Basin Development Act (Public Law 81-356, Oct 14, 1949). The U.S. Army Corps of Engineers constructed Folsom Dam and transferred it to Reclamation for coordinated operation as an integral part of the Central Valley Project. Re authorized the Central Valley Project to include the American River development including construction of Folsom Dam and Reservoir and hydroelectric plant.
flood control releases	Water released, as designated by the U.S. Army Corps of Engineers, to maintain a reservoir's water surface elevation at or below the elevation of dedicated flood control space.
flood control reservation	Space within a reservoir dedicated to the capture and temporary storage of flood runoff.
flood damage	The tangible and intangible costs of flooding, including physical damage, and economic damage.
flood frequency analysis	A process used to estimate the probability of occurrence of a given flood event through use of statistical techniques relying on hydrologic information from the watershed. (See *return period*.)
flood hazard	The potential risk to life and limb and potential damage to property resulting from flooding. The degree of flood hazard varies with circumstances across the full range of floods.
Flood Insurance Rate Map (FIRM)	An official map of a community on which the Federal Emergency Management Agency has delineated both the special hazard areas and the risk premium zones applicable to the community. FIRMs typically identify the elevation of the 1% annual chance flood and the areas that would be inundated by that level of flooding; FIRMs are used to determine flood insurance rates and for floodplain management.
Flood Insurance Studies (FIS)	Studies that define flood risk areas of communities determined using statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses.
Flood Management Plan	See *Water Resources Development Act 1999*.
flood risk	The risk associated with being flooded. Risk performance indicators are expressed as 1) annual exceedence probability; 2) long-term risk; and 3) conditional non-exceedence probability.
flood runoff	Surface water resulting from rainfall or snowmelt that flows overland to streams.

floodgates	Locks or gates built across a river; these can be opened or closed to prevent flooding downstream.
floodplain	The relatively flat area adjoining and including the channel or a river, stream, watercourse, bay, or other body of water that is subject to occasional periodic inundation by floodwaters.
floodplain management	The coordinated management of activities that occur on a floodplain.
flow (discharge)	The rate of flow of water measured in terms of volume over time (i.e., the amount of water moving past a point). *Discharge* and *flow* are interchangeable terms. (A commonly used value is cubic feet per second (cfs). (See *discharge.*)
Folsom Dam Joint Federal Project	Construction of the Folsom Dam Joint Federal Project began in 2008. This project includes both flood risk management and dam safety components; the main feature is a gated auxiliary spillway. The primary purpose is to reduce the flood risk to the Sacramento area and to allow Folsom Dam to pass the probable maximum flood without overtopping the dam.
Folsom Unit	Authorized in 1949 as part of the American River Division of the CVP. Consists of Folsom Dam, Folsom Lake, Folsom Powerplant, Nimbus Dam, Nimbus Powerplant, and Lake Natoma.
freeboard	Freeboard protects dams and embankments from overflow caused by wind-induced waves. It is defined as the vertical distance between the crest of a dam and some specified pool level, usually the normal operating level or the maximum flood level. Depending on the importance of the structure, the amount of freeboard can vary from zero for structures that can withstand overtopping to 2 m or more for structures where overtopping would constitute a major hazard. The freeboard allowance accounts for wind set and wave action.

G.

gradient control structures	Structures such as dams and weirs that alter the slope of a waterway in its descent.
gross pool elevation	See *normal full pool elevation*.

H.

historical flood	A flood that has actually occurred.
Hodge flows	Reoperation alternatives formulated and evaluated under the assumption that flow-related impacts could be avoided using the principles articulated by Judge Hodge in *Environmental Defense Fund v. East Bay Municipal Utility District (*EBMUD*)*. The Hodge decision stated that EBMUD can use the Folsom South Canal diversion only when specified flows would remain in the lower American River. These flows have come to be known as the *Hodge flows*.
hydraulic analysis	The analysis undertaken to determine the capacity of a particular drainage work. Such an analysis is used to determine the attributes of the flowing water such as water level or surface profile, velocity, total energy, and erosive force.
hydraulics	Refers to the relationship among channel geometry and flow, velocity, and water depth in the study of water flow in rivers, estuaries, and coastal systems.
hydroelectric afterbay power plant	Power plant located downstream of the area of the watercourse where water is discharged after passing through turbines.
hydrograph	A graph showing how a river or stream's discharge changes with time. The time scale may be in minutes, hours, days, months, years, or decades.
hydrology	The term given to the study of the rainfall-runoff process in catchments. Used to refer to the occurrence, distribution, and circulation of water on the earth, including precipitation, stormwater runoff, and groundwater.

hypothetical flood	Hypothetical floods are floods of a predetermined pattern, that are associated with the generation of stream flow peaks and/or volumes of a specified exceedence frequency or specified probability (i.e. a 2, 1, 0.5% chance event or a 0.02, 0.01 or 0.005 exceedence probability).

I.

inactive capacity (inactive storage)	The reservoir capacity exclusive of and above the dead capacity from which the stored water is normally not available because of operating agreements or physical restrictions. Under abnormal conditions, such as a shortage of water or a requirement for structural repairs, water may be evacuated from this space. The inactive capacity extends from the top of inactive capacity to the top of dead capacity. (See *inactive storage.*)
inactive storage	See *inactive capacity*.
inflow forecast system	A physically-based model that incorporates the hydrologic processes in a given basin. The current forecast system uses input data for mean areal precipitation, mean areal temperature, and freezing level. These input variables are derived using a variety of data sources including hydrometeorological observation networks, meteorological models, and climatological information. Current outputs from the forecast system include deterministic short-term 5 day flow forecasts and probabilistic flow forecasts for both the short and long-term (one year) time frames.
Interim Agreement of Folsom Dam and Reservoir (also known as Folsom Reop), 1994	Contract for operation of Folsom Dam and Reservoir between Sacramento Area Flood Control Agency (SAFCA) and the U.S. Bureau of Reclamation (Reclamation) to operate Folsom Dam and Reservoir in accordance with the 400/670 variable flood control diagram. For the agreement, SAFCA and Reclamation negotiated a proposed contract under which Reclamation would operate Folsom Dam and Reservoir in accordance with a revised flood control diagram designed to permit safe containment of a 100-year or larger flood in the watershed. In turn, SAFCA would agree to bear the costs of compensating for or otherwise mitigating all incremental impacts caused by such flood control operations.
isohaline	A line on a map of the ocean connecting all points of equal salinity.

J.

Joint Federal Project (JFP)	See *Folsom Dam Joint Federal Project*.
joint use capacity	The reservoir capacity assigned to flood control purposes during certain periods of the year and to conservation purposes during other periods of the year.

K.

L.

levee (dike)	A long, elevated berm usually built along a watercourse to protect adjacent low-lying ground from flooding.
level of protection (LOP)	Historically, this now obsolete term characterized the flood project performance. The LOP was used to describe the annual exceedence probability (often expressed as a return interval in years) of the flood event when it begins to cause damage in the protected area.
littoral macroinvertebrate community	Zooplankton, crustaceans, mollusc larvae, and nymph stages of aquatic and emergent flying insects that live in, among, and under rocks, sand, and pebbles in the shoreline zone.

M.

maximum pool	See *maximum water surface*.

maximum water surface (maximum pool)	The highest acceptable water surface elevation with all factors affecting the safety of the structure considered. It is the highest water surface elevation resulting from a computed routing of the Probable Maximum Flood (PMF) through the reservoir under established operating criteria.
municipal and industrial (M&I)	Municipal and industrial water refers to water supplies used by public owned water supply facilities (municipal) and water used in industrial processes.

N.

National Environmental Policy Act (NEPA)	The federal law, adopted in 1969, that provided the model for California Environmental Quality Act (CEQA). The law requires that agencies make a diligent effort to involve the public in the project planning process. NEPA regulations must be followed when a project is constructed on federal lands, is constructed with federal funds, or is found to be regulated by other federal environmental regulatory laws. The federal agencies undertaking or funding the project are responsible for ensuring that the project complies with NEPA.
National Geodetic Vertical Datum of 1929 (NGVD29)	Formerly known as the “Sea Level Datum of 1929” or “mean sea level”, this vertical datum for elevations was derived by collecting the average sea level measurement over a period of many years at 26 tide stations located in the United States and Canada. It does not necessarily represent local mean sea level at any particular place.
net benefit	The difference between average annual benefits obtainable through operation of a project and average annual cost of the project.
normal full pool elevation (gross pool elevation)	Corresponds to the top reservoir level that would be attained for routine storage of water for flood control, hydroelectric power, recreation, water supply, downstream fishery enhancement, or other authorized storage uses; this level corresponds to the total design capacity of reservoir selected initially on the basis of planning and design studies, excluding surcharge storage.
normal objective flow	The peak (objective) rate of release that typically equates to the maximum safe channel capacity at some location either at the primary flood control reservoir or at some location within the downstream distribution system.
North American Vertical Datum of 1988 (NAVD88)	"The North American Vertical Datum of 1988 (NAVD 88) is the vertical control datum established in 1991 by the minimum-constraint adjustment of the Canadian-Mexican-U.S. leveling observations. It held fixed the height of the primary tidal bench mark, referenced to the new International Great Lakes Datum of 1985 local mean sea level height value, at Father Point/Rimouski, Quebec, Canada. Additional tidal bench mark elevations were not used due to the demonstrated variations in sea surface topography, i.e., the fact that mean sea level is not the same equipotential surface at all tidal bench marks." Link: http://www.ngs.noaa.gov/faq.shtml#WhatVD29VD88

O.

OMRR&R	The operation and maintenace, repair, replacement and rehabilitation of an entire project or a functional portion of a project by a nonfederal sponsor at no cost to the Federal government.
outlet	An opening through which water can be freely discharged from a reservoir.

P.

Partner	For the purposes of the Flood Management Operations Study for Folsom Dam, the Study Partner is the U.S. Bureau of Reclamation.
peak flows	The maximum flood level, flow, or velocity of a stream occurring during a flood.
penstock	Channel or pipe that delivers water under pressure from a river or reservoir to a power plant’s turbines.
penstock shutters	Power generation inlet ports (intake structures) on penstock towers that allow some flexibility in providing intake water to the penstock from different elevations, thus permitting the blending of water from varying temperatures.

Principles and Guidelines (P&G) — Federal Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.

probabilities of occurrence — See *recurrence intervals*.

probability — A statistical measure with values ranging from zero to one indicating the likely occurrence of flooding. Probability equals the frequency divided by 100.

probable maximum flood (PMF) — The flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. PMF discharge is 906,000 cfs as documented in USACE, Sacramento District; American River Basin, California Folsom Dam and Lake Revised PMF Study; Hydrology Office Report; October 2001

Q.

R.

real-time forecast informed operations — Real-time operations utilize short duration (1 to 5 day) forecasts to assist operators in the development of hourly release scheduling.

recurrence interval (average recurrence interval) (probabilities of occurrence) — The average number of years between floods of a certain size is the recurrence interval. The actual number of years between floods of any given size can vary greatly because of the variability of the climate.

Recurrence interval (years)	Probability of occurrence in any given year		Chance of occurrence in any given year (%)
200	1 in 200	.005	.05
100	1 in 100	.01	1
50	1 in 50	.02	2
25	1 in 25	.04	4
10	1 in 10	.10	10
5	1 in 5	.20	20
2	1 in 2	.50	50

reservoir — A body of water stored in an artificial or natural pond or lake.

reservoir surface — The surface of a reservoir at any elevation.

return frequency (recurrence interval) — The average time interval between actual occurrences of a hydrologic event of a given or greater magnitude. In an annual flood series, the average interval in which a flood of a given size is exceeded as an annual maximum. In a partial duration series, the average interval between floods of a given size, regardless of their relationship to the year or any other period of time. The distinction holds even through for large floods, recurrence intervals are nearly the same for both series.

return period — A term commonly used to characterize the likelihood of flooding. A frequently used alternative is flood frequency in years. Both terms are meant to represent the long-term average flooding frequency. Return period is computed as the reciprocal of the annual exceedence probability. In recent years, use of this term is increasingly discouraged since it is often mis-represented as an indication of the length of time between floods and thus leads to confusion. *(See level of protection.*)

risk analysis	The analysis of flood risk management measures and plans by application of the principles associated with formal risk and uncertainty analysis. Risk considers the full range of events, outcomes, and consequences of proposed plans, including those that exceed project capacity. Uncertainty in the values for the various key functions such as discharge-probabilities, stage probabilities, geotechnical performance, and damage potential is explicitly included.
risk-based process	U.S. Army Corps of Engineers-initiated multidisciplinary approach that evaluates the total risk of flooding, reflecting possible contributions of various operational, hydrologic, hydraulic, and geotechnical factors and how they might act individually, jointly, or collectively. Risk is measured as a function of: Probability and Consequence.

S.

Sacramento Area Flood Control Agency (SAFCA)	In 1989, local agencies responsible for operating and maintaining the levee system around the Sacramento metropolitan area and for managing land use in the floodplain, reacted to the diminishing level of flood protection provided by Folsom Dam by creating SAFCA, a regional joint exercise of powers agency consisting of the City of Sacramento, Sacramento County, Sutter County, Reclamation District 1000, and the American River Flood Control District.
sensitivity analysis	Computation of the effect on the output due to changes in input values or assumptions
slurry wall	A slurry wall is a mixture of native soil, bentonite (clay) and sometimes cement inserted in the levee and below the levee to prevent water moving from the river to the land side. The wall can be constructed in a variety of ways.
spillway	A specially built structure to catch overflowing water from dams. Types include: • Auxiliary spillway (emergency spillway) – A secondary spillway designed to operate only during exceptionally large floods. • Primary spillway (principal spillway) – The principal, or first-used, spillway during normal inflow and flood flows.
stage	Water depth above some arbitrary datum, commonly measured in feet.
stage hydrograph	A graph of water level over time.
stakeholders	General: Individuals or groups who: 1) can affect or be affected by an organization's activities, 2) have an interest in what happens as a result of any decision or action.
State Water Project (SWP)	California's State-owned and operated water project consisting of 22 dams and reservoirs that delivers water 600 miles from the Sacramento Valley to Los Angeles.
structural floodplain management controls	The use of dams, levees, channels, storm drains, or other flood control devices to confine and direct flows away from people and property. This has been the historically preferred method of protecting residents in urbanized floodplains.
surcharge capacity	The total capacity or capability of a reservoir to store water within a reservoirs surcharge zone (the space residing between the maximum water surface elevation and the highest of the following elevations: top of exclusive flood control capacity, top of joint use capacity, or top of active conservation capacity).
surcharge storage	Any volume of storage being held within a reservoirs surcharge zone (that space between the maximum water surface elevation and the highest of the following elevations: top of exclusive flood control capacity, top of joint use capacity, or top of active conservation capacity).
synthetic unit hydrograph method	A method for estimating the amount and pattern of runoff due to a "unit" of rainfall flowing into the watershed over a certain period of time.

T.

tainter gate	A tainter gate is a type of radial arm floodgate used in dams to control water flow. A side view of a tainter gate resembles a triangle facing the source or upper pool of water and a triangle pointing toward the destination or lower pool. The face, or skinplate, of the gate takes the form of a cut cylinder. Triangular arms extend back from each end of the cylinder section and meet at a trunnion that serves as a pivot point when the gate rotates. When a tainter gate is closed, water bears on the convex (upstream) side. When the gate is rotated, the rush of water passing under the gate helps to open and close the gate. The rounded face, long radial arms, and trunnion bearings allow it to close under its own weight. Tainter gates are usually controlled from above with a chain/gearbox/electric motor assembly.
temperature control shutters	Steel control gates placed around the Folsom Dam penstocks that can be raised or lowered manually to selectively discharge water from different levels to provide cool water for anadromous fish species during reservoir drawdown.
temporary storage	The storing of flood runoff water in a reservoir during high flow periods that is released in a controlled manner after the flood event.
thermal stratification	Thermal stratification refers to a temperature layering effect that occurs in water. Stratification is due to differences in water density: warm water is less dense than cool water and therefore tends to float on top of the cooler heavier water.
toe	• The downstream edge at the base of a dam • The line of a natural or fill slope where it intersects the natural ground
top of active conservation capacity	The reservoir water surface elevation at the top of the capacity allocated to the storage of water for conservation purposes only.
top of dam	See *crest elevation.*
top of dead capacity	The lowest elevation in the reservoir from which water can be drawn by gravity.
top of exclusive flood control capacity	The reservoir water surface elevation at the top of the reservoir capacity allocated to exclusive use for the regulation of flood inflows to reduce damage downstream. See *reservoir*.
top of inactive capacity	The reservoir water surface elevation below which the reservoir will not be evacuated under normal conditions. The highest applicable water surface elevation described below usually determines the top of inactive capacity: • The lowest water surface elevation at which the planned minimum rate of release for water supply purposes can be made to canals, conduits, the river, or other downstream conveyance systems. Normally, this elevation is established during the planning and design phases and is the elevation at the end of extreme drawdown periods. • The established minimum water surface elevation for fish and wildlife purposes. • The established minimum water surface elevation for recreation purposes. • The minimum water surface elevation as set forth in compacts and/or agreements with political subdivision(s). • The minimum water surface elevation at which the power plant is designed to operate. • The minimum water surface elevation to which the reservoir can be drawn down using established operating procedures without endangering the dam, appurtenant structures, or reservoir shoreline. • The minimum water surface elevation or top of inactive capacity established by legislative action.

top of joint use capacity	The reservoir water surface elevation at the top of the reservoir capacity allocated to joint use, i.e., flood control and conservation purposes. See *reservoir*.

U.

uncertainty	The estimated amount by which an observed or calculated value may differ from the true value.

V.

variable space operation	Variable space operation refers to the regulating criteria, guidelines, guide curves and specifications of a flood control diagram that influence the normally computed maximum allowable storage [its top of conservation]. Variable space operation adjusts the maximum allowable storage, with the purpose of allowing temporary increases in that storage for the purposes of water supply (and other beneficial uses of that supply). Adjustments are typically made from basin indices reflecting average basin wetness through application of cumulative rainflood, soil wetness, snow pack parameters

W.

Water/Flood Control Diagram (WCD)	A compilation of the regulating criteria, guidelines, guide curves and specifications governing the storage and release functions of Folsom Dam and Lake as a water resource project. The diagram indicates pool level requirements and limiting rates of project releases required during various seasons of the year to meet all functional objectives of Folsom Dam and Reservoir, acting independently or in combination with other projects in the system.
Water Control Plan	Regulation that defines both the basic goals and objectives for operation of the project and the procedures governing the use of storage allocated to flood control.
Water Forum	A group of American River watershed area businesses, agricultural leaders, citizens groups, environmentalists, water managers, and local governments convened by the City of Sacramento in 1993 to develop collaborative solutions to regional water supply, environmental, and flood risk management issues. As a result, the Water Forum Agreement was released in 2000; actions in the Agreement are currently being implemented.
Water Resources Development Act (WRDA)	The Water Resources Development Act is generally a biennial piece of legislation that is the main vehicle for authorizing water projects to be studied, planned and developed by the U.S. Army Corps of Engineers.
Water Resources Development Act of 1999 (WRDA 99)	The Water Resources Development Act of 1999 (WRDA 99) provides for the conservation and development of water and related resources. It authorizes the U.S. Army Corps of Engineers to construct various projects for improvements to rivers and harbors of the United States, and for other purposes. WRDA 99 required the Secretary of the Army, in cooperation with the Secretary of the Interior, to update the Flood Management Plan for Folsom Dam to reflect the operational capabilities created by a modification to increase outlet capacity and by improved weather forecasts based on the Advanced Hydrologic Prediction System (AHPS) of the National Weather Service (NWS). The overall goal is to obtain as much flood control as can reasonably be achieved with the existing infrastructure.
water surface elevation (WSE)	The depth of flowing water, measured to a common datum (stream channel invert, sea level, etc.), at a prescribed location. Water surface elevation is also defined as the height of a channel (or storm drain) above mean sea level (or other datum) plus the height of the hydraulic grade line above the channel.

watershed	• An area that, because of topographic slope, contributes water to a specified surface water drainage system, such as a stream or river • All lands enclosed by a continuous hydrologic drainage divide and lying upslope from a specified point on a stream; a region or area bounded peripherally by a water parting and draining ultimately to a particular watercourse or body of water.
Western Area Power Administration (WAPA) (Western)	WAPA falls under the administration of the Department of Energy. WAPA markets hydroelectric power from federal dams to a 15 state region, which includes South Dakota and part of Minnesota. The Sierra Nevada Region, one of four regions of WAPA, markets and transmits the energy that the Central Valley Project produces from dams in northern and central California to wholesale customers such as towns, rural electric cooperatives, public utility and irrigation districts, Federal, state, and military agencies, Native American tribes, investor-owned utilities, power marketers, and U.S. Bureau of Reclamation customers. Also known as *Western*.
Wild and Scenic River	The National Wild and Scenic Rivers System was created by Congress in 1968 to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations.
wing dam	A wing dam is a man-made barrier that, unlike a conventional dam, extends only partway into a river. Wing dams force water into a fast-moving center channel that reduces the rate of sediment accumulation, while slowing water flow near the riverbanks. Wing dams are typically constructed so that they point slightly into the current (meaning that the riverbank end is slightly downstream of the riverward end).

X.

X2 Ratio	X2 is the distance, in kilometers, from the Golden Gate Bridge to the tidally averaged near-bed, 2-psu (practical salinity unit) isohaline (a kind of “contour line” in the estuary’s waters where the salinity is 2 psu). A salinity standard established under the 1994 Bay-Delta Accord requires that between February and June, freshwater flows be released from upstream in a way that maintains X2 within a range of positions in Suisun Bay associated with the abundance of aquatic organisms and some threatened and endangered fish.

Y.

Z.