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California

WaterPlan

A FRAMEWORK FOR ACTION

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A Framework for Action

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Chapter 17 *Surface Storage – CALFED¹*

The CALFED Record of Decision (2000) identified five potential surface storage reservoirs that are being investigated by the California Department of Water Resources, U.S. Bureau of Reclamation, and local water interests. Building one or more of the reservoirs would be part of CALFED's long-term comprehensive plan to restore ecological health and improve water management of the Bay-Delta. The five surface storage investigations are:

- Shasta Lake Water Resources Investigation (SLWRI)
- In-Delta Storage Project (IDSP)
- Upper San Joaquin River Basin Storage Investigation (USJRBSI)
- North-of-the-Delta Offstream Storage (NODOS)
- Los Vaqueros Reservoir Expansion (LVE)

In one of the most ambitious integrated water management plans in the nation, the CALFED Bay-Delta Program set forth objectives and actions to protect water quality and at-risk species, restore habitat in the San Francisco Bay-Sacramento-San Joaquin River Delta and continue to meet the water needs of farms and cities. CALFED recognized early on that its plan must include the means for more fully integrating California's water supply system to provide more reliable water supplies and to meet competing needs. More storage is crucial to successfully meeting those needs.

The five investigations are being completed under the direction provided by the CALFED Record of Decision (ROD) and the California Bay-Delta Authority (CBDA). The ROD includes a number of implementation commitments and solution principles to guide potential project implementation. For example, a fundamental principle is that costs should, to the extent possible, be paid by the beneficiaries of the program actions. CALFED has also provided a forum for independent scientific review of important project-related issues through development of a Science Program with expert panels. In addition, the CBDA agencies have committed to science-based adaptive management that would allow their facilities operations to be modified as understanding of issues improve or new issues are identified.

Originally, a CALFED interagency team began with an inventory of 52 potential reservoir locations and screened those to 12 locations that appeared to contribute to CALFED goals and satisfy solution principles, objectives, and policies. For example, potential reservoirs smaller than 200,000 acre-feet of storage were considered too small to materially contribute to the program. In addition, CALFED policy focused on off-stream reservoirs, but also considered expansion of existing on-stream reservoirs. The five storage investigations identified in the ROD appeared to be more promising in their ability to contribute to ecosystem, water quality, flood control and water supply objectives.

The surface storage regional/local strategy gives a broader background of surface storage in California that may also be helpful to the reader. Details and project-specific descriptions of the investigations can be found in the April 2005 CALFED Bay-Delta Surface Storage Investigations Progress Report that is included in Volume 4, Reference Guide.

Current Status of CALFED Surface Storage

Planning for the five CALFED-directed investigations has made varying levels of progress. Current timelines have targeted 2006–2009 for completing the planning documents. Essen-

¹ The primary source of information for this strategy narrative is the DWR and U.S. Bureau of Reclamation report entitled, "CALFED Bay-Delta Surface Storage Investigation" April, 2005, included in Volume 4, Reference Guide.

ally, the planning consists of project formulation, environmental documentation and engineering design. As relevant and useful information becomes available, both stakeholders and the public are notified to ensure that a broad array of input and response are incorporated into the planning activities and documentation. More specifically, as project costs, environmental effects, and benefits are compiled, regulators, the public, and ultimately decision-makers will be asked to respond to the evaluations and conclusions (see Box 17-1).

The CALFED surface storage investigations have reached a critical milestone. With input from stakeholders and assistance from local agencies, USBR and DWR have completed preliminary environmental impact studies and conceptual modeling scenarios based on general operational objectives. Now each investigation must move toward a specific set of operational objectives to formulate detailed alternatives that can be used in decision-making processes. Future efforts now hinge on the willingness of interested parties and stakeholders to participate and shape the alternative formulations that will be used to make decisions on these projects. Evaluations to date demonstrate that the surface storage projects have the potential to provide both broad public benefits and local/regional benefits.

Potential Benefits from CALFED Surface Storage

CALFED noted that perhaps the greatest benefit of new surface storage would be the operational flexibility that storage adds to today's constrained system (See Box 17-2). The Bay-Delta system provides water for a wide range of needs, including in-stream flows for aquatic species, riparian habitat, wetlands, as well as benefits to municipal, industrial, and agricultural users. These often-competing demands have restricted the operational flexibility of the SWP and CVP systems and consequently negatively impacted the quantity, quality, and timing of deliveries. The inflexibility and resulting consequences are then passed

along to water users that are partially or wholly dependent on the operations or deliveries of the CVP and SWP systems. By storing additional water, new surface storage can contribute to improved operational flexibility in the SWP and CVP systems and associated users for the enhanced statewide water resources benefits described below.

Each of the five surface storage reservoirs could be used to improve water supply reliability. The surface storage projects could also improve source water quality directly or facilitate blending of water from different sources. New surface storage can help provide water for the CALFED Environmental Water Account and other environmental needs including ecosystem restoration actions also identified by the CALFED Program. New surface storage can also help reduce the risk associated with potential future climate change by mitigating the effects of a relatively smaller seasonal snowpack storage capacity. Implementation of individual surface storage reservoirs could augment average annual water deliveries by anywhere from a negligible amount to over 400,000 acre-feet (according to initial operations simulations), depending on the mix of benefits selected by participating agencies and operational considerations (DWR and USBR, April 2005).

The total amount of potential water supply improvements from implementation of all five surface storage projects is unknown since operations with multiple new reservoirs have not yet been modeled. However, initial model simulations show that the potential reservoirs could provide a wide range of type and geographic scope of benefits including agricultural uses, CALFED Environmental Water Account and Environmental Water Program and water supply for refuges. Additional potential benefits include urban uses, improvement of Delta water quality for the ecosystem as well as Delta users and exporters, improvement of streamflows during times critical for fisheries and other ecosystem processes, flexibility for changing the timing of existing diversions to protect fisheries, and other water management purposes.

Box 17-1 Ongoing Surface Storage Investigations

The planning process for surface storage is both comprehensive and demanding. The CALFED surface storage investigations have been developed to comply with both the state and federal environmental laws, which require extensive documentation and public involvement. In addition, implementation of any one surface storage project would likely require more than 30 regulatory permits and compliances. Both the environmental laws and the permits and compliances will allow the public to participate in a more comprehensive and informed manner and on specific issues at the appropriate time. For more information related to public involvement in the investigations, visit www.storage.water.ca.gov/index.cfm

Other strategies can be more effective with additional storage. For example, water transfers can be more easily accommodated if water can be stored temporarily and then released from an upstream location at appropriate times and the receiving areas have capacity to store the transferred water. In addition, surface storage can improve the effectiveness of conjunctive management strategies by more effectively capturing runoff that can ultimately be stored in groundwater basins.

Potential Costs of CALFED Surface Storage

New feasibility engineering cost estimates are in various stages of development for each of the five surface storage investigations (DWR and USBR, April 2005). Costs will depend on project selected objectives and configurations. The estimated capital cost for developing the individual surface storage projects identified in the ROD could range from \$180 million for the smallest Shasta Lake Expansion, to \$2.4 billion for Sites Reservoir with the most extensive conveyance facilities; the least expensive configuration of Sites Reservoir could be about half as much as the most expensive. These costs do not include anticipated annual costs such as operations and maintenance, power, or costs associated with the use of existing facilities. As the investigations continue to move forward, more complete descriptions of costs and more specific allocation of benefits will allow an economic evaluation where costs can be assigned to specific beneficiaries and benefits. Implementation of any of the five potential surface storage projects would likely include some State and federal public funding to pay for broad public benefits.

Major Issues Facing CALFED Surface Storage Funding

Sufficient and stable State and federal funding are critical to successful completion of the feasibility and environmental studies for the five projects. California's Proposition 50 provided State funding for surface storage investigations. In October 2004, the president reauthorized the CALFED Bay-Delta Program. PL108-361 reaffirms federal feasibility study authorization for four of the five storage investigations (SLWRI, NODOS, LVE, and USJRBSI). DWR, USBR and CBDA recently estimated funding necessary to complete the five investigations at \$64.3 million. An estimated \$29.2 million remains available from Proposition 50 bond proceeds to support surface storage investigations. The federal budget for this fiscal year and the president's proposed budget for next year amount to approximately \$13.5 million, leaving an unmet need of \$21.6 million. Any future federal appropriations will reduce this need further. Other efforts are underway that are also likely to help facilitate decisions regarding future funding for the surface storage investigations.

DWR has prioritized its work efforts to focus resources on identifying the most viable projects and project tasks. DWR and USBR will work cooperatively to evaluate projects using information associated with federal planning studies and reports. In addition, DWR and USBR are working with stakeholders to identify which projects have the greatest local interest and possible willingness to pay for project costs. The

Box 17-2 Los Vaqueros, Olivenhain and Diamond Valley Reservoirs

Three locally developed reservoirs that have been completed in the past seven years, Los Vaqueros in Northern California and Olivenhain and Diamond Valley in Southern California, are examples of offstream surface storage. The use or objectives of these reservoirs focused on benefits other than the traditional energy generation, flood control, and water supply. The primary benefits of these new reservoirs are related to water quality, system flexibility, and system reliability against catastrophic events and droughts. More specifically, water supply augmentation is not a primary objective of these reservoirs.

Los Vaqueros, Olivenhain, and Diamond Valley also help illustrate a potential misunderstanding of benefits in applying simplified cost calculations where yield is divided by total cost, generating a cost per acre-foot. This approach would evaluate storage projects based on cost per acre-foot of water supply improvement only. Since these projects were constructed for other benefits, the "yields" of these reservoirs are incidental. Consequently, a simplified cost per acre-foot evaluation would generate almost infinite unit cost. Similarly, application of a simplified cost allocation for the CALFED surface storage investigations is not appropriate, since these projects focus on operational flexibility, water quality, ecosystem restoration or other nontraditional benefits, in addition to water supply improvement.

CALFED surface investigations will then use results of these evaluations to develop partnerships with stakeholders to advance alternatives development and plan formulation. If partnerships are not formed (demonstrating lack of interest in advancing a project) and/or the outcome of technical and economic studies indicate any of the five projects are not feasible, the State may decide to defer future studies of specific projects. Given the estimated funding shortfall, one or more of the studies, of lesser determined priority, may have to be delayed or even terminated unless they are provided specific financial support.

Common Assumptions Effort

DWR, USBR, and CBDA initiated the Common Assumptions process to develop consistency and improve efficiency among the surface storage investigations. While each of the investigations addresses a unique purpose to meet different combinations of water supply and water quality needs, all of the surface storage investigations share some common requirements including completing planning reports and feasibility studies and the associated alternatives analyses to comply with the California Environmental Quality Act (CEQA), National Environmental Protection Act, and Clean Water Act Section 404 requirements.

The Common Assumptions teams have also been developing a set of common tools and consistency protocols among the surface storage investigations. The Common Assumptions effort has established a number of teams to address different areas required to develop consistency among the individual storage studies. Attaining consistency in modeling assumptions and analytical approach will allow the surface storage projects' performance, costs, and benefits to be compared and will inform decisions about project prioritization. The Common Assumptions process also makes more efficient use of limited technical resources.

Developing Project Alternatives

One of the next key steps in the surface storage planning process is developing project alternatives that meet the requirements of federal, State, and local participants. Alternatives development requires identifying and solving specific problems and needs. To date, USBR and DWR have developed general modeling scenarios for the five surface storage investigations. To develop project alternatives, additional detail will be needed to describe the specific goals of potential federal, State, and local participants. Project feasibility studies and environmental documents can be completed when potential participants are able to provide more specificity regarding their needs and interests.

The CALFED surface storage investigations are refining project alternatives and evaluating the level of potential participants' interests. The federal planning process is being used to determine if a federal interest exists for a specific project. In addition, USBR and DWR are working directly with potential participants by performing requested studies and are providing information to these participants as they perform their own evaluations to determine if the surface storage projects can contribute to meeting their specific water resource needs.

USBR and DWR have begun environmental documentation on three of the projects (NODOS, IDSP, and USJRBSI). These reports are being prepared concurrently with the federal feasibility planning process. However, until alternatives are developed, detailed impact analyses cannot be completed. Utilizing the planning process, identifying each surface storage project's broad public benefits and working directly with potential participants to assess their needs and interests in specific surface storage projects, the needs of all participants should be identified when the feasibility studies and the environmental documents are developed.

Recommendations to Help Promote Implementation of CALFED Surface Storage

1. CALFED signatories and stakeholders should continue to prioritize work efforts to complete the feasibility and environmental studies of the surface storage projects identified in the ROD.
 - As indicated in the funding discussion above, DWR is prioritizing future surface storage work efforts due to insufficient funding to complete environmental documentation and feasibility analyses for all five CALFED surface storage investigations. Prioritization criteria include reviewing conclusions and recommendations from ongoing State and federal planning studies; determining federal, State, and local interest, including willingness to pay; and assessing legal and logistical issues related to specific projects.
 - The investigations should continue to test all five potential projects against CALFED solution principles and implementation commitments as well as other local, State, and federal planning criteria for deciding to move to construction of any projects.
 - Engage more stakeholders and potential project participants in the process.

- Develop information on how the projects could be operated for a variety of purposes, costs, and impacts.
 - Continue evaluation and presentation of operational scenarios that will allow potential participants to assess their interest in specific projects.
 - Develop mechanisms to provide assurances that projects will be operated in a manner consistent with the objectives.
2. DWR, USBR, other CBDA agencies and local interests should cooperatively develop specific project alternatives for the CALFED surface storage projects for use in planning.
 3. CBDA, DWR, and the USBR should continue their development of conceptual finance plans that will include descriptions of relevant State and federal financial policies and a determination of the potential for State and federal investment in benefits to the general public. The scenarios and finance plans will help facilitate potential investment decisions by local, regional, State and federal decision-makers.

Selected References

- CALFED Programmatic EIS/EIR and ROD, CALFED, July and August 2000
- North-of-the-Delta Offstream Storage Investigation Progress Report, DWR, July 2000.
- North-of-the-Delta Offstream Storage Scoping Report, DWR, October 2002
- Initial Surface Water Storage Screening Report, CALFED, August 2000
- Draft Project Concept Report, Contra Costa Water District, August 2002
- In-Delta Storage Program Draft Summary Report and supplemental reports on operations, water quality, engineering, environmental, and engineering evaluations, DWR, May 2002
- In-Delta Storage State Feasibility Study Draft Reports, DWR, January 2004
- Flow Regime Requirements for Habitat Restoration along the Sacramento River between Colusa and Red Bluff, CALFED, Revised February 14, 2000
- Upper San Joaquin River Basin Storage Investigation, In-Progress Review, Initial Surface Storage Options Screening, U.S. Bureau of Reclamation, November 2002
- Upper San Joaquin River Basin Storage Investigation, Phase 1 Investigation Report, U.S. Bureau of Reclamation, October 2003

Shasta Lake Water Resources Investigation Mission Statement Milestone Report, U.S. Bureau of Reclamation, March 2003

California Bay-Delta Surface Storage Program Progress Report, DWR and U.S. Bureau of Reclamation, April 2004 www.storage.water.ca.gov/docs/Briefing_Report.pdf

California Bay-Delta Surface Storage Program Progress Report, DWR and U.S. Bureau of Reclamation, April 2005
www.storage.water.ca.gov/public_docs.cfm

Project websites: Shasta Lake Water Resources Investigations: www.usbr.gov/mp/slwr

North-of-the-Delta Offstream Storage:

www.storage.water.ca.gov/northdelta/index.cfm

In-Delta Storage:

www.storage.water.ca.gov/indelta/index.cfm

Los Vaqueros Reservoir Enlargement:

www.lvstudies.com

Upper San Joaquin River Basin Storage Investigation:

www.usbr.gov/mp/sccao/storage

Chapter 18 *Surface Storage – Regional/Local*

Surface storage is the use of reservoirs to collect water for later release and use. Surface storage has played an important role in California where the pattern and timing of water use does not always match the natural runoff pattern. Most California water agencies rely on surface storage as a part of their water systems. Similarly, surface storage is often necessary for, or can increase, benefits from other water management activities such as water transfers, conjunctive management and conveyance improvements. Some reservoirs contribute to water deliveries across several regions and some only contribute to water deliveries within the same watershed. Surface reservoirs can be formed by building dams across active streams or by building off-stream reservoirs where the majority of the water is diverted into storage from a nearby water source.

Surface storage capacity can also be developed by enlarging, reoperating (see the System Reoperation narrative) or modifying outlets on existing reservoirs. Smaller reservoirs typically store water in one season for use in another season, while larger reservoirs can do the same or store water for use over several years.

This strategy covers regional and local surface storage alternatives not currently under State and federal investigations as described in the CALFED Record of Decision. However, regional/local storage alternatives might include projects that are being investigated by CALFED but not ultimately implemented. They might also include storage alternatives that were eliminated at any juncture of the CALFED process since regional/local priorities and principles may be different than those used by CALFED. The potential CALFED surface storage projects are described in Chapter 17, Volume 2.

Surface Storage in California

California has nearly 200 surface storage reservoirs greater than 10,000 acre-feet with a combined storage capacity of more than 41 million acre-feet. In addition, many smaller reservoirs are used to provide for a wide range of water uses, stabilize water delivery to customers and provide a backup for emergency supply. Similar to many other parts of the world,

most California reservoirs were developed over 30 years ago. As of the mid-1990s, there were about 1,242 dams being built worldwide – 55 in the United States¹. In California, nearly 40 dams have been built over the past decade². Examples of recently completed surface storage reservoirs completed by local/regional entities include: Olivenhain, Los Vaqueros, Diamond Valley and Seven Oaks reservoirs. The primary benefits of these new reservoirs are related to flood control (Seven Oaks), water quality, system flexibility, and system reliability against catastrophic events and droughts rather than for traditional water supply.

Over the past several decades, fisheries have received improved benefits from surface storage reservoirs through regulation and legislation. Specifically, many existing reservoirs have been managed to achieve ecosystem and other benefits beyond water supply. As water supplies dedicated to meeting both environmental and urban uses have grown, the state's surface water system has become increasingly inflexible. Water and ecosystem managers have less ability to adapt as use and regulatory requirements frequently control operations.

The relative need for local surface storage development may be greatest in the interior mountainous areas of the state such as the Cascades and the Sierra Nevada. Although much of the

¹ United States Society on Dams, November 2000

² Source: CA Division of Safety of Dams; includes DSOD jurisdictional dams only.

water used throughout the state originates in the mountains, these locations generally possess a much narrower array of available water management strategies to meet local needs. This is largely due to geographic, hydrogeologic or hydrologic limitations. Of these few strategies, some form of surface storage may hold the greatest potential for achieving local supply reliability objectives. Local surface storage development options include the reoperation of existing reservoirs, increasing the yield of existing reservoirs through expansion of their capacity, or construction of new reservoirs.

Potential Benefits of Surface Storage

Many of California's reservoirs were originally built for the primary purposes of hydropower, flood control, and consumptive water use. Although the allocation of benefits for proposed surface storage can affect the occurrence and magnitude of different types of benefits, they generally can include the following:

- Water quality management
- System operational flexibility
- Power generation
- Flood management
- Ecosystem management
- Sediment transport management
- Recreation
- Water supply augmentation
- Emergency water supply

The presence of new surface storage could allow ecosystem and water managers the flexibility to take actions and make real-time decisions that would not be possible without the storage. Water transfers between regions could be easier if water can be released from upstream storage at appropriate times and the receiving regions have reservoirs to store the transferred water. Surface storage can improve the effectiveness of conjunctive water management strategies by more effectively capturing runoff that can ultimately be stored in groundwater basins.

Storage projects can improve the movement of water at times to improve source water quality directly or facilitate blending of water from different sources to optimize system water quality. New surface storage can help provide water resources assets for the CALFED Environmental Water Account and Environmental Water Program, and for refuges. New surface storage can also help reduce the risk associated with potential future climate change by mitigating the effects of a relatively smaller seasonal snowpack storage capacity as well as increased or more sustained peak flood flows.

Potential Costs of Surface Storage

Cost estimates for potential surface storage alternatives are not specified in this narrative since they are only useful if created for a specific project with defined operation rules and allocation of benefits and costs. The costs of multipurpose storage projects will be shared by many beneficiaries. The magnitude of the benefits and corresponding costs for such things as water supply, water quality and flood management can be expected to vary significantly from project to project.

Major Issues Facing Surface Storage

Identifying Beneficiaries

There are concerns related to how the beneficiaries will be determined, who will actually pay, and who will control the storage operation. The challenge is to develop financial and operations agreements for the multiple beneficiaries and uses.

Funding

Construction usually requires a lot of money in a short time – perhaps \$1 billion or more over five years for larger projects. Included in the long-term capital outlay are planning costs such as administrative, engineering, legal, financing, permitting and mitigation, which can also require significant investments. Some new storage options such as raising existing reservoirs, reoperating them or the construction of small local reservoirs may require significantly less capital, but may require local funding through revenue or general obligation bonds. Even these less costly projects could face financial challenges.

Impacts

New storage can affect environmental and human conditions, create economic impacts for the surrounding community, and flow impacts both up and downstream of diversions. New reservoirs may result in the loss of property tax revenue to local governments in the area they are located, or by increasing local property values by firming up a water supply. Regulatory and permitting requirements require surface storage investigations to consider potential impacts to stream flow regimes, potential adverse effects on designated wild and scenic rivers, potential water quality issues, potential changes in stream geomorphology, loss of fish and wildlife habitat, and risk of failure during seismic and operational events. Existing environmental laws require that these types of effects be mitigated. Mitigation of environmental effects is normally accomplished through implementation strategies that avoid, minimize, rectify, reduce over time, or compensate for negative impacts. New surface storage projects may need to address impacts

under the application of various laws, regulatory processes and statutes such as Public Trust Doctrine, State dam safety standards, Area of Origin statutes, California Environmental Quality Act, National Environmental Protection Act, the Clean Water Act and the Endangered Species Acts.

Suitable Sites

Most of the best reservoir sites have already been used and the new standards of environmental regulations are significant constraints to development of surface storage in the mountains. The range of surface storage development options for smaller local agencies is more limited than for the State and federal governments. Local agencies have limited ability to use State or federal funds, nor do they have the ability to work as closely with their corresponding resource regulatory agencies such as the State and federal agencies do as part of CALFED. Additionally, there are physical limitations on storage options in some parts of the state. In some areas, offstream storage is not feasible. These circumstances severely constrain the ability of local governments and agencies to finance and implement the projects necessary to sustain the local economy and serve increasing populations.

Science

Biologists and water managers continue to struggle to identify and understand the relationships between hydrodynamics, flow timing, water temperature, geomorphology, water quality, environmental responses, and other conveyance related considerations. Increased understanding of these considerations will enable resource planners and managers to better determine the causes of observed impacts and hence, more effectively restore, preserve and manage at-risk resources, such as modified operations and environmental mitigation.

Recommendations to Better Manage and Increase Surface Storage Benefits

1. Local agencies seeking to implement storage projects should develop a comprehensive methodology for analyzing all benefits and full costs of projects. DWR should provide technical expertise and assistance to the local agencies if asked.
2. Reservoir operators and stakeholders should continue to adaptively manage operations of existing facilities in response to increased understanding of system complexities and demands as well as changes in natural and human considerations such as social values, hydrology, and climate change.
3. DWR and other local, State and federal resource management agencies should continue studies, research and dialogue focused on a common set of tools that would help determine the full range of benefits and impacts as well as the costs and complexities of surface storage projects.
4. Water resources scientists, engineers and planners, including DWR should recognize the potential long development time for new surface storage in securing funding needed for continuity of planning, environmental studies, permitting, design, construction, and operation and maintenance.