Supplemental Information Report

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American River Watershed Project, California

Volume 1 - Appendixes A - D

US Army Corps
of Engineers
Sacramento District

The Reclamation Board
State of California

SAFCA
Sacramento Area
Flood Control Agency

Increased Folsom Dam & Reservoir Outlet Efficiency

This category includes measures to improve the flood control release efficiency of Folsom Dam's outlets to the lower American River. They include:

- Improved operational response time
- Normalized use of auxiliary spillways
- Lower main spillway
- Conjunctive use of river outlets & main spillway
- Enlarge river outlets
- New river outlets
- Use of existing diversion tunnel
- New tunnel outlets through right abutment
- Early flood releases prior to storms based on weather forecast

Increased Folsom Dam Flood Releases

This category includes various measures to safely accommodate higher floodflows downstream from Folsom Dam. Measures identified include:

- Increased Objective Releases Through Levee Modification
- Increased Objective Releases Through Setback Levees
- Flood Control Bypass South of Sacramento

Increased Total System Flood Storage

This category includes a host of measures aimed at increasing the reservoir storage in the watershed creditable to flood control. These measures include:

- Flood Control Dam at Auburn
- Use of Existing Private Reservoir Storage Upstream from Folsom
- Multiple Small Upstream Detention Facilities
- Offstream (Out of Basin) Storage on Deer Creek
- Modifications to Reoperation of Folsom Dam and Reservoir
- Raise Folsom Dam & Spillway
- Credit Surcharge Storage for Flood Control
- Excavate Folsom Lakebed

Non Traditional Methods

This category includes measures aimed at protection of individual property, land usage, or actions during a flood. These measures include:

- Flood Proofing
- Flood Plain Evacuation

TABLE II-11

Summary of Reoperation Costs
($ million)

Affected Resource	Reoperation Level (1,000 acre-feet)		
	280/500	475/670	535/835
Power	+4.00	-1.30	- 3.00
Water	+1.50	-7.20	- 10.00
Local Pumping	+0.03	-0.02	-0.04
Recreation	+0.10	-0.10	-0.10
Environmental Mitigation	+0.10	-0.10	-0.10
Total Reoperation Annual Cost	+$5.73	-$8.70	-$13.24

Raise Folsom Dam and Spillway

Existing Conditions and Problems. A second method to increase the amount of storage in Folsom Reservoir available for flood control is to increase the space above the existing gross pool of elevation 466. Because of its location low in the foothills, the existing concrete dam would have to be raised, and approximately 5 miles of wing dams and supplemental dams and dikes that fill in low spots around the reservoir perimeter raised and extended.

Potential Modifications. This measure consists of increasing flood storage capacity above the existing gross pool by raising Folsom Dam and Spillway. Two levels of dam raising were analyzed, 30 feet and 17 feet. The 30-foot raise is thought to be a maximum acceptable increase in reservoir size. The 17-foot raise is the minimum size required to control the probable maximum flood (PMF) flow. Both raises maintain the existing 14.5 feet of freeboard that is currently used to control higher-than-design storms up to the spillway design flood. With the dam raise, the freeboard or surcharge area is used to control the PMF for dam safety reasons. A dam raise of 30 feet would increase storage by 366,000 acre-feet and a dam raise of 17 feet could provide 199,000 acre-feet. The increased space would be only for use as additional flood storage. No additional water supply storage would be available under this measure. That means that the lake would usually remain at current levels (gross pool 466 feet) and water would only rise into the flood space for up to 7 days in the event of a larger flood, such as a 50-year storm or greater.

Adding the storage to the existing reservoir would affect the maximum storage required for the without project variable flood control operation. In both cases the maximum storage required would require the reservoir to be periodically drawn down to less than 100,000 acre-feet of water. Because this operation is not practicable, for this measure, the operation of Folsom Dam and reservoir would return to the fixed seasonal food control storage of 400,000 acre-feet below the existing gross pool.

The dam raise measures would require raising the existing concrete dam section and extending the right and left wing blocks. In addition, the right and left wing dams, Mormon Island Auxiliary Dam, and the eight dikes would need to be raised and lengthened. All structures would be raised to elevation 510.5 for the 30-foot raise and 497.5 for the 17-foot raise. The embankment structures would be raised on the downstream (landward) side to avoid the need for drawing down the reservoir for construction. The downstream raise would result in shifting the dam crest and centerlines.

To raise and extend the concrete portion of the dam, the reservoir would need to be drawn down to allow excavation of the adjacent areas to a firm foundation. To reduce the extent of this drawdown, the left and right wing dams would be only partially excavated next to the concrete monolith. A sheet pile or slurry cutoff wall would be placed in the upstream side of the dam embankment to elevation 426. The reservoir would be drawn down to elevation 416 during the second year of construction. The area around the concrete dam sections would be excavated to bedrock and the new concrete sections placed and embankment replaced to the new dam heights. Materials required for embankment raises would be obtained from borrow sites within the reservoir.

In addition to raising the dam, the existing 50-foot gates would be replaced with 65-foot tall gates. These taller gates would improve the spillway capacity so the dam would be able to pass a probable maximum flood safely, as well as improve the normal flood control capacity. To support these new gates, the concrete support piers would have to be strengthened with additional reinforced concrete and an external steel frame. The increased spillway capacity would also require enlarging the stilling basin downstream. The work on the main dam would require closing the dam road for up to 2 years, so a new bridge nearby would be necessary to handle the displaced traffic.

The 17- or 30-foot raise would take a total of 6 years to complete according to the following schedule:

- Year 1 - Normal Reservoir Levels - stockpile aggregate, prepare embankments for excavation and raising.
- Year 2 - Water Level 416 - complete concrete dam extensions on north and south sides.
- Year 3-6 - Raise the main concrete dam, replace gates, raise embankments and dikes.

Impacts and Mitigation Features.

Construction Impacts. Several structures exist in the 30-foot inundation zone which would need to be relocated. Undeveloped parkland or private grazing land would continue to be used as is, with restrictions on future development.

Water quality could be affected during construction, as 3.6 million cubic yards of material used to raise the main dam and wing dams would be excavated from the lakebed.

Construction impacts to fisheries would be caused by lowering the reservoir to accommodate raising the dam. The reservoir would be lowered to elevation 390 feet for the first and last years of the 6-year construction period. At 390 feet, about 300,000 acre-feet of water is held in the reservoir, about 30 percent of full capacity. The 2 years of drawdown would substantially reduce the habitat available for breeding. The shallow breeding areas would be exposed and inaccessible to fishes. Lowering the reservoir would reduce coldwater habitat for the reservoir fisheries, especially rainbow trout. Depending on the weather during this drawdown period, there could potentially be water temperature impacts on the lower American River, which could negatively affect salmon.

Folsom Dam Road would be closed for at least a year during construction of this measure. When open, the road would be congested with construction vehicles. Construction schedules estimate a 6-year construction period. Depending on the chosen construction schedule, the first 12 months of this time would be to prepare for and set up the construction area and to begin excavation for borrow materials. Initially, traffic to the construction site would include delivery of machinery and materials.

Air quality and noise impacts are expected as a result of construction. These impacts would include combustion emissions from heavy-duty construction equipment and dust/particulate generation from earthwork activities and blasting.

The draw down of the reservoir could have recreation and economic impacts in that limiting refill of the reservoir during dam raising could result in much lower lake levels the following year and reduce flows in the American River and water deliveries.

Operation Impacts. During large storms, such as a 50-year storm or greater, the water surface would rise above the normal maximum of 466 and affect the lakeshore and some surrounding structures. A 17-foot water-surface rise would inundate parking lots, boat ramps, campgrounds, comfort stations, and several recreation service buildings. These facilities could be cleaned up and repaired or replaced after being flooded. Flood proofing measures on buildings could reduce flood damage, making reopening facilities easier. Flood proofing and repair of facilities appears to be more practical than relocating them to higher ground, far from the lakeshore. The winter boat storage at Brown's Marina, however, would be relocated, as winter boat storage does not need to be near the lakeshore. The 17-foot water rise would also inundate about five private residential structures that would have to be purchased or raised. Two miles of road along the south shore would need to be relocated and

the Salmon Falls bridge raised. The PG&E Newcastle Powerhouse would need to be flood proofed. In addition to the impacts of a 17-foot raise, a 30-foot raise would impact about 10 more houses and an additional 2 miles of road.

Operational impacts associated with this measure would adversely affect recreational facilities around the lake during flood operations when the lake would rise and damage buildings. These structures would be repaired after each occurrence (estimated to occur only during 100-year storms or greater).

Impacts are expected to habitat on the North and South Forks American River. Filling the expanded reservoir area would flood about 3 miles of the North Fork and 0.5 mile of the South Fork. Model simulations estimate that flooding would last no more than 6 days. Inundation of these currently free-flowing reaches could adversely affect fisheries in the area. Slumping of the canyon walls because of soil saturation would increase sedimentation, and this sediment would potentially cover spawning habitat.

Because the vegetation would be inundated, raising Folsom Dam would cause changes in the vegetation composition of the area between 466 feet and 496 feet and soil erosion and slippage on steep slopes along the upper reservoir and the forks of the American River. Inundation of the North and South Forks would affect mostly blue oak-digger pine woodland cover and substantial amounts of oak woodland, riverine, grassland, and chaparral habitats. In addition, smaller amounts of riparian habitat around the reservoir would be subject to inundation. Table II-12 summarizes the acreage of habitat types subject to inundation for a dam raise of 30 feet. For this analysis it was assumed that raising the dam 17 feet would result in one-half the loss for the 30-foot raise.

The vegetation types expected to be exposed to inundation are not highly tolerant of flooding, and some losses would be expected if inundation lasts up to 2 weeks. Wildlife within the areas of inundation would be affected; slow-moving species, such as reptiles and amphibians, and hibernating species would likely drown. Mitigation for this impact would include acquiring and preserving or enhancing land adjacent to the reservoir.

Potential Accomplishments. Raising Folsom Dam would improve the ability of the food control system to control floodflows at the existing objective release of 115,000 cfs. The 30-foot and 17-foot raises would increase Folsom Dam's ability to control storms from an 85-year return frequency to a 180-year and 130-year return frequency, respectively, assuming a variable operation of the flood control space.

Costs. The cost would be about $655 million for the 30-foot raise and about $456 million for the 17-foot raise. Annual cost are $59 million and $41 million, respectively.

TABLE II-12

Estimate of Habitat Areas Subject to Inundation
by Expanded Folsom Reservoir

Habitat Type	Potentially Inundated Acres 17-Foot Raise	Potentially Inundated Acres 30-Foot Raise
Blue oak-digger pine	521	1,041
Oak woodland	247	494
Annual grassland	44	88
Chaparral	33	66
Riparian	8	16
Disturbed	60	120
Riverine	64	127

Excavate Folsom Lakebed

Existing Conditions and Problems. The third way to increase the total amount of space in Folsom Reservoir would be to increase the amount of space below the gross pool. Folsom Dam was designed to provide 1.01 million acre-feet of space. Sedimentation of the reservoir caused by erosion of upstream bank and bed materials into the reservoir have reduced the total available space to 975,000 acre-feet at the gross pool elevation of 466 feet. The total space available in the reservoir can be increased by excavating sediment and bed materials from the bottom of the reservoir.

Potential Modifications. This measure would consist of excavating Folsom lakebed to create more reservoir capacity. In general, this is not practical for large impoundments due to cost, but is included here for completeness. To have a significant impact on flood control, and to compare to other measures, an excavated volume of 100,000 acre-feet is used as an example. There has not been an engineering study done for this measure, so the cost estimate is presented here is only an estimate.

To estimate the cost of excavating 100,000 acre-feet (160 million cubic yards) from Folsom Reservoir one must address how such a project might be done. The geology of Folsom Reservoir is basically rocky hills with very thin (3- to 4-foot) soil veneer. The only major quantities of soil are found in the American River streambed, which is under water most of the time. So, excavation difficulties are significant.