Comments of Friends of the River
CALFED Bay-Delta Program DEIS/R
July 1, 1998

I. The CALFED Mission

The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system.

The word "restore" is defined as bringing something back "to a previous or original condition." For reasons that will become clear in our detailed comments, Friends of the River does not believe that the CALFED program can truly restore the Bay-Delta system. At best, CALFED can only mitigate the environmental impacts of the existing system of dams and diversions in the delta watershed. At worst, CALFED's plans to build new or enlarged storage and conveyance facilities may actually increase the adverse impacts to the Bay-Delta ecosystem.

CALFED's intent to restore the delta is incompatible with the other half of the mission to improve water management. This largely translates into increasing the reliability of water supplies through the development of additional surface water storage and conveyance facilities, which directly competes with and is contrary to CALFED's intent to restore the delta and its tributary watersheds.

Likewise, the competing directions of the CALFED mission will inevitably fail to satisfy the basic CALFED solution principles, including conflict reduction, equity, affordability, durability, implementability, and no redirected impacts. CALFED's proposal to significantly increase surface storage and conveyance increases conflicts. The proposed facilities are neither equitable or affordable. CALFED's intent to pursue the same old solution (concrete) for the same perceived problem (lack of water) is not a durable solution, nor is it implementable within our current framework of environmental laws. CALFED's strategy of building upstream storage to increase and improve delta flows clearly redirects the adverse impacts of the facilities from the delta to the upstream watersheds affected by the new projects.

II. Surface Water Storage & Conveyance

CALFED estimates that an additional three million acre feet (MAF) of new surface water storage north of the delta and an additional two MAF of new storage south of the delta would be required to achieve water supply benefits. Consequently, seven of the 12 alternatives considered by CALFED include these programmatic targets for new surface water storage. The intent of increasing surface water storage is to skim off high flows during wet and above normal water years for storage and use during normal, below normal, dry, and critical years.

Unfortunately, the high flows targeted under the CALFED strategy are critical to the survival of migratory and resident fish populations in the delta and upper watersheds. There is an undisputed correlation between successful salmon outmigration and high delta outflows. If these high delta outflows are reduced or eliminated by CALFED's surface storage and conveyance program, many of the delta's and Central Valley's threatened, endangered, and sensitive fish species could become extinct. CALFED intends to mitigate this threat by "solving" hydraulic problems in the delta, reducing fish losses elsewhere in the system, and restoring habitat. But if this mitigation strategy fails, so will the fish populations.

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North of delta storage projects in the Sacramento River watershed under consideration by CALFED include:

- Shasta dam/reservoir enlargement (6.75-14.3 MAF)
- Cottonwood Creek complex (1.6 MAF)
- Red Bank project (354,000 AF)
- Thomes-Newville offstream project (1.84-3.08 MAF)
- Sites-Colusa offstream project (1.2-3.3 MAF)
- Berryessa reservoir enlargement (6-13.3 MAF)

The Red Bank, Thomes-Newville, Site-Colusa, and Berryessa enlargement projects would require expansion and/or extension of the existing Tehama-Colusa diversion and canal, and/or construction of up to two new diversions and canals (Chico Landing intertie and/or Berryessa intertie).

Significant environmental impacts associated with these upstream projects include:

- Destruction of Aquatic/Terrestrial Habitat -- All of the projects would miles of aquatic habitat (instream and wetlands) and thousands of acres of terrestrial habitat drown under new or enlarged reservoirs. The most egregious example is the Shasta dam enlargement which threatens 42 miles of stream habitat, including key segments of the upper Sacramento, McCloud, and Pit rivers, as well as 30,000 acres of public and private forest and recreation lands. Critical habitat for threatened, endangered, and sensitive (TES) species such as the Pacific fisher, northern spotted owl, Shasta salamander, foothill yellow-legged frog, valley elderberry longhorn beetle, and fairy shrimp would be inundated.

- Blocking of Spawning Habitat -- The Cottonwood Creek, Red Bank, and Thomes-Newville projects would block access by endangered steelhead and salmon to current spawning habitat in Cottonwood Creek and Thomes Creek, adding to the 95 percent of historic salmon habitat already blocked by dams in the Central Valley. Dams on Cottonwood Creek would reduce recruitment of critical salmon/steelhead spawning gravel to the Sacramento River.

- Diversion Impacts on Salmon/Steelhead -- New or enlarged diversions from the Sacramento River to supply water to offstream projects such as Thomes-Newville, Sites-Colusa, and Berryessa enlargement will result in "double jeopardy" for salmon and steelhead which must negotiate one or more new or enlarged diversions for offstream projects, as well as a new diversion for the peripheral canal or the existing delta pumps.

- Habitat Loss Due To Flow Modification -- Skimming high delta outlfows for storage could reduce successful salmon outmigration and impact resident delta fisheries. Major flow modifications in the Sacramento River as a result of new or enlarged upstream dams could contribute to the loss of critical riparian habitat and shaded riverine aquatic habitat along the Sacramento River. Reduced flows along the river may encourage conversion of riparian/riverine habitat to agricultural and other uses. Increased summertime flows could increase bank erosion through sloughing, leading to new bank protection projects (rock riprap) and loss of riparian/riverine habitat. Potentially impacted TES species include aquatic species such as salmon and steelhead, as well as terrestrial species such as valley elderberry longhorn beetle, yellow-billed cuckoo, bank swallow, Swainson's hawk, and others.

- Public Lands, Policies, & Laws -- Thousands of acres of public lands managed by the Forest Service and Bureau of Land Management for fish and wildlife habitat, as well as for outdoor recreation, would be inundated by the projects. Segments of the Sacramento River,

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McCloud River, Cottonwood Creek, Beegum Creek, and Thomes Creek considered eligible for National Wild & Scenic River status would be impacted by the projects. State participation in Shasta dam enlargement is forbidden by state law. TES species and their habitat protected under state and federal law would be lost. Federal and state water quality standards could be threatened. Flow modifications in the Sacramento River can cause erosion that leads to bank protection, and/or new diversions that create "hard points" along the river. This threatens existing state and federal policies to create a Sacramento River meanderbelt to support a naturally functioning riparian/riverine ecosystem.

Similar impacts are associated with the so called "isolated delta conveyance" (a.k.a. -- peripheral canal) and storage projects proposed south of the delta. Diversion impacts on salmon, steelhead, and resident fish species in the delta are particularly significant. Loss of terrestrial and aquatic habitat associated with large offstream reservoirs such as Los Banos Grandes, Montgomery, or Orestimba, as well as onstream projects such as Millerton reservoir enlargement, would also be significant.

Some of the impacts could be mitigated, but much remains unknown about our technological ability to meet this challenge. For example, the adverse impacts on endangered fish could be serious if proposed fish screens fail to work as hypothesized. It is critical to note the long history of failed fish screens on major diversions in the Sacramento River and delta. Habitat protection and restoration could mitigate the loss of habitat associated with new or enlarged storage projects, but only if CALFED uses rigorous and quantifiable criteria for its protection and restoration programs which would ensure a no net loss of habitat. Some impacts, such as the loss of some of California's few remaining free flowing river segments, are significant and unmitigable.

Regardless of mitigation efforts, the likely and potential adverse environmental impacts associated with these new or enlarged storage and conveyance projects clearly result in a "redirecting" of environmental impacts from the delta to watersheds north and south of the delta.

III. Water Efficiency Technical Appendix

General Comments

CALFED includes water efficiency in its "Common Programs." However, nowhere in the Draft EIR/EIS is water efficiency linked back to ecosystem restoration and protection of the Bay-Delta. After factoring in wet year/dry year scenarios, environmental constraints, and similar information, CALFED models then assume that the Delta pumps will always operate at 100% capacity. Such modeling fails to take into account additional water conservation that may be conserved *south* of the Delta.

In testimony by Martha Davis of the Mono Lake Committee, "The unthinkable has happened: today the MWD [Metropolitan Water District] service area is using about the same amount of water as it used fifteen years ago despite an almost 30% growth in its population." Unfortunately, the Southern California conservation success story is disconnected from CALFED's modeling assumptions.

We strongly urge CALFED to incorporate the figures for water conserved through urban and agricultural efficiency measures into its modeling scenarios and to credit this conserved water to improving the health of the Bay-Delta ecosystem.

Friends of the River also wishes to register our strong opposition to any use of Bulletin 160-98 (the California Water Plan) as the basis for any planning under CALFED. Bulletin 160-98 is not an objective analysis of California's future water supply and it dramatically overstates the future gap between supply and demand. The document relies on inappropriate assumptions and modeling which biases the analysis in favor of construction of new storage facilities, drastically underestimates the potential for water conservation, water recycling, and other efficiency measures. Bulletin 160-98 fails to use real numbers in its base case and, without explanation, presents dramatically inflated urban demand figures. Some independent analyses have shown that Bulletin 160-98 overestimates future urban water demand by over one million acre feet.

Specific Comments

The table on page 1-6 is confusing and seems to contradict the table on page 55 of the Phase II interim report.

We disagree (on page 2-6) that DWR certification of urban or agricultural water management plans is sufficient. CALFED must do more than "consider" that a water supplier meet criteria for measurement of water deliveries and water pricing contained in the U.S. Bureau of Reclamation's CVPIA water conservation criteria. Section 3405(e) of the CVPIA *requires* the Bureau of Reclamation to develop these criteria and requires that water contractors comply with federal law.

Furthermore, CALFED should require compliance with SB 901. This state law requires that when cities and counties prepare environmental documentation for approval of large developments, they must request an assessment of water supply availability during normal and drought years by the appropriate local water agency. The agency must provide this assessment and the city or county must include this assessment in the environmental documentation.

We agree on page 2- 6 that "Widespread demonstration of efficient use by local water suppliers and irrigation districts [should] be a prerequisite to CALFED implementation of other Program actions for water supply reliability." However, CALFED needs to stipulate specifically what "widespread demonstration" means.

Friends of the River supports Action 4, *Management Improvements to achieve Multiple Benefits*, found under the Agricultural Water Efficiency Actions (page 2-12). CALFED should develop such a program more fully to give adequate consideration of the water quality, timing, instream flows, and fish migration.

On page 2-13, the assurances for agricultural water use efficiency must be strengthened. Relying on the Agricultural Memorandum of Understanding created by AB 3616 to provide such assurances is completely unacceptable. The Agricultural MOU only requires signatories to develop a plan; they are not required to implement any best management practices. In fact, the MOU lists water measurement and pricing by volume as optional measures.

We support CALFED's decision (page 2-13) to trigger legislative and regulatory mechanisms when the majority of agricultural water suppliers have not prepared, adopted, and implemented their Agricultural Council endorsed plans by January 1, 1999. We agree that an acceptable majority consists of districts serving at least 2/3s of the total acreage in the CALFED solution area, including the Sacramento and Imperial Valleys.

Friends of the River agrees with CALFED [page 2-21] that water recycling should be included as a best management practice under the California Urban Water Conservation Council. We also agree [page 2-22] that region-wide water recycling should be encouraged and that CALFED

should provide funding assistance. However, state, federal, and local water and sanitary agencies must do more than "provide opportunities" for region wide recycling. Such efforts must be required and sufficiently funded. Furthermore, CALFED and state and local agencies must not engage in a "Rob Peter to pay Paul" scenario in which water conservation programs must compete with water recycling programs.

We are pleased to see that the pie chart on page 3-1 gives a more accurate depiction of water use in California than does the biased information in DWR's Bulletin 160-98. However, we disagree with the assertion that "overall environmental water use (including instream flows) is equivalent to agriculture." Instream flows, including those from rivers designated under the Wild and Scenic River Act, are used multiple times for agricultural, urban, and recreational uses. Agricultural water use is a consumptive use whose return flows degrade water quality.

Friends of the River is pleased to see CALFED acknowledge that water efficiency provides "significant benefits to water quality and the ecosystem." CALFED should also note that water efficiency makes it possible for diverters to take less water out of the system at the outset. CALFED should factor in the cost of degraded water quality to instream flows as well as the cost of wastewater treatment and energy costs associated with diverting water from rivers and streams.

Requiring all agricultural water users [page 4-2] within the CALFED solution area to achieve at least an 85% efficiency level and irrigation distribution uniformity of 80 to 90% is already being reached by growers in Westlands Water District. This is an attainable CALFED goal and should be supported with federal and state funding assistance, provided on a cost-sharing basis with local agencies.

Furthermore, in assessing the cost of implementing these improvements, CALFED should factor in the *true* cost of water, including the cost of current federal and state subsidies to water districts.

On page 4-5, why are changes in crop mix, fallowing, and permanent land retirement considered "changes in use" rather than "efficiency improvements"? These measures would permanently reduce the amount of water used by agriculture which could be released for ecosystem restoration. In fact, are not these measures "real" water savings?

Page 4-6 considers factors which growers evaluate when considering the merits of improving irrigation efficiency. An additional factor which CALFED should consider is implementation of Section 3408(I) under the Central Valley Project Improvement Act. Section 3408(I) would allow farmers and the Bureau of Reclamation to cost-share irrigation efficiency measures. The percentage of water conserved as a result of Reclamation's financial assistance could be credited to ecosystem restoration.

In discussing conveyance seepage and evaporation [page 4-12], has CALFED also considered the amount of seepage and evaporation in the Central Valley Project and State Water Project which convey water to water contractors? What is the amount of seepage and evaporation for these Projects?

On pg. page 4-13, the *Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers* is grossly mischaracterized. The MOU does not represent a consensus between agricultural and environmental interests. Only one environmental organization working primarily in water has signed the MOU. In earlier correspondence to CALFED, a number of environmental organizations have explained their opposition to the current MOU and have made specific recommendations, including more meaningful requirements on water measurement and pricing, to make the MOU acceptable.

We take issue with the distinction between irrecoverable and recoverable losses [page 4-15] and how CALFED will account for them. Recoverable losses are important in contributing to CALFED's ultimate objective -- to restore the Bay-Delta ecosystem. Reducing the amount of applied water by urban or agricultural water suppliers reduces the need to divert water out of streams and improves compliance with Endangered Species Act requirements.

On Page 4-20, CALFED states that "if efficiency is improved, indirect use of 'losses' by subsequent users will decline, but direct use of water by those subsequent users will increase." Why should subsequent users receive subsidized water completely free of charge? What is the true cost of this free-loading?

Figure 4-7 and the accompanying text on page 4-21 does not make a case for maintaining current inefficient water management practices. Rather, these assertions illustrate the need for comprehensive groundwater management. We request that CALFED develop a framework for creating such a program.

We agree that more efficient water management which reduces diversions can have a significant benefit in reducing aquatic entrainment and improving instream water quality. These benefits should be emphasized even more. We agree that the focus should be on the benefit of each unit of water.

In discussing "irrecoverable" loss on page 4-25, is degraded water quality an irrecoverable loss? What is the cost of this degraded water quality?

In determining throughout Chapter 4 that existing average on-farm irrigation efficiencies are between 73% and 76% throughout the state, how did DWR arrive at this figure? Did DWR provide data to reinforce their assumptions?

In discussing "estimated on-farm efficiency improvement costs" on page 4-46, CALFED's figures seem to be arbitrary. What is the amount of subsidies which keeps the existing price of surface water low? Most importantly, what are the assumptions used to create the Central Valley Production Model?

The table and text on page 4-47 raise many questions. For instance, is the cost of electricity for pumping factored in? Are the costs of irrigation efficiency improvements amortized over time? If so, for how long a period? How does the table factor in how much farmers now obtaining free water from their inefficient upstream neighbors would be paying if they were not freeloading?

Page 4-48: What would the actual cost of CVP and SWP water be if there were no taxpayer subsidies?

The statement on page 5-3 that the cost to improve urban efficiency is between $300 and $600 is too simplistic and fails to take into account the marginal price of water. Urban water agencies with increasing block structures often use marginal cost as the breakpoint between tiers. This sends an appropriate price signal to large and/or wasteful users and can significantly affect water use. CALFED fails to incorporate price with supply and demand. This is a major oversight.

We reject the projected urban per capita water use developed by DWR in Table 5-2. As many environmental organizations explained in their comments on Bulletin 160-98, DWR fails to include the price of water in any discussion of water demand. Furthermore, in developing Bulletin 160-98, DWR did not rely on data collected annually from local water agencies to

determine actual water use in California. DWR also used "normalized" data with no explanation as to why or how they developed such data.

In looking at "UR1- Sacramento River" in DWR's table, we do not see evidence that DWR took into account the Sacramento Water Forum agreement in which unmetered agencies (including the City of Sacramento) agree to a phased-in metering program starting in the year 2000. Numerous studies show that water meters reduce per capita use from 15 to 25 percent.

Page 5-23 discusses unaccounted for water and the need for leak detection. This effort would be helped if all urban customers were metered.

We disagree with the assumption on page 5-24 that "real water savings can only be achieved by reducing irrecoverable losses..." This is the same argument which DWR made -- without explanation -- in its Bulletin 160-98.

We request instead that CALFED carefully consider the Pacific Institute's memorandum of May 20, 1998, entitled "Application of Applied Water/Real Water/New Water Distinction in Bulletin 160-98 and CALFED DEIR/DEIS. The memorandum explains that the distinction between "real" and "applied" water is only relevant in situations with fixed demand. In the case of inland urban California, demand is growing and, as the Pacific Institute states, "In numerical terms, this error means the distinction drawn in CALFED between 'applied water' and 'real water' savings potential should be counted as reductions in estimated future demand on a one-for-one basis.

In discussing the Sacramento River, page 5-26, we support CALFED's acknowledgment of the water quality degradation caused by urban and agricultural inefficient water management. We request that CALFED quantify the benefits and costs related to water quality, ecosystem, timing, and energy savings. We also request that CALFED include the future estimates of water savings when water agencies implement the Sacramento Water Forum agreement.

Page 5-28 assumes that changes in types of outdoor landscaping will only have negligible savings. What happens if soil evaporation is minimized?

Page 5-38: What will be the price of water in the Central Coast when the State Water Project is completed? Won't the high cost of water spur further water efficiency measures?

On page 5-44 and 5-48, CALFED states that greater water efficiency among Palm Springs users and Colorado River users are "unlikely" to benefit the Bay-Delta because those savings could not be transferred to another urban user. However, isn't it likely that greater local efficiency will translate into less impetus to import water from the Bay-Delta? Shouldn't Imperial Valley and Palm Springs water savings be included?

Is it correct to assume, based on tables 5.4 and 5.5 that the total amount of water -- both applied water reductions and water available for reallocation -- will be between 5,170,000 and 5,720,000 acre feet each year?

We urge CALFED not to use figures from Bulletin 160-98 for water recycling potential [page 6-10]. In Bulletin 160-98, DWR discusses the options for reuse in one chapter and then substantially discounts them in a later chapter. Furthermore, DWR discounted all projects in the "conceptual stage" without explanation. We urge CALFED to consider a range of 1.5 to 2.5 million acre feet as the actual potential for water reuse statewide by the year 2020. Furthermore, we urge CALFED to promote indirect potable reuse of recycled water.

Friends of the River urges CALFED to insure that the most economically- and environmentally-viable alternatives be pursued fully, and that conservation and recycling be integrated into CALFED's modeling scenarios. From its inception, the stated primary goal of CALFED has been to restore the degraded Bay-Delta ecosystem. Aggressive water conservation and water recycling will enable agricultural and urban water agencies to develop cost-effective, reliable water supplies while phasing out the current disastrous water management planning which has brought the Bay-Delta ecosystem to the brink of collapse.

IV. Ecosystem Restoration Program

CALFED's ecosystem restoration program (ERP) is critical to mitigating the impacts of existing storage and conveyance. However, it is unlikely that the ERP will be able to mitigate existing impacts as well as new impacts associated with CALFED's new storage and conveyance components. The key to effective implementation of the ERP will be the adoption of rigorous and quantifiable restoration criteria to ensure that the public's investment in restoration achieves the goal of stabilizing and restoring species and their habitat.

Currently, the DEIS/R and the ERP fail to quantify just how much habitat will be restored and to what population level TES species will be recovered. The DEIS/R provides no "balance sheet" that allows the reader to compare habitat/species restored with habitat/species impacted. In addition, entire regions affected by current facilities and by the CALFED plan are ignored in the ERP, including the San Joaquin River, Trinity River, and Tulare basin. CALFED cannot truly restore the Bay-Delta system without addressing these critical regions.

Most of the objectives, targets, and programmatic actions outlined in the ERP represent positive steps towards effective mitigation and restoration. Some of the more laudable multi-targeted objectives and actions include:

- Sustain instream flows and maintain water temperatures suitable for native species.
- Remove some small dams which block fish migration and downstream recruitment of spawning gravel.
- Establish stream meander corridors, setting back levees, and enlarging flood plains to support and restore natural ecological processes and habitat.
- Sustain natural erosion processes and protect riparian habitat, by phasing out and reducing activities such as bank protection, gravel mining, and streamside grazing.

While the ERP suggests that some small dams may be removed to restore habitat, the failure to specifically identify potential removal targets suggests that actual implementation is unlikely. Dams in the Central Valley have reduced salmon spawning habitat by 95% and contributed to the 90% reduction of riparian habitat. To provide significant restoration in these critical areas, the ERP must pursue a specific and aggressive program of dam removal, levee setbacks, and meanderbelt establishment on Central Valley rivers and streams.

Obviously, large dams that provide important water supply, power, and flood control benefits cannot be removed. However, there are many single purpose smaller dams which would provide access to significant habitat if removed. These include:

- Englebright Dam on the Yuba River -- This dam was constructed to capture debris from a speculative resumption of hydraulic mining that never occurred. It has since been retrofitted to provide a small amount of hydroelectric power. Removal of the dam would provide

access to more than 50 miles of potential spawning habitat for endangered salmon and steelhead.

- Our House Dam on the Middle Yuba River -- This dam diverts water from the Middle Yuba River into New Bullards Bar reservoir on the North Yuba River for hydroelectric and water supply purposes. In conjunction with Englebright removal, elimination of the Our House dam would provide access to more than 39 miles of spawning habitat for endangered salmon and steelhead.

- Daguerra Point Dam on the Yuba River -- The purpose of this dam was to capture debris in the Yuba gold fields. It is now a major water diversion facility which could be replaced with screened pumps. Removal of the dam would facilitate access upstream for endangered salmon and steelhead runs.

- Centerville Dam on Butte Creek -- Centerville dam is a part of an old and marginal hydroelectric project. The project diverts water from the Feather River water into Butte Creek which may result in hybridization between native Butte Creek salmon and hatchery-based Feather River salmon. Removal of the dam and the Feather River diversion would eliminate the hybridization problem and open access to more than twelve miles of spawning habitat for endangered salmon and steelhead.

- Clough Dam on Mill Creek -- This relatively large and poorly constructed dam was blown out by the 1997 flood. Numerous studies identified the Clough dam as a serious obstacle to upstream migration of salmon and steelhead. The water diversion could be easily supplied by an upstream diversion dam. The dam should not be rebuilt.

- Wildcat, Eagle Canyon, and Coleman Dams on Battle Creek -- These dams are part of another marginal hydroelectric project. The dams currently have no functioning screens or fish ladders. Removal of the dams would reduce the power generating capacity of PG&E's Battle Creek hydro project by less than a third, while providing access to more than 42 miles of spawning habitat for endangered salmon and steelhead.

- McCormick-Saeltzer Dam on Clear Creek -- This dam provides few if any benefits, while blocking access to more than eight miles of potential spawning habitat for endangered salmon and steelhead.

Some ERP objectives and programmatic actions are highly experimental, speculative, and unsubstantiated by existing science. For example, programmatic actions for upper watershed processes include development of experimental "fuel profile zones" that have not been proven as an effective fire control or reduction measure. In fact, the cumulative water quality impacts of an extensive system of fuel profile zones in the upper watersheds could be much worse than the water quality threats associated with wildfire. Similarly, the ERP's objectives and programmatic actions for delta hydraulics is little more than unsubstantiated justification for CALFED's highly theoretical strategy of restoring the delta by increasing upstream water storage. These specific objectives and actions should be modified or eliminated.

V. Summary of Surface Water Storage/Conveyance Impacts

a. Shasta Dam & Reservoir Enlargement

The existing Shasta dam was constructed on the upper Sacramento River, McCloud River, and Pit River in 1945. Shasta dam is the highest dam in California and forms the largest reservoir in the state. It was built by the Bureau of Reclamation to provide cheap water for agricultural, municipal, and industrial uses, as well as provide flood control for much of the Sacramento

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Valley. Unfortunately, the environmental cost of the dam includes the decimation of the Sacramento River's salmon and steelhead fishery and the loss of much of the river's riparian habitat through conversion to agricultural uses. Government agencies have been studying ways to increase the height of the dam in order to increase its storage capacity.

Two alternatives for the enlargement of Shasta dam and reservoir are considered by CALFED. These include raising the dam by 63 feet or by 200 feet. A comparison of the existing dam and the alternative enlargement plans follows:

	EXISTING DAM	RAISE 63 FEET	RAISE 200 FEET*
Dam Height	602 feet	665 feet	802 feet
Reservoir Elevation	1,068 feet	1,130 feet	1,270 feet
Capacity	4.55 maf**	6.75 maf**	14.3 maf**
Reservoir Area	30,000 acres	37,500 acres	60,500 acres
Design Flow Release	190,000 cfs	333,000 cfs	443,000 cfs
Upper Cost Estimate	$135.5 million	$3.2 billion***	$5.5 billion***

** Raising Shasta dam 200 feet would require the construction of four saddle dams, and the enlargement of the Keswick dam and reservoir downstream. ** maf = million acre feet. *** Does not include all costs. See below. Source: CALFED Storage and Conveyance Components, Facility Descriptions and Cost Estimates, Vol. 2, October 1997.*

The environmental impacts of an enlarged Shasta dam and reservoir include:

Aquatic Habitat & Species: Up to 42 miles of stream habitat would be inundated, including 16 miles of the upper Sacramento River, 6 miles of the McCloud River, 5 miles of the Pit River, and several tributaries. 53 miles of streamside wetlands would be affected, as well as 29 acres of wetlands adjacent to the existing reservoir. Wild trout production in the McCloud and upper Sacramento rivers would be adversely affected. Several threatened, endangered, or sensitive aquatic species would be affected, including McCloud redband trout, rough sculpin, hardhead, pit roach, river lamprey, Shasta crayfish, Shasta salamander, tailed frog, foothill yellow-legged frog, red-legged frog, northwestern pond turtle, Shasta sideband snail, and vernal pool fairy shrimp. Inundation of several abandoned mine sites in the area could result in toxic mine pollution.

Terrestrial Habitat & Species: Up to 30,000 acres of terrestrial wildlife habitat would be inundated, including 80 percent of the available winter range in the area for deer and elk. This habitat also supports more than 200 species of migratory birds, 50 species of mammals, and several species of reptiles, invertebrates, and amphibians. Several threatened, endangered, or sensitive terrestrial species would be affected, including northern spotted owl, wolverine, Southern bald eagle, peregrine falcon, valley elderberry longhorn beetle, Pacific fisher, ferruginous hawk, northern goshawk, willow flycatcher, tri-colored blackbird, white-faced ibis, California horned lizard, Western spadefoot toad, Siskiyou ground beetle, Trinity Alps ground beetle, and several species of bats. Seven plant species that are candidates for federal protection or are considered rare would be adversely affected.

Human Habitat: Many existing resorts, marinas, and an unknown number of permanent and seasonal residents would be displaced, including houses and commercial businesses at Lakehead, Delta, Riverview, Volmers, and Lamoine. Hundreds of acres of private land would be put underwater. PG&E's Pit River No. 7 hydroelectric project would be inundated. More than 18 miles of Interstate 5 would have to be relocated, requiring four new bridges. More than 34 miles of the Union Pacific railroad would have to be relocated, requiring eight new tunnels and six new bridges. The combined I-5/UPRR crossing at Bridge Bay would require one of the

world's longest and most expensive spans for a combined facility. 335 known archeological sites and 126 ethnographic sites would be covered and lost.

National Forest Resources: Portions of the Shasta-Trinity National Recreation Area, providing recreation for more than two million people annually, would be inundated. More than 50 campgrounds, marinas, and resorts would be lost or be relocated. Because of its huge size, the reservoir would seldom fill, but a large and unsightly "bathtub ring" consisting of barren canyon slopes hundreds of feet high would be visible throughout the area. The enlarged reservoir would drown segments of the upper Sacramento and McCloud rivers determined by the Forest Service to be eligible for inclusion in the National Wild & Scenic Rivers System in recognition of outstanding fishery, scenic, geologic, and historical/cultural values. These river segments are renowned for their wild trout fishery and have become increasingly popular for whitewater boating. Portions of three National Forest roadless areas would be inundated, including Devils Rock, West Girard, Dog Creek, and Backbone. Portions of the Shasta-Trinity National Forest managed as reserves for endangered species and for unroaded non-motorized recreation would also be adversely affected.

State Law: In 1989, the California Legislature and the Governor amended section 5093.542 of the California Public Resources Code to state, "no department or state agency shall assist or cooperate with, whether by loan, grant, license, or otherwise, any agency of the federal, state, or local government in the planning or construction of any dam, reservoir, diversion, or other water impoundment facility that could have an adverse effect on the free-flowing condition of the McCloud River, or on its wild trout fishery." The code permits the Dept. of Water Resources to participate in studies concerning the enlargement of Shasta dam and reservoir, but clearly prohibits state participation in funding and construction of an enlarged Shasta dam, including granting of state regulatory permits for Shasta dam enlargement.

Downstream Impacts: Highly modified flows from an enlarged Shasta reservoir could adversely impact downstream habitat for several threatened, endangered, or sensitive fish species including winter run chinook salmon, spring run chinook salmon, fall run chinook salmon, late fall run chinook salmon, steelhead trout, Delta smelt, and Sacramento splittail. Increased flows from an enlarged Shasta reservoir could increase bank erosion and threats to existing bridges, structures, agricultural land, and wildlife habitat. Bank erosion could lead to increased bank protection efforts, and loss of riparian habitat which supports several threatened, endangered, or sensitive terrestrial species, including valley elderberry longhorn beetle, bank swallow, Western yellow-billed cuckoo, Swainson's hawk, and others. Bank protection also creates engineered "hard points" along the river which are contrary to existing state and federal policy to restore an ecologically functional riparian "meanderbelt" along the Sacamento River.

Costs: Raising Shasta dam by 63 feet would cost between $2.5 and $3.2 billion. Of this amount, Shasta dam and powerplant reconstruction costs account for about 22 percent, and transportation relocation costs account for about 31 percent of the total. Raising Shasta dam by 200 feet would cost between $4.3 and $5.5 billion. Of this amount, the dam and powerplant reconstruction costs account for about 28 percent, the necessary enlargement of the Keswick dam and powerhouse downstream account for about 4 percent, and transportation relocation costs account for about 22 percent of the total. Both alternatives require the relocation and expansion of the I-5/UPRR crossing at Bridge Bay, which would cost more than a half billion dollars alone. None of the cost estimates include necessary modifications to the Shasta dam temperature control device, costs of the existing dam and powerplant, compensation for PG&E's lost power generation revenues, environmental studies and mitigation, operation and maintenance, power costs, reservoir filling costs, and interest.

b. Cottonwood Creek Dams

Cottonwood Creek is the largest undammed tributary to the Sacramento River. It rises from the eastern crest of the Coast Range and flows into the Sacramento Valley to its confluence with the Sacramento River. Numerous proposals have been considered since the early 1940's to construct dams of varying sizes on Cottonwood Creek. Two storage projects consisting of several different dams are considered by CALFED in the Cottonwood Creek watershed. Both projects would store Cottonwood Creek water for delivery downstream to water users. These include:

Dutch Gulch/Tehama Project -- This plan calls for two relatively large dams located on the main stem and the South Fork Cottonwood Creek. The 247 foot high Dutch Gulch dam on the main stem of Cottonwood Creek would create a 900,000 acre foot reservoir. The 215 foot high Tehama dam on the South Fork Cottonwood Creek would create a 700,000 acre foot reservoir. The Tehama reservoir would also require construction of eight saddle dams ranging in height from 40 to 80 feet.

Dippingvat/Red Bank Project -- Located approximately 20 miles west of Red Bluff, the Red Bank project consists of two relatively large dams, two smaller dams, and several saddle dams, as well as a 1,800 foot long tunnel and 2.3 miles of conveyance canals connecting the various reservoirs. The project's primary facility would be the 251 foot high Dippingvat dam on the South Fork Cottonwood Creek, creating a 104,000 acre foot reservoir. This facility is designed to divert 800 cubic feet per second of winter flows from the South Fork Cottonwood Creek southward into the Red Bank Creek basin, through a series of tunnels, canals and two smaller reservoirs to create a 250,000 acre foot reservoir behind the 300 foot high Schoenfield dam on Red Bank Creek. Because it diverts water from Cottonwood Creek into an adjacent watershed for storage, the Red Bank project is considered a so called "offstream" storage project, although it results in environmental impacts more generally associated with onstream projects.

The environmental impacts of the Cottonwood Creek dams include:

Aquatic Habitat & Species: The Dutch Gulch/Tehama project would inundate 130 miles of Cottonwood Creek and tributaries and the Red Bank/Dippingvat project would inundate up to 27 miles of Cottonwood and Red Bank creeks. Cottonwood Creek supports fall, late fall, and spring run chinook salmon, as well as a small run of steelhead trout. All three runs of chinook salmon and steelhead trout have been listed or proposed for listing as federal protected threatened or endangered species. The chinook salmon runs vary in size from 500 to 8,000 fish. There are no steelhead population estimates. CALFED technical reports estimate that the Dutch Gulch/Tehama project could result in an average annual loss of 1,600 chinook salmon and 1,000 steelhead, as well as adversely affect another 2,700 salmon downstream by blocking access to spawning areas, reducing downstream recruitment of spawning gravel, and modifying downstream flows. The Dippingvat dam on the South Fork Cottonwood Creek would block steelhead and spring run salmon migration, inundate critical spawning and holding areas for these stocks, and reduce downstream flows needed for migration and spawning. Either project could adversely impact gravel recruitment from Cottonwood Creek critical to spawning for the endangered winter run and threatened (proposed) fall and late fall run chinook salmon in the Sacramento River. The Dutch Gulch/Tehama project would also eliminate approximately 40 miles of smallmouth bass habitat and adversely impact several other resident aquatic species, including rainbow trout, Pacific lamprey, Sacramento squawfish, prickly sculpin, and California roach. Other protected or sensitive aquatic species which could be impacted by the projects include green sturgeon, red legged frog, yellow legged frog, western spadefoot toad, northwestern pond turtle, fairy shrimp, and possibly Valley elderberry longhorn beetle. Approximately 1,600 acres of riparian habitat, 27 miles of perennial streams, 53 miles of intermittent streams, and 39 acres of riverside wetlands would be affected by the Dutch

Gulch/Tehama project. The Red Bank/Dippingvat project would affect up to 6.5 miles of perennial stream, 20 miles of intermittent streams, and five acres of riverside wetlands.

Terrestrial Habitat & Species: Approximately 21,400 acres and 4,200 acres of terrestrial wildlife habitat would be respectively lost to the Dutch Gulch/Tehama and the Dippingvat/Red Bank projects. The habitat consists primarily of foothill oak woodland, grassland, chaparral, yellow-pine forest, and riparian vegetation. This area provides important habitat for deer, waterfowl, 15 species of furbearers, approximately 130 species of songbirds, several birds of prey, and eight species of amphibians and reptiles. Federally protected or sensitive wildlife species which could be impacted by the projects include American peregrine falcon, Aleutian Canada goose, northern spotted owl, two species of beetles, three species of bats, San Joaquin pocket mouse, western burrowing owl, ferruginous hawk, little willow flycatcher, and white-faced ibis. Six sensitive plants could also be impacted by the projects.

Human Habitat: The project areas are sparsely populated. Approximately 18 miles of roads would have to be relocated for the Dutch Gulch/Tehama project, including a segment of State Highway 36. No estimate of required road relocation was provided for the Dippingvat/Red Bank project, although at least three county roads would be inundated. Up to 251 archeological sites, 236 historic sites, and 19 ethnographic sites could be inundated or affected by the projects.

Public Land Resources: A few thousand acres of scattered public lands administered by the Bureau of Land Management (BLM) would be inundated by the projects. The upper segments of the North Fork, Middle Fork, and South Fork Cottonwood Creek, as well as Beegum Creek (a Middle Fork tributary), have been determined by the BLM to be eligible for National Wild & Scenic River status in recognition of outstanding scenic, recreational, and geological values. A portion of the eligible segment of the South Fork Cottonwood Creek would be inundated by the Dippingvat reservoir. BLM guidelines require the protection of the creek's free flowing character and outstanding values of eligible river segments until a suitability study is completed and recommendation concerning whether the segment should be added to the system is made to Congress.

Seismic Impacts: Previous government studies have identified few seismic concerns. However, the region where the Sacramento Valley meets the Coast Range has been identified as a "fundamental tectonic boundary" with hidden faults capable of producing moderate size earthquakes such as the 1892 Winters quake and 1983 Coalinga quake (both 6.7 on the Richter scale). Seismic concerns increase the cost of the proposed dams and raise the possibility of reservoir induced seismicity (such as the 1975 Oroville quake caused by Oroville dam and reservoir).

Costs: The Dutch Gulch/Tehama project could cost up to $1.3 billion. The Dippingvat/Red Bank project could cost up to $247 million. These cost estimates do not include mitigation costs or interest.

c. Sacramento Valley Offstream Storage Reservoirs

Numerous proposals have been considered since the early 1900's to construct so called "offstream" water storage reservoirs in the western Sacramento Valley. "Offstream" projects divert water from an existing source and then store the water in another area that is presumably less environmentally sensitive. State and federal dam engineers have resurrected three separate offstream storage project proposals for consideration in the CALFED program. One of the projects is located on Cottonwood Creek (see "Cottonwood Creek Dams"). The other two offstream storage projects considered by CALFED include:

Sites/Colusa -- The Sites/Colusa project would be located six miles west of the small town of Maxwell and Interstate 5 in the western Sacramento Valley. The project has three alternative variations: (1) a small Sites project requiring two large dams approximately 250 feet in height and five earthen dikes storing 1.2 million acre feet (maf) of water; (2) a large Sites project requiring two large dams approximately 300 feet in height and 12 saddle dams storing 1.9 maf of water; or (3) a Colusa project requiring 4 large dams up to 300 feet high and nine saddle dams storing 3.3 maf of water. * All three variations would depend on water diverted from the Sacramento River. The diversion options include an enlarged Tehama-Colusa canal with a conveyance capacity of 5,000 cubic feet per second (cfs), and a new diversion and canal from the Sacramento River called the "Chico Landing Intertie." The project could also be supplied by the existing Glenn-Colusa Irrigation District (GCID) diversion and canal.

* *In comparison, the existing Shasta dam on the Sacramento River is the eighth highest dam in the world, with a height of 600 feet and a storage capacity of 4.5 maf.*

Thomes/Newville -- The Thomes/Newville project would be located in the western Sacramento Valley approximately 15 miles west of the town of Orland and Interstate 5. The project includes a 300-400 foot high Newville dam storing 1.84 maf to 3.08 maf of water, as well as a 112 foot high Tehenn dam and 32,500 af reservoir just downstream of the Newville dam. The Newville and Tehenn dams would be located on the North Fork Stony Creek upstream from the existing Black Butte reservoir on Stony Creek. Water behind Newville dam would come from the North Fork, from a 90 foot high diversion dam on Thomes Creek via a new 2.5 mile canal, and from the Sacramento River. Storage of Sacramento River water would require two new canals totaling nine miles in length connecting an enlarged Tehama-Colusa canal with the Black Butte reservoir, a new five mile long canal connecting Black Butte with the proposed Tehenn reservoir, and three pumping-generation plants to lift the water from the Tehama-Colusa canal to all three reservoirs. The Thomes Creek diversion would be capable of diverting 10,000 cfs to the Newville reservoir. The Sacramento River diversion via the enlarged Tehama-Colusa canal to the Newville reservoir would be 5,000 cfs.

Enlarged Tehama-Colusa Canal -- The proposed Sites/Colusa and Thomes/Newville offstream storage projects would partially depend on water supplied by an enlarged Tehama-Colusa canal. Water from the 41 mile canal is diverted by the Red Bluff diversion dam (RBDD) from the Sacramento River in the town of Red Bluff. Currently, the canal has a carrying capacity of approximately 2,500 cfs. Both projects would be predicated on enlarging the canal capacity to 5,000 cfs. Currently, the RBDD gates are required to be raised from September 15 to May 15 every year to facilitate migration of endangered salmon. Since the proposed offstream storage projects would require winter and spring diversions into the Tehama-Colusa canal, the RBDD would either have to be lowered during the critical salmon migration period or a 5,000 cfs pumping plant could be constructed just downstream of the RBDD. The first option could be mitigated by constructing a new, larger fish ladder on the RBDD, but the efficacy of this measure is unknown. Increasing the capacity of the Tehama-Colusa canal could be accomplished by enlarging the existing canal or building a new canal parallel the existing canal.

Chico Landing Intertie -- The Sites/Colusa project could also be supplied with Sacramento River water via a new diversion from the river near its confluence with Stony Creek downstream of Chico Landing. The proposed Chico Landing Intertie would consist of 10 miles of concrete canals and three pumping plants capable of diverting and conveying up to 5,000 cfs of water. The intertie would connect to the enlarged Tehama-Colusa Canal and thence to the Sites/Colusa project.

The environmental impacts of Sacramento Valley offstream storage projects include:

Aquatic Habitat & Species: A primary concern with offstream storage projects in the Sacramento Valley is the impact of proposed water diversions from the Sacramento River on the river's endangered salmon and steelhead. Currently, all four runs of the river's chinook salmon, as well as steelhead trout, are listed or proposed for listing as threatened and/or endangered species. Existing diversions at the Red Bluff Diversion Dam and at the GCID pumping plant have played a key role in decimating these populations. New fish screens may not be effective in significantly reducing the number of salmon and steelhead killed by the existing and proposed new diversions. In addition, the RBDD acts as a barrier to salmon migration and encourages predation on young salmon by other species. If the dam gates are in operation during key migration periods, even an enlarged fish ladder may not successfully mitigate these impacts. Construction of new diversion facilities also destroys shaded riverine aquatic habitat, an essential habitat for young migrating salmon, steelhead, and other fish species.

The Thomes/Newville project could impact remnant runs of endangered chinook salmon and steelhead in Thomes Creek and Stony Creek by blocking access to spawning habitat and by modifying or reducing downstream flows. The project could also indirectly impact salmon and steelhead habitat in the Sacramento River by reducing spawning gravel recruitment from Thomes Creek. The project would inundate 35 miles of perennial streams, 36 miles of intermittent streams, 14 miles of streamside wetlands, and 152 acres of other wetlands. The project could adversely impact numerous resident fish species, including rainbow trout, brown trout, Sacramento squawfish, Sacramento sucker, and smallmouth bass, as well as resident sensitive amphibians such as the tailed frog. Diversion canals which supply water to the project could also adversely impact aquatic habitat and species. The Tehama-Colusa canal enlargement crosses 30 intermittent streambeds and 71 wetlands.

The Sites/Colusa project would inundate 25 miles of intermittent stream habitat, 38 miles of streamside wetlands, and 39 acres of other wetlands. The project could potentially impact habitat for sensitive amphibian species such as the northern red-legged frog, yellow-legged frog, western spadefoot, and western pond turtle. Other aquatic species potentially impacted include federally listed fairy and tadpole shrimp. In addition, vernal wetlands providing seasonal habitat for waterfowl would be lost. Diversion canals which supply water to the project could also adversely impact aquatic habitat and species. The Tehama-Colusa canal enlargement crosses 30 intermittent streambeds and 71 wetlands.

Terrestrial Habitat & Species: Depending on its size, the Thomes/Newville project could inundate up to 13,900 acres of terrestrial wildlife habitat, including 2,000 acres of critical winter range for the Thomes Creek deer herd, displacing more than 600 migratory and resident deer and impacting habitat that supports up to 145 species of birds. Protected and sensitive wildlife species that could be impacted include bald eagle, northern spotted owl, bank swallow, willow flycatcher, Swainson's hawk, northern goshawk, prairie falcon, golden eagle, osprey, Coopers hawk, yellow warbler, and tricolored blackbird. One protected and ten sensitive plant species could also be impacted, as well as two special-status habitats: Great Valley cottonwood riparian forest and northern interior cypress forest.

Depending on its size, the Sites/Colusa project would inundate up to 29,600 acres of terrestrial wildlife habitat, including 600 acres of oak woodland considered critical habitat for many species of mammals, birds, reptiles, and amphibians. Protected or sensitive species which may use the area include bald eagle, Swainson's hawk, golden eagle, burrowing owl, greater sandhill crane, San Joaquin pocket mouse, and the endangered Valley elderberry longhorn beetle. There are at least twelve rare or sensitive plant species in the area.

Human Habitat: The project areas are relatively sparsely populated. Approximately ten miles of public and private roads and an unknown number of residences would have to be relocated

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for the Thomes/Newville project. A portion of the Maxwell-Stonyford road, the small community of Sites and up to 100 people would be displaced by the Sites/Colusa project. Approximately 223 prehistoric sites, 70 historic sites, and 35 ethnographic sites would be impacted by the Thomes/Newville project. Approximately 18 prehistoric sites, 13 historic sites, and three ethnographic sites would be impacted by the Sites/Colusa project.

National Forest Resources: The Thomes Creek diversion could back water up onto upstream public lands managed by the Forest Service to protect critical habitat for the endangered northern spotted owl and other old growth forest dependent species. The dam could also block migration of chinook salmon and steelhead to and from upstream habitat on National Forest lands. The upstream segment of Thomes Creek has been determined eligible by the Forest Service for possible inclusion in the National Wild & Scenic River System in recognition of its outstanding geologic values.

Seismic Impacts: The Thomes/Newville and Sites/Colusa projects would be located over a "fundamental tectonic boundary" between the Sacramento Valley and the Coast Range that includes "hidden" faults capable of producing moderately powerful earthquakes such as the 1892 Winters quake and the 1983 Coalinga quake (both were 6.7 on the Richter scale). Seismic concerns could significantly effect the design and cost of the projects. In addition, the project reservoirs are of sufficient size to raise concerns about reservoir induced earthquakes such as the one caused by the Oroville reservoir in 1975.

Water Quality: Proposed offstream storage reservoirs in the western Sacramento Valley would be relatively shallow. Water released from the reservoirs would be relatively warm in comparison to the colder water in the Sacramento River and undammed tributaries which support salmon and steelhead. In addition, the soils in the western valley are highly mineralized and erosive. Water stored and released from this area would likely carry a high sediment and mineral load (including selenium). Offstream storage water could exacerbate existing poor water quality conditions in the lower Sacramento River. High water temperatures, heavy sediment loads, and pesticide run-off could impact migrating salmon and drinking water quality for the City of Sacramento and other downstream consumers.

Costs: Depending on its size, the Thomes/Newville project could cost from $1.3 billion to $1.9 billion dollars (not including the cost of new or enlarged diversion canals from the Sacramento River). Depending on its size, the Sites/Colusa project could cost from $451 million to $1.7 billion (not including the cost of new or enlarged diversion canals from the Sacramento River). The proposed enlargement of the Tehama-Colusa canal to supply the offstream reservoir(s) could cost up to $830 million depending on the type of diversion and canal constructed. The proposed Chico Landing Intertie diversion and canal could cost up to $471 million.

d. Berryessa Reservoir Enlargement

Numerous proposals have been considered since the early 1960's to enlarge Berryessa reservoir on Putah Creek. The current Berryessa reservoir is located approximately eight miles west of the town of Winters. State and federal dam engineers have resurrected the plan to enlarge the reservoir for consideration in the CALFED program. The Berryessa enlargement project is intended to store water diverted from the Sacramento River for delivery to downstream water users.

Two alternatives are considered by CALFED for enlarging Berryessa reservoir. The first alternative would enlarge the current 1.6 million acre foot (maf) reservoir to six maf. The second alternative would enlarge the reservoir to 13.3 maf. Both alternatives would require the construction of a new dam approximately two miles downstream of the 271 foot high Monticello dam, which creates the current reservoir. The six maf alternative would require a

470 foot high dam and the 13.3 maf alternative would require a 620 foot high dam. The current reservoir fully utilizes all run-off from Putah Creek. The enlarged reservoir could increase downstream flood releases into Putah Creek to as much as 125,000 cfs. The highest observed flow on Putah Creek was 81,000 cfs in 1942. The highest flow in Putah Creek since Monticello dam was constructed in 1957 was 18,700 cfs in 1983.

Both enlargement alternatives are intended to store water diverted from the Sacramento River and delivered either through a 21 mile extension of the Tehama-Colusa canal (which diverts water from the river near Red Bluff) or from construction of a new 25 mile canal called the Berryessa Intertie which would divert 5,000 cubic feet per second (cfs) of water from the Sacramento River just upstream of the City of Sacramento. To pump water uphill from the river, the Berryessa Intertie would also require construction of three pumping plants. To connect the enlarged reservoir to either the Tehama-Colusa canal or Berryessa Intertie would require the construction of a 2.25 mile long tunnel, a four mile long connecting canal, and two pumping plants.

The environmental impacts of Berryessa enlargement include:

Aquatic Habitat & Species: Putah Creek is widely regarded as supporting one of the last and best examples of native fish assemblages remaining in the Sacramento Valley. Fish species native to Putah Creek include rainbow trout, largemouth bass, smallmouth bass, black crappie, white catfish, bluegill, California squawfish, and California roach. Chinook salmon were formerly considered extirpated from Putah Creek due to flow modifications as a result of Monticello dam and downstream water diversions, but fall run chinook salmon were recently observed returning to the creek in 1997. Enlarging Berryessa reservoir would likely adversely impact Putah Creek's native fishes by further modifying downstream flows. The construction of a new dam approximately two miles downstream of the existing Monticello dam would bury at least two miles of Putah Creek which currently supports a popular wild trout fishery. The project would also inundate up to 12 miles of streams flowing into the reservoir, 35 miles of streamside and reservoir related wetlands, and nearly 300 acres of other wetlands. A major indirect impact of the project is associated with increased diversion of water from the Sacramento River -- the primary source of water for an enlarged Berryessa reservoir. Existing diversions have played a major role in the decline of all four runs of chinook salmon and steelhead trout in the Sacramento River. Increased diversions into an enlarged and extended Tehama-Colusa canal or a newly constructed Berryessa Intertie could push these salmon and steelhead runs over the brink to extinction.

Terrestrial Habitat & Species: Berryessa enlargement would drown up to 43,600 acres of terrestrial habitat, including 1,600 acres of riparian habitat, 24,000 acres of foothill woodland, 10,400 acres of chaparral, and 6,700 acres of grassland. This habitat supports a wide variety of wildlife. Endangered, threatened, or sensitive species which could be affected by the project include Valley elderberry longhorn beetle, northern spotted owl, bank swallow, California freshwater shrimp, foothill yellow legged frog, northwestern pond turtle, sharp shinned hawk, golden eagle, prairie falcon, purple martin, and yellow breasted chat. Up to 18 endangered, threatened, or sensitive plant species could be impacted by the project. All or portions of three areas managed specifically for their diverse habitat would be drowned, including the University of California's Cold Canyon Ecological Reserve, the Butts Canyon Natural Area, and the Quail Ridge Preserve. Indirect impacts associated with mining of materials for dam construction would occur at potential quarry sites on Cache Creek, Putah Creek, Putman Peak, Plesants Ridge, and Blue Ridge. Construction of the Berryessa Intertie would impact 760 acres of agricultural lands, 150 acres of grassland, 10 acres of woodland, and three acres of riparian and marsh land. Extension of the Tehama-Colusa canal would impact 560 acres of agricultural land, 342 acres of grasslands, and nine acres of riparian habitat.

Human Habitat: The small communities of Berryessa Pines and Spanish Flat would have to be relocated, along with several reservoir associated resorts, marinas, and campgrounds. Portions of State Highway 128 and six county roads would also require relocation. Reservoir enlargement would also drown 224 archeological sites and four known ethnographic sites, including three graveyards or grave sites. Emergency flood releases from the enlarged reservoir of up to 125,000 cfs into Putah Creek could flood portions of downstream urbanized areas in the cities of Winters and Davis, rural residences, and several public roads and bridges.

Public Land Resources: Enlargement would drown virtually all of the Bureau of Reclamation's Lake Berryessa Recreation Area. Several hundred acres of public lands managed by the Bureau of Land Management (BLM) would also be inundated. A portion of the BLM's Cedar Roughs Wilderness Study Area and adjacent private lands slated for public acquisition would be impacted by the enlargement.

Seismic Impacts: The enlarged Berryessa reservoir and its new dam would be located over a "fundamental tectonic boundary" between the Sacramento Valley and the Coast Range that includes both identified and hidden faults capable of producing moderately powerful earthquakes such as the 1892 Winters quake and the 1983 Coalinga quake (both were 6.7 on the Richter scale). The 1892 quake virtually destroyed the town of Winters, which is only eight miles from the dam site. Seismic concerns could significantly effect the design and cost of the project. In addition, the enlarged reservoir is of sufficient size to raise concerns about reservoir induced earthquakes such as the one caused by the Oroville reservoir in 1975.

Costs: The six maf enlargement alternative would cost up to $1.9 billion and the 13.3 maf alternative would cost up to $3 billion. These cost estimates do not include environmental mitigation, relocation costs, or interest. In addition, the cost of the facilities needed to divert and convey water from the Sacramento River to fill an enlarged Berryessa reservoir include up to $746 million for the Berryessa Intertie and up to $839 million for an enlarged and extended Tehama-Colusa canal.

e. Friant Dam/Millerton Reservoir Enlargement

The existing Friant dam was completed on the San Joaquin River in 1942, forming the 520,000 af Millerton reservoir. CALFED is considering enlarging the reservoir to 1.2 maf by raising the existing 319 foot-high Friant dam by an additional 144 feet. Enlargement of the reservoir would require construction of two saddle dams and modification of the existing outlet and spillway works. The Millerton enlargement project is intended to store water for consumptive and flood control purposes.

The environmental impacts of Friant dam/Millerton reservoir enlargement include:

Aquatic Habitat & Species: Raising Friant dam and enlarging Millerton reservoir would inundate approximately three miles of the main stem of San Joaquin River, ten miles of seasonal tributaries to the river and reservoir, and 13 miles of streamside wetlands. The enlargement would inundate several miles of upstream spawning habitat used by the American shad and striped bass populations in the reservoir. Reservoir fluctuations would also adversely impact large mouth bass resident in the reservoir. Flow modifications and reductions downstream of the enlarged dam and reservoir could adversely impact sensitive river fisheries, including greens sturgeon, river lamprey, Kern brook lamprey, Pacific lamprey, and longfin smelt. Other fish which could be impacted by the project include spotted bass, bluegill, hardhead, Sacramento squawfish, threadfin shad, and golden shiner.

Terrestrial Habitat & Species: Approximately 3,500 acres of terrestrial habitat would be inundated by the reservoir enlargement. The habitat consists primarily of foothill oak and

grasslands which supports diverse wildlife, including mule deer, California quail, mourning dove, raccoon, skunk, bobcat, gray fox, coyote, ringtail and various waterfowl and songbirds. Raptors include golden eagles, kestrels, red-tailed hawks and white tailed kites. The enlargement could adversely impact several protected and sensitive species, including vernal pool fairy shrimp, vernal pool tadpole shrimp, valley elderberry longhorn beetle, Bohart's blue butterfly, molestan blister beetle, California tiger salamander, western spadefoot toad, California red-legged frog, foothill yellow-legged frog, prairie falcon, and several species of bats. Special status habitats threatened by the enlargement include vernal pools, mixed riparian forest, and sycamore alluvial woodland. Special status plants which could be impacted by the enlargement include succulant owls clover, San Joaquin Valley orcutt grass, Hartwig's golden sunburst, Madera linanthus, and spiny-sepaled coyote thistle.

Human Habitat: Structures associated with the Millerton Lake Recreation Area, a few scattered residences, and PG&E's Kerckhoff No. 1 and No. 2 powerhouses would be inundated by the reservoir enlargement. Several hundred acres of private land would also be impacted. Approximately 63 prehistoric and four historic sites would be inundated by the enlarged reservoir.

Public Land Resources: The entire Millerton Lake Recreation Area would be drowned. Several hundred acres of public land in the Squaw Leap area currently managed by the Bureau of Land Management for wildlife habitat and outdoor recreation would also be lost. When flows are available from the PG&E hydro dams upstream, the Squaw Leap segment of the river provides a Class IV-V whitewater run. The Squaw Leap rapid is considered one of the wildest rapids in California by Holbek and Stanley. Flow fluctuations downstream of the enlarged dam could impact recreation use and natural values of the San Joaquin River Parkway. Two natural areas adjacent to the current reservoir could also be impacted by the enlargement, including the Friant South Significant Natural Area and Big Table Mountain Significant Natural Area.

Costs: Raising Friant dam and building the necessary saddle dams would cost up to $1.3 million. This cost does not include interest, environmental mitigation, or relocation of facilities such as PG&E's powerhouses.

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