CHAPTER VI
POTENTIAL INITIAL PLANS

RESOURCE MANAGEMENT MEASURES

Following development of the planning objectives, constraints, and criteria for the study, the next major step in formulating alternative plans is to identify potential resource management measures. A resource management measure is any structural or non-structural action that could address the study objectives. Alternative plans are formulated by combining the most applicable management measures.

An initial list of potential resource management measures to address the planning objectives listed in Chapter V and an indication of the relative application of the measures to the planning objectives are highlighted in **Table 13**. Additional efforts to identify and evaluate management measures will occur in the Initial Plans Phase (see **Figure 5**) and will be described in the Initial Alternatives Information Report.

Primary Planning Objectives

Following are potential measures to address the primary planning objectives.

Water Supply Reliability

"Increase water supplies and water supply reliability for agricultural, M&I, and environmental purposes in the CVP to help meet future water demands with a primary focus on modification of Shasta Dam and Reservoir."

- **Increase the conservation storage space in Shasta Reservoir by raising Shasta Dam** – This measure consists of increasing the amount of available space for conservation storage in Shasta Lake through raising Shasta Dam and thereby enlarging Shasta Reservoir. Various raises have been considered by previous studies. A raise of 6.5-feet is included in the PPA for the CALFED ROD. Previous studies also looked at raising the dam from about 30 feet to over 200 feet.

Included in **Plate 6** are estimates of the relative increases in storage capacity and water surface area for dam raises up to about 200 feet. **Plate 13** is a plan view of Shasta Reservoir showing the relative increase in inundation area for raises of 100 and 200 feet. A 6.5 foot raise would result in an estimated 290,000 acre-feet of additional storage space with an increase in surface area inundated at gross pool from about 29,500 acres to about 30,200 acres. The enlarged space would help increase water supply reliability by adding over 70,000 acre-feet per year to the yield of the CVP. A 200-foot raise would result in an estimated 9.1 MAF of storage space in Shasta Reservoir and cover an area at gross pool of about 60,000 acres.

Raising Shasta Dam directly contributes to the primary planning objective and previous studies have indicated that raising the dam is technically feasible. It is believed therefore, that this measure should be retained for further development. However, for consistency with the planning constraints and criteria, and to be more consistent with recommendations in the CALFED ROD, emphasis should be placed on smaller dam raises.

TABLE 13
POTENTIAL RESOURCE MANAGEMENT MEASURES

Planning Objective		Potential Resource Management Measure	Potential to Address Planning Objective
Primary Objectives	Water Supply Reliability	Increase the conservation storage space in Shasta Reservoir by raising Shasta Dam.	Very high – Raising dam directly contributes to increased water supply reliability.
		Increase the conservation pool in Shasta Reservoir by encroaching on dam freeboard.	Very low – Very limited potential to encroach on existing freeboard above gross pool which is only 9.5 feet.
		Increase the conservation storage space in Shasta Reservoir by reallocating space from flood control.	Very low –Very low potential for implementation due to high resulting adverse impacts on flood control accomplishments.
		Increase the effective conservation storage space in Shasta Reservoir by increasing the efficiency of reservoir operation for water supply reliability.	Low to moderate – Some potential for increased water supply reliability and for operational efficiency for flood control but reduced likelihood for implementation due to perceived adverse impacts to flood control.
		Construct new conservation storage reservoir(s) upstream from Shasta Lake.	Very low – Upstream storage sites capable of CVP system-wide benefits would be very costly, result in environmental impacts difficult to mitigate, likely not be supported by local interests, and be inconsistent with the CALFED ROD.
		Construct new conservation storage on tributaries to the Sacramento River downstream from Shasta Dam.	Very low – Although potentially feasible sites/projects exist to significantly increase water supply, there are significant overriding environmental issues restricting implementation at this time.
		Construct new conservation offstream surface storage near the Sacramento River downstream from Shasta Dam.	Moderate – Although not as effective as additional storage at Shasta, significant potential for conjunctively using releases from Shasta in new surface water facility to enhance system yield.
		Construct new conservation surface water storage south of the Sacramento-San Joaquin River Delta	Low – Not viewed as an alternative to additional storage at Shasta. Independent feasibility scope studies are being initiated under PL 108-7.
		Develop new conservation groundwater storage near the Sacramento River downstream from Shasta Dam.	Moderate – Similar to offstream storage. When combined with new storage at Shasta, potential to enhance system yield depending on availability of groundwater storage sites.
		Develop additional conservation groundwater storage south of the Sacramento-San Joaquin River Delta.	Low –When combined with new storage at Shasta, limited potential to enhance system yield depending on availability of groundwater storage sites.
		Increase total or seasonal conservation storage at other CVP facilities.	Very low – Not a substitute for additional storage at Shasta.
		Implement additional demand management programs.	Low – Not a substitute for additional storage at Shasta, but potential for inclusion in an alternative plan.

TABLE 13 (CONTINUED)
POTENTIAL RESOURCE MANAGEMENT MEASURES

Planning Objective		Potential Resource Management Measure	Potential to Address Planning Objective
Primary Objectives	Anadromous Fish Survival	Further modify the outlets at Shasta Dam to release cooler water during critical spawning periods.	Moderate to High – Although existing temperature control device at Shasta effectively meets objectives, potential exists to further modify the device to benefit anadromous fish. Potential effectiveness increases with increase in storage at Shasta.
		Create shaded riverine habitat at critical locations along Sacramento River downstream from Shasta Dam	Moderate to High – Significant potential to help contribute to restoration of primarily fish habitat in upper Sacramento River.
Secondary Objectives	Other Environmental Opportunities	Restore of warm and cold water fisheries through creation of riverine habitat along lower reaches of major tributaries to Shasta Reservoir.	Moderate to High – Significant potential to help restore fish habitat at critical locations near reservoir and creek/river interface.
		Create riparian and wetland resources at critical locations along lower reaches of major tributaries to Shasta Reservoir.	High – Strong potential to help restore wildlife habitat at critical locations near reservoir and creek/river interface.
		Create riparian, wetland, and upland habitat at critical locations along the Sacramento River downstream from Shasta Dam.	Moderate to High – Significant potential to help contribute to restoration of primarily wildlife habitat in upper Sacramento River.
	Flood Damage Reduction	Increase flood control storage space in Shasta.	Low – Estimated low net economic flood damage reduction benefits due to relatively high cost related to raising the dam or reducing water supply benefits.
		Increase the conservation storage space in Shasta Reservoir by reoperating the reservoir.	Moderate – Potential to marginally increase flood damage reduction accomplishments of Shasta under both existing space allocations or in conjunction with increased conservation space through revising of reservoir operation rules for flood control.
		Increase flood control operation effectiveness of Shasta Dam and Reservoir during a flood event.	Moderate to High – Significant potential to enhance real-time flood control operations at Shasta both at current or expanded size.
	Hydro-power	Increase hydropower generation at Shasta Dam.	Moderate – Potential to realize some increase in hydropower output from Shasta with increased sizes of Shasta Reservoir.
	Recreation	Increase recreation opportunities in Shasta Reservoir.	Moderate – Potential to realize some increase in recreation resources in and near Shasta Reservoir with increased sizes of Shasta Reservoir.

- **Increase the conservation pool in Shasta Reservoir by encroaching on dam freeboard** – This measure consists of increasing the conservation storage space in Shasta by raising the gross pool elevation without raising Shasta Dam. The current gross pool elevation at Shasta is 1,067 feet (msl) and the top of dam elevation is approximately 1,076.5 feet. Accordingly, the design freeboard above maximum water surface elevation is 9.5 feet. It is estimated that major modifications would be required at the dam and appurtenances to allow operational encroachments into the design freeboard of the dam, only to gain a fairly small potential increase in reservoir storage. Consequently, there is a low potential for this measure to effectively address the planning objective and it is likely to be found that this measure should be deleted from further consideration.

- **Increase the conservation storage space in Shasta Reservoir by reallocating space from flood control** – This measure consists of decreasing the maximum seasonal flood control storage space in Shasta Reservoir and dedicating that space to conservation water supply. The maximum seasonal flood control storage space in Shasta is 1.3 MAF from 1 December through 20 March depending on accumulated seasonal inflow volumes. Reducing the seasonal flood control storage space would reduce the ability of the reservoir to control peak flood flow releases. This would result in an increase in the frequency of flooding and flood damages along the Sacramento River downstream from Shasta Dam.

It is estimated that there is very low potential for implementing this measure due to the adverse impact to the flood control accomplishments of the existing facility and potentially costly mitigation for increases in downstream flood damages. Because of this, it is likely to be found that this measure should be deleted from further consideration.

- **Increase the effective conservation storage space in Shasta Reservoir by increasing the efficiency of reservoir operations to benefit water supply reliability** – This measure consists of changing the flood control operations of Shasta Dam and Reservoir (without reducing the flood pool) with a goal to increase water supply reliability. This measure would focus on revising the operation rules for flood control such that the facility could potentially be managed more efficiently for flood control, thereby vacating some seasonal storage space for water supply. A primary constraint would be no adverse impact to the existing level of flood protection provided by the Shasta Dam project. It is believed that some amount of efficiency could be gained through a critical assessment of reservoir operations using more current analytical and weather forecasting tools.

It is also believed that although the potential for increased water supply reliability through reoperation efficiencies for flood control would likely be small, this measure should be carried forward for more detailed consideration for possible inclusion in alternative plans.

- **Construct new conservation storage reservoir(s) upstream from Shasta Lake** – This measure consists of constructing dams and reservoirs at various locations upstream from Shasta Lake, primarily for increased water conservation storage and operational flexibility. Numerous reservoir storage projects have been considered and many constructed in the watershed upstream from Shasta Lake. Three sites that have held the most promise were also identified in the Initial Surface Water Storage Screening Report (August 2000) prepared for CALFED. They included

Allen Camp Reservoir at about 180,000 acre-feet on the Pit River in Modoc County, Kosk Reservoir at about 800,000 acre-feet on the Pit River in Shasta County, and Squaw Valley Reservoir at 400,000 acre-feet on Squaw Valley Creek in Shasta County. Other potential sites have been considered in previous studies.

The Allen Camp Reservoir site was eliminated from further consideration at this time because it is relatively small and has a very limited potential for increased water supply to the CVP. The other two reservoir sites, Kosk and Squaw Valley reservoirs, were eliminated from further consideration primarily because they would not be consistent with screening criteria established in the CALFED Integrated Storage Investigations, would likely not be supported in the local area because the water would need to be developed for CVP system reliability (not retained for local use), and would result in a relatively high unit water cost to implement (over $800 per acre-foot).

- **Construct new conservation storage on tributaries to the Sacramento River downstream from Shasta Dam** – Various on-stream reservoir storage projects along tributaries to the Sacramento River downstream from Shasta Dam were considered in the CALFED Initial Surface Water Storage Screening Report. These and other potential surface water reservoir sites have also been considered as part of numerous other studies over the years. Several projects having the potential to significantly contribute to increasing water supply reliability is the Cottonwood Creek Project (1.6 MAF on Cottonwood Creek north of Red Bluff), the Auburn Dam Project (2.3 MAF on the middle fork of the American River near Sacramento), and the Marysville Lake Project (920,000 acre-feet on the Yuba River near Marysville). Although each project would likely be economically feasible given the estimated future need for new water supplies, and each would include mitigation features to offset potential adverse environmental impacts, they have been rejected by state and local interests as potential candidates for new water sources. Each was eliminated from further consideration by CALFED primarily because of potential adverse environmental impacts. It is likely to be found that this measure should be removed from further consideration due to significant overriding environmental issues restricting implementation at this time.

- **Construct new conservation offstream surface storage near the Sacramento River downstream from Shasta Dam** - Various offstream reservoir storage projects were considered in the CALFED Initial Surface Water Storage Screening Report. All but one were eliminated from further consideration in the CALFED ROD primarily due to project cost considerations, potential environmental impacts, and lands and relocation issues. The one project that was retained for initial consideration was Sites Reservoir (a.k.a. NODOS). As initially conceived, the reservoir would have a storage capacity of up to 1.9 MAF. The reservoir would be filled primarily by through water diverted from the Sacramento River and most likely pumped to the reservoir through Tehama Colusa Canal during periods of excess flows in the river. Further development of NODOS Project and appurtenances are being accomplished primarily under the leadership of the DWR.

Although NODOS has a potential to help increase water supplies to the CVP and/or SWP, it is believed that this measure is not a substitute for enlarging Shasta Dam and Reservoir, as initial cost estimates indicate that a Shasta enlargement is more cost efficient. However, there is a significant potential for conjunctively using some of the water supply from Shasta, especially during average and wet years, in an offstream storage reservoir. Accordingly, it is believed that

offstream storage as a potential adjunct to raising Shasta Dam should be considered further in the plan formulation process.

- **Construct new conservation surface water storage south of the Sacramento-San Joaquin River Delta** – A relatively large portion of the CVP's future water needs are in service areas in the San Joaquin River Basin, south of the Delta. In addition, there will continue to be large demands, primarily on the SWP, to provide water for M&I purposes further south via the California Aqueduct and for increased water supply reliability to the South Bay areas. A portion of these demands could be provided from on-stream and/or offstream surface water storage within the San Joaquin River Basin. Numerous surface water storage sites have been identified in the past along the east side and west side of the San Joaquin Valley and in areas to the west of the Delta near Stockton.

On-stream storage sites are exclusively located on the east side of the valley due to the lack of significant annual runoff from the Coast Mountain Range. Several potential on-stream storage sites could include enlarging Pardee Reservoir on the Mokelumne River, enlarging and modifying Farmington Dam on Littlejohns Creek, and enlarging Friant Dam on the upper San Joaquin River. Through the CALFED Program, numerous potential offstream storage sites were also considered in the San Joaquin Valley. Several sites were on the east side of the valley and were conceived to receive diverted flows from nearby rivers, but most of the sites were adjacent to the California Aqueduct and would receive pumped water from the aqueduct during periods of excess flows.

As mentioned, one of the CALFED surface water projects authorized for feasibility scope investigation in Section 215 of PL 108-7 is the Upper San Joaquin River Storage Investigation. This study will further assess potential surface water storage measures primarily along the San Joaquin River and its tributaries.

- **Develop conservation groundwater storage near the Sacramento River downstream from Shasta Dam –** This measure consists of developing groundwater recharge projects near the Sacramento River. This would include pumping and using groundwater during dry periods, and diverting excess Sacramento River flows and recharging depleted groundwater basins during wetter periods.

As with offstream storage discussed above, it is believed that this measure has the potential to allow all or a portion of an increase in storage from a modification of Shasta to be temporally stored in groundwater basins along the Sacramento River for later use during critical dry periods. It is likely that this measure will be retained for further development and consideration.

- **Develop additional conservation groundwater storage South of the Sacramento-San Joaquin River Delta –** This measure consists of either developing new groundwater recharge projects south of the Delta or contributing to existing recharge projects. It would include diverting flows during periods of excess from the San Joaquin River or from the Delta Mendota Canal or California Aqueduct and helping recharge depleted ground water basins. Although limited, it is believed that this measure could have a potential to allow for a portion of an increase in storage from a modification of Shasta to be temporally stored south of the Delta for later use during critical dry periods.

- **Increase total or seasonal conservation storage at other CVP facilities –** This measure consists of increasing the conservation storage space in other major CVP or SWP reservoirs in the Sacramento River Watershed. Several potential project expansions were considered in the CALFED Initial Surface Water Storage Screening Report. Besides Shasta Dam and Reservoir, this included additional storage in facilities such as Lake Berryessa on Putah Creek, Folsom Reservoir on the American River, Trinity Lake on the Trinity River, and Lake Oroville on the Feather River. It is believed that, of the existing reservoirs in the CVP/SWP systems, modifications to Shasta would be the most cost effective. Because of this, it is believed that this measure should be removed from further consideration.

- **Implement additional demand management programs –** This measure consists of reducing the demand to the CVP. This could include concepts such as increased water conservation, removing lands from agricultural production, increasing the price paid by CVP customers, and restricting urban growth in the Central Valley through regulatory practices. Various ongoing programs primarily as part of CVPIA and CALFED are focused on demand management measures. There is a potential for at least some of the measures to be further considered in the plan formulation process.

Anadromous Fish Survival

"Increase the survival of anadromous fish populations in the Sacramento River primarily upstream from the RBDD."

- **Further modify the outlets at Shasta Dam to release cooler water during critical spawning periods –** This measure consists of further modifying the outlet works at Shasta Dam to better control the temperature of outflows. The existing TCD at Shasta is a multi-level water intake structure located on the upstream face of the dam. By drawing water from the top of the reservoir during the winter and spring when the surface water temperatures are cool, and from deep in the reservoir in the summer and fall when the surface water is warm, Reclamation is able to fulfill most contractual obligations for both water delivery and power generation while benefiting downstream fisheries. There may be a potential to further modify the existing TCD to benefit anadromous fish survival. This potential would be enhanced with any enlargement of Shasta Dam and Reservoir.

- **Create shaded riverine habitat at critical locations along Sacramento River downstream from Shasta Dam –** This measure consists of identifying locations along the Sacramento River from Shasta Dam downstream to about Red Bluff where creation of additional shaded riverine habitat could be beneficial primarily for anadromous fish. This measure could include acquiring specific riverbank areas and planting these locations with native vegetation to create the shaded habitat and managing the area over time. It could also include gravel replacement, introduction of woody debris, and other habitat improvements. It is believed that this measure could be most applicable when coupled with ongoing efforts by local conservation groups and consistent with ongoing efforts of CALFED.

Secondary Planning Objectives

Following are several potential measures identified to address the secondary planning objectives.

Other Environmental Opportunities

"Preserve and restore ecosystem resources in the Shasta Lake area and along the upper Sacramento River."

- **Restore warm and cold water fish through creation of in-stream riverine habitat along the lower reaches of major tributaries to Shasta Reservoir –** This measure consists of identifying locations along the lower reaches of major tributaries to Shasta Lake where there are opportunities to create or improve instream habitat beneficial to warm and cold water fish species. This measure could include planting shaded riverine habitat, constructing/placing fish habitat devices within the stream environment, and constructing/refurbishing fish spawning beds. Primary areas of opportunity would be along the upper Sacramento River, McCloud River, Squaw Creek, and Pit River. It is believed that this measure would be most applicable when coupled with ongoing efforts by local conservation groups.

- **Create riparian and wetland resources at critical locations along lower reaches of major tributaries to Shasta Reservoir –** This measure is similar to the one above except it consists of creating the riparian, wetland, and related wildlife habitat along the lower reaches of major tributaries to Shasta Lake. There are believed to be numerous opportunities along the upper Sacramento River, McCloud River, Squaw Creek, and Pit River to implement this measure. It is believed that this measure would be most applicable when coupled with ongoing efforts by local conservation groups.

- **Create riparian, wetland, and upland habitat at critical locations along the Sacramento River downstream from Shasta Dam –** This measure consists of creating healthy riparian, wetland, and upland vegetation communities at opportunity locations along the Sacramento River from Shasta Dam to about Red Bluff. It could also include tributary streams and locations where urban development is encroaching on the river. As with the above ecosystem restoration measures, it is believed that this measure would be most applicable when coupled with ongoing efforts by local conservation groups and consistent with ongoing efforts of CALFED.

Flood Damage Reduction

"Reduce flood damage along the Sacramento River."

- **Increase flood control storage space in Shasta –** This measure consists of increasing the flood control storage space in Shasta Reservoir primarily through raising the dam or reducing water conservation storage space. Both measures, however, would generally conflict with the primary planning objectives. A variation would be to substitute water conservation storage space in Shasta with storage in another reservoir, such as the NODOS Project, and use the vacant seasonal space in Shasta for increased flood control. However, it is believed that the potential flood damage reduction benefits to be gained would be far less than the costs to create the increased storage space either in Shasta Reservoir or other facilities. Accordingly, it is likely that this measure will be removed from further consideration.

- **Increase the conservation storage space in Shasta Reservoir by reoperating the reservoir –** This measure consists of revising the established rules for operating Shasta Dam and Reservoir primarily for flood control. It would include reassessing the operation rules for flood control and determining if there is a potential to use updated hydrology, currently available mathematical modeling tools, and state-of-the-art weather forecasting technology to increase the effectiveness of Shasta in reducing the frequency of downstream floodflows. Because this measure would not adversely impact the other study objectives and may even help advance the objectives, it is believed that it should be retained for further evaluation.

- **Increase flood control operation effectiveness of Shasta Dam and Reservoir during a flood event –** Flood control operations at Shasta Dam during a flood event, even with explicit rules provided in the flood control manual, are very difficult to manage for extended periods. This measure consists of developing an enhanced real-time flood flow prediction system. This could include adding additional stream gages to better estimate inflows into Shasta and into the Sacramento River downstream of Keswick Dam. It also could include an enhanced rainfall forecasting system to better predict runoff and plan for pre-flood releases. Other features could include modifications to the flood control manual to aid in real-time operation. It is believed that this measure has the potential to improve flood operations at Shasta and help reduce the risk of catastrophic flooding along the lower Sacramento River. Accordingly, this measure should be retained for further evaluation.

Hydropower

"Develop additional hydropower capabilities at Shasta Dam."

- **Increase hydropower generation at Shasta Dam –** This measure consists of modifying the hydropower generation facilities at Shasta Dam to take advantage of any increases in water surface elevations resulting from enlarging the dam, if applicable. This measure should be part of any plan considered that includes a modification of Shasta Dam.

Recreation

"Provide additional water-related recreational opportunities in the Shasta Lake area."

- **Increase recreation opportunities in Shasta Reservoir –** This measure consists of modifying the recreation and related facilities in Shasta Reservoir to take advantage of any increases in seasonal water surface area, if applicable. This measure should be part of any plan considered that includes a modification to Shasta Reservoir storage space.

CONCEPT PLANS

During the next phase of the study, the above management measures will be further developed and others will be identified. Alternative plans will then be formulated considering the planning objectives, constraints, principles, and criteria described in Chapter V. However, for discussion purposes as part of this interim report, general concept plans were developed to highlight the range in possible alternatives from those measures above believed to best address the planning

objectives. Many combinations of measures are possible. Again, formulation of alternative plans will be the primary focus of further study efforts.

Concept Plan Identification

Following is a brief description of preliminary concept plans that capture a range of formulation scenarios and strategies.

- **Enlarge Shasta - Low Option Concept –** This concept is primarily the plan suggested in the CALFED ROD. Its main feature consists of enlarging Shasta Reservoir by 290,000 acre-feet through raising the dam 6.5 feet. The concept could incorporate ecosystem restoration through establishment or expansion of existing riverine, riparian, and wetland resources at available locations not yet identified around Shasta Lake and along the Sacramento River upstream from Red Bluff. It is estimated that the plan would improve the water supply reliability in the CVP system by increasing the average annual supplies by about 70,000 acre-feet per year with about 80 percent of this yield to areas south of the Delta. It would also provide for an enlarged cold water pool at Shasta, allowing added flexibility to benefit downstream anadromous fish. This concept would not require major relocations to Shasta area facilities. It would increase the inundated area at gross pool by about 700 acres. Infrequent inundation would extend upstream on the McCloud and Pit rivers an estimated 1,400 feet and 1,700 feet at gross pool, respectively. This concept would represent a low raise option within the range of potential dam raises identified previously.

- **Enlarge Shasta – Expanded Option Concept –** This concept consists of increasing the water supply reliability to the CVP and cold water pool at Shasta by enlarging Shasta Dam and Reservoir an amount significantly larger than suggested in the CALFED ROD. In addition to benefiting the cold water pool in Shasta Reservoir for downstream anadromous fish, it would help restore ecosystem values through establishment or expansion of existing riverine, riparian, and wetland resources at available locations not yet identified around Shasta Lake and along the Sacramento River upstream from Red Bluff.

As mentioned, previous studies have estimated that dam raises up to about 200 feet are physically feasible. However, such raises would double the aerial extent of inundation at gross pool causing significant environmental concern and displacement of area facilities and residents. It would require relocating a major railroad, Interstate 5, numerous smaller roads and bridges, several small community centers, and all recreation facilities currently along the lake shore. As the study progresses, this concept would likely consist of enlarging Shasta Dam and Reservoir by an amount limited by these major relocations, less than about 20 to 30 feet.

- **Conjunctive Use Concept –** The major components of this concept consists of (1) enlarging Shasta Reservoir about 290,000 acre-feet by raising the dam 6.5 feet, (2) developing a conjunctive use storage area, and (3) constructing ecosystem restoration features near Shasta Reservoir and along the upper Sacramento River. The Shasta Dam and Reservoir modifications and ecosystem restoration components would be similar to those highlighted above.

The purpose of the conjunctive use storage area component of this concept could be to enhance the ability for long-term carry over storage, which could increase the reliability of critical dry

period supply in the CVP. Conjunctive use consideration would include storage in either groundwater or in new or existing offstream surface water storage facilities.

- **Non-Structural Concept –** This concept primarily consists of reoperating Shasta Dam and Reservoir for increased water supply reliability and increasing the real-time flood control operation reliability of Shasta Dam. This could include enhancing the use of long range weather forecasting to modify the maximum seasonal drawdown for flood control and potentially allow earlier fill periods in the spring.

For improving real-time flood operations, this could include expanding the network of telemetered precipitation and streamflow gages in the upper watershed and on tributary watersheds to the upper Sacramento River. Also included would be enhanced real-time streamflow prediction capabilities at important decision points along the Sacramento River. This concept would require minimal physical changes and have minimal adverse environmental impacts.

- **Multiple Interest Concept –** The major components of this concept includes a combination of the following:

  - Enlarging Shasta Reservoir between about 290,000 and acre-feet 1 MAF by raising the dam between about 6.5 feet and 30 feet.
  - Developing a groundwater or offstream surface water storage area for carryover storage into dry years.
  - Reoperating Shasta Dam and Reservoir for increased water supply reliability.
  - Increasing the real-time flood control operation reliability of Shasta Dam.
  - Constructing ecosystem restoration features near Shasta Reservoir and along the upper Sacramento River.

Potential features to address other secondary planning objectives for additional recreation and hydropower opportunities at Shasta Dam and Reservoir could be considered in a multiple interest concept.

Continued Formulation

Of those measures that are determined to be most applicable in meeting the identified planning objectives, constraints, and criteria, there are numerous combinations that might form alternative plans. As mentioned, the concepts identified represent a range of potential variations and combinations of resource measures. It will be the focus of studies for the Initial Alternatives Information Report to refine the management measures and more completely define and evaluate initial alternatives for consideration in the remainder of the feasibility study.