Mokelumne River Water & Power Authority

Mokelumne River Regional Water Storage and Conjunctive Use Project - MORE WATER

Feasibility Analysis/Environmental Documentation Phase I - Reconnaissance Study Summary Report

June 2004

HDR

Mokelumne River Power and Water Authority

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List of Acronyms

$/acre-foot	Dollars per acre foot
AB	Assembly Bill
Association	Mokelumne River Association
Authority	Mokelumne River Water and Power Authority
BMPs	Best Management Practices
CCWD	Contra Costa Water District
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
county	San Joaquin County (geographic area)
County	San Joaquin County (entity)
CSJWCD	Central San Joaquin Water Conservation District
DWR	Department of Water Resources
EBMUDSIM	East Bay Municipal Utility District Simulation Model
EBMUD	East Bay Municipal Utilities District
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FONSI	Findings of No Significant Impact
IRP	Integrated Resource Plans
MARS	Mokelumne Aquifer Recharge and Storage Project
mgd	Million Gallons Per Day
MORE WATER	Mokelumne River Regional Water Storage and Conjunctive Use Project
MOU	Memorandum of Understanding
MWDSC	Metropolitan Water District of Southern California
NEPA	National Environmental Policy Act
NOAA Fisheries	National Marine Fisheries Services
NOD	Notice of Determination
NOI	Notice of Intent
NOP	Notice of Preparation
NSJWCD	North San Joaquin Water Conservation District
OID	Oakdale Irrigation District
PG&E	Pacific Gas & Electric
Reclamation	Bureau of Reclamation
ROD	Record of Decision
SEWD	Stockton East Water District
SSJID	South San Joaquin Irrigation District
SWC	State Water Contractors
SWRCB	State Water Resources Control Board
taf	thousand-acre-feet
TNF	True Natural Flow
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WID	Woodbridge Irrigation District
WMP	San Joaquin Water Management Plan

EXECUTIVE SUMMARY

ES-1 Introduction

The principal goal of the Mokelumne River Regional Water Storage and Conjunctive Use Project (MORE) Feasibility Analysis is to identify opportunities to capture unappropriated flows from the Mokelumne River for storage and beneficial use consistent with water supply and quality needs identified in the San Joaquin County Water Management Plan (WMP) and in accordance with the California State Water Resources Control Board (SWRCB) Water Right Applications 29835 and 29855. A multi-phase approach is being undertaken as part of the Feasibility Analysis – the first of which is a reconnaissance study and the subject of this report.

The goals of this Reconnaissance Study are:

- Establish the purpose and need for the project.
- Determine the lead and cooperating agencies.
- Establish an environmental process with potential lead agencies.
- Identify agency and key stakeholder issues.
- Identify an adequate and appropriate range of project alternatives meeting the purpose and need for the project.
- Refine the list of alternatives to carry into subsequent phases.
- Refine the scope for subsequent phases based on information learned during the Reconnaissance Study.

As HDR proceeded with the Reconnaissance Study, 16 technical memoranda were prepared summarizing activities and identifying future study needs. This report summarizes the efforts of the project team in conducting the Reconnaissance Study and provides recommendations for further study of alternatives which met certain screening criteria. Subsequent phases of the MORE WATER Feasibility Analysis include the following:

- Phase 2: East Basin Groundwater Management Plan/Programmatic California Environmental Quality Act (CEQA) Compliance and MORE WATER Engineering Feasibility Study.
- Phase 3: Project-Specific CEQA/National Environmental Policy Act (NEPA) and Permitting Compliance.

ES-2 History of Water Right Applications 29835 and 29855

On October 4, 1990, the Mokelumne River Power and Water Authority (Authority) filed Water Right Application 29835 with the SWRCB for the direct diversion off the Mokelumne River of 110,000 acre-feet per year and storage of up to 434,000 acre-feet per year, with a diversion period from December through June.

Several points of diversion and additional storage alternatives were proposed in the application that included new facilities located at Middle Bar on the Mokelumne River upstream from Pardee Reservoir, a new facility on Duck Creek and direct diversions downstream from Camanche Dam and the Bellota Weir along the Calaveras River and Mokelumne Slough.

Water Right Application 29855 was also filed with the SWRCB in late 1990 for the power generated from reservoir releases which could occur as a result of the Middle Bar Dam Reservoir project.

In early 2003, the SWRCB requested further information regarding the Authority’s intention to pursue a project on the Mokelumne River. To demonstrate its commitment, the Authority is undertaking the MORE WATER Feasibility Analysis including this Reconnaissance Study. Additional efforts will include an engineering feasibility study and environmental documentation undertaken for the purpose of securing permits from the SWRCB and the Federal Energy Regulatory Commission (FERC).

In a letter to the SWRCB dated March 2, 2004, the Authority demonstrated its commitment to the development of a new storage facility by addressing the status of current tasks being performed by the Authority that were outlined in the 2003 Work Plan for the MORE WATER Project. Discussed were:

- Project development activities that were required for Application 29835.
- Preparation of a water availability analysis that measured water availability in terms of timing and amounts.
- Progress on the Environmental Impact Report/Statement.
- Status of Protest Negotiations and actions being taken to resolve all issues addressed by protestants.
- Land access issues.
- Progress in obtaining a FERC preliminary permit.

ES-3 Water Resources in San Joaquin County

San Joaquin County (County) is growing rapidly, with a population of nearly 600,000 in 2002, projected to double by 2040 (CDM 2001). Water resources necessary to adequately sustain the diverse economy and environment of the county will be required. Opportunities to provide this water are heavily constrained by interim use of currently available water, including water that has been developed for use outside of the county. Additionally, there are a number of existing water resource management challenges in the county that are becoming more difficult as demands grow and the location and pattern of demand changes. While growth in urban demand will largely be offset by urbanization of agricultural lands, the differing water quality and demand pattern needs of this growth will add to currently stressed resources.

The county is currently reliant on groundwater for about 60 percent of its supplies. The remaining 40 percent is made up of primarily surface water (Authority/County 2003). In the eastern portion of the county, the Eastern San Joaquin sub-basin groundwater is overdrafted at a rate of about 150,000 to 200,000 acre-feet per year, putting the basin and the City of Stockton's drinking water supply in jeopardy of saline intrusion (CDM 2001). The cause and source of this saline intrusion has not been definitively determined. However, the County is currently coordinating with the United States Geological Survey (USGS), California Department of Water Resources (DWR), and the Groundwater Banking Authority to study this issue.

Surface water supplies also present challenges for the county. In the south Delta area, water quantity and quality is often inadequate for some agricultural uses, limiting the types of crops that can be grown and reducing crop yields of those that are grown. The north Delta region faces possible changes in operation of the Delta Cross-Channel that could adversely affect water quality by requiring more frequent closure of the Cross-Channel gates, further degrading surface water supplies available in the South Delta. In the southwest area of the county, urban growth is increasing demands on a limited supply.

In addition to local threats to water supplies, the county has been adversely affected by changes in federal and state policy which erode existing supplies and have upset longstanding plans to bring new supplies to the region.

ES-4 Water Management Plan

Recognizing that the county has growing water resource management problems, the Flood Control and Water Conservation District commissioned development of the WMP in April of 2000 to array the county's needs, identify possible solutions and develop a consensus on actions necessary to address the identified needs.

Current and projected water demands were quantified and a need for development of 200,000 acre-feet of new supply was identified, primarily recognizing the current groundwater overdraft (CDM 2001). The WMP ultimately identified numerous management options (referred to herein as, “alternatives”) (e.g., in-lieu recharge, water transfer reoperation, existing facilities and capturing unappropriated flows) that collectively address the County’s planning goals while performing acceptably under a set of common screening criteria.

Although the MORE WATER Feasibility Analysis is a Tier II Alternative (that is, it did not meet the objectives required for Tier I consideration), and would generally be considered a lower priority for implementation than Tier I Alternatives, it is moving forward due to its broad support among the WMP stakeholders and its potential for great flexibility in meeting a large portion of unmet water needs in the county. Further, it is important to note that the Mokelumne River option was initiated prior to the WMP development by the filing of the water right applications in 1990. The 2001 WMP simply confirmed the need for the MORE WATER Feasibility Analysis.

ES-5 Statement of Purpose and Need

Background

During the initial stages of this Reconnaissance Study, a range of alternatives were considered which could potentially meet the overall water resource needs of the county. As more information was obtained about the water right applications the Authority has on file with the SWRCB, and as input was received from agencies, it was determined that the MORE WATER Feasibility Analysis should focus on alternatives that would benefit from the opportunities available through the water right applications specifically. As a result, the purpose and need for a project resulting from the MORE WATER Feasibility Analysis has been more specifically defined than the purpose and need initially developed and informally discussed with agencies. The purpose and need presented below was developed in accordance with the water right applications that the Authority holds and is specific to capturing unappropriated flows on the Mokelumne River.

As a result of this revision to the purpose and need, several alternatives that were considered in the initial stages of this Reconnaissance Study are no longer being considered (because they would not capture Mokelumne River flows), but are addressed as part of the WMP.

Purpose and Need

The purpose of a project resulting from the MORE WATER Feasibility Analysis is to capture unappropriated flows on the Mokelumne River for storage and beneficial use within San Joaquin County. The need for the project is as an element in fulfilling the mission of the County’s WMP, that is, as an element in providing reliable water supplies for sustaining San Joaquin County’s current and future economic, social and environmental viability.

ES-6 Rationale for Environmental Regulatory Strategy

Originally, the scope of work for the MORE WATER Feasibility Analysis was to be divided into four phases including: Phase I - a Reconnaissance Study; Phase II - an Engineering Feasibility Study; Phase III - Corps Section 404(b)(1) Analysis; and Phase IV - a Project Specific NEPA/CEQA analysis for the preferred project alternative. This approach was initially recommended because the Mokelumne River project was initiated prior to the development of the WMP. However, this approach raised concerns because the WMP identified a wide-ranging suite of water supply actions necessary to correct the groundwater overdraft condition in San Joaquin County. Further, the County did not prepare a programmatic CEQA document, or any other CEQA document, to support the approval of the WMP. The lack of CEQA documentation could provide an opportunity for project opponents to assert that the purpose and need of a project resulting from the MORE WATER Feasibility Analysis could be served by other less damaging actions presented in the WMP or even by other actions not currently contemplated. It is possible that a carefully worded purpose and need statement could survive such a challenge. However, based on preliminary discussions with affected water agencies, a challenge can be expected. In addition, the United States Army Corps of Engineers (Corps) and the United States Environmental Protection Agency (USEPA) will likely carefully scrutinize the purpose and need to ensure it is written to allow for a full range of alternatives to be considered.

The proposed regulatory strategy, described in detail in this report, presents a more conservative approach to satisfying the environmental and regulatory requirements necessary for project approval. This approach includes three phases:

- Phase 1 - Reconnaissance Study
- Phase 2 - East Basin Groundwater Management Plan/Programmatic CEQA Compliance and MORE WATER Engineering Feasibility Study.
- Phase 3 - Project-Specific CEQA/NEPA and Permitting Compliance.

The primary difference between the present approach herein and the initial approach is the East Basin Groundwater Management Plan/Programmatic CEQA Compliance component and the inclusion of an East Basin Groundwater Management Plan as a technical appendix to the programmatic document. The technical appendix is needed to refine water supply and groundwater management actions. This work will draw heavily from the San Joaquin County Water Management Plan, but will go further in refining conservation and wastewater reuse, and will identify alternative strategies to be compared in the PEIR. The results will be included in the PEIR.. The WMP would be refined to integrate three elements, the first of which is the grouping of water management options into approximately three alternatives. These alternatives could be based on different themes, for example, one alternative could be developed around the MORE WATER Project and another alternative may be developed around maximum use of existing facilities. Each alternative would provide a regional approach to meeting the County's water needs. Secondly, preparation of the East Basin Groundwater Management Plan would allow further development of the following common elements under each alternative: water conservation (i.e., demand management) programs and water recycling projects. Finally, the East Basin Groundwater Management Plan would integrate a general implementation schedule for the programs tied to the forecasted needs of the County.

Following preparation of the East Basin Groundwater Management Plan, a Program Environmental Impact Report (EIR) would be prepared and the document including the technical appendix would serve as the roadmap for implementing the projects needed to provide the County with a reliable water supply.

A Program Environmental Impact Statement (EIS) could be prepared jointly with a Program EIR if a federal agency participates in funding the effort.

A Program EIR/EIS will support the implementation of future site-specific projects by:

- Allowing proper consideration of the broader scale impacts, alternatives and mitigation criteria of the East Basin Groundwater Management Plan than would be possible in an individual site-specific Project EIR.
- Focusing on the cumulative and growth-inducing impacts of implementation of the East Basin Groundwater Management Plan.
- Addressing policy, design and management issues at the program level rather than repeated consideration at the project level.
- Considering broad policy alternatives and programmatic mitigation measures at an early stage in the development of the East Basin Groundwater Management Plan when policy flexibility is greatest.
- Conserving resources by encouraging the reuse of data.

The Program EIR will also analyze the potential environmental effects of the East Basin Groundwater Management Plan objectives and assumptions, policy alternatives to achieving identified objectives, broad-scale impacts, and establish mitigation criteria for the overall plan.

ES-7 Agency and Key Stakeholder Concerns

Early identification of agency and stakeholder issues and concerns is critical to the development and successful implementation of water resource projects. As part of this reconnaissance study, an effort was made by the MORE WATER project team to gather information from agencies and interested stakeholders through preliminary meetings and presentations concerning the MORE WATER Feasibility Analysis. The purpose of this approach was to identify key agency and stakeholder concerns early in the process so that, where possible, a collaborative effort could be used to address concerns or adjust processes where necessary.

Numerous concerns and issues were raised by regulatory agency representatives, specifically with regard to the draft purpose and need statements and the project-specific approach. Following consideration of agency concerns as well as the risks associated with a project-specific NEPA/CEQA approach, the Authority determined that a programmatic approach would be most appropriate. A programmatic approach, that is refining the WMP and conducting CEQA compliance through a Program EIR, will address or eliminate many of the issues presented by the regulatory agency representatives.

Stakeholder issues and concerns were received by the MORE project team during meetings held in July of 2003. Interested project stakeholders included the Mokelumne River Association (Association), Contra Costa Water District (CCWD), East Bay Municipal Utility District (EBMUD), The State Water Contractors (SWC) and CALFED Integrated Storage Investigations staff (i.e., DWR and the United States Bureau of Reclamation (Reclamation). Some of the concerns relayed by stakeholders included:

- The amount of flood flow diversion proposed and its availability
- The modeling accuracy for estimating potential downstream-reduced flow impacts and cumulative impacts of other proposed projects on the Mokelumne River.
- Water quality and water supply impacts
- The Authority's ability to claim superior rights to surplus Mokelumne River water before it reaches the Delta and whether CCWD can claim a portion of this flow as being appropriated through a Delta surplus.
- Cumulative impact analyses with regard to flow and water quality.
- Verification of the level of County's groundwater overdraft.
- The difficulty of underpinning a purpose and need for a project resulting from the MORE WATER Feasibility Analysis in the absence of rigorous conservation and recycling efforts.
- The need for a program EIR to lay the groundwork for implementation of a Tier 2 project.

ES-8 Identification of Federal Lead Agency

There are three agencies with the highest probability of being designated as the "Federal Lead Agency". These potential lead agencies include, in order of preference:

1. Reclamation
2. Corps
3. FERC

Following is a discussion concerning the potential for the above agencies to become the Lead Agency for a project resulting from the MORE WATER Feasibility Analysis.

U.S. Bureau of Reclamation (Reclamation)

Reclamation could have jurisdiction because there is a potential for Federal authorization of funds for the project via Reclamation's budget, water supply is a primary Reclamation mission, and Reclamation has an existing relationship with the affected area via a Central Valley Project contract.

It is anticipated that Reclamation's Mid-Pacific Region Planning Division would engage in a project resulting from the MORE WATER Feasibility Analysis, although full engagement would not occur until Reclamation released funds. If ultimately Reclamation does not obtain funding to participate, the Corps would be the Lead Agency for those portions of the project affected by Section 404 and/or Section 10. The following section discusses the Corps' potential role.

U.S. Army Corps of Engineers – Sacramento District (Corps)

The Corps will likely have jurisdiction for a project resulting from the MORE WATER Feasibility Analysis under Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act of 1899, and as a part of preparing the USEPA's 404(b)(1) analysis. Because the Corps is responsible for regulating the discharge of dredge or fill materials into waters of the United States (Section 404) and ensuring no obstruction to navigable waterways, it would likely have significant permitting purview over a project designed to capture unappropriated flows on the Mokelumne River.

Federal Energy Regulatory Commission (FERC)

Generally, the principal trigger for FERC involvement is when a change in a license is required to accommodate operational changes to a FERC licensed facility (such as Camanche or Pardee Reservoirs), or when there is a hydropower component to a project and a new application for power development is necessary.

ES-9 Identification of Alternatives

As previously mentioned, several alternatives that were considered in the initial stages of this Reconnaissance Study are no longer being considered as part of the MORE WATER Feasibility Analysis. However, these alternatives are included in the WMP and could undergo further consideration in the East Basin Groundwater Management Plan. These alternatives include:

- New Hogan Dam and Reservoir Reoperation
- Auburn Dam and Reservoir Construction
- EBMUD Freeport Regional Water Project
- San Joaquin County Freeport Interconnect
- South Fork American River Diversion to County Line Reservoir
- American River Diversion to Clay Station Reservoir
- Regulatory Fee Assessment
- Joint Use Program
- Desalination of Connate Groundwater

The 12 alternatives that were considered as part of this Reconnaissance Study can be grouped into five categories and are listed below. The five categories include 1) on-stream storage, 2) off-stream storage, 3) direct diversions, 4) additional diversions, and 5) non-structural groundwater management.

On-Stream Storage Alternatives

Pardee Dam and Reservoir Replacement/Enlargement

The Pardee Dam and Reservoir Replacement/Enlargement alternative would involve constructing a new concrete dam three-quarters of a mile downstream and 42 feet higher (i.e., crest elevation of 617 feet versus 575 feet) than the existing dam.

This alternative would allow capturing unappropriated Mokelumne River flows for potential use in direct diversion for beneficial use. The captured flows would be diverted from the reservoir or conveyed down the Mokelumne

River to diversion points located along the lower Mokelumne River from below Camanche Reservoir to Interstate 5 where the water would be diverted for beneficial use.

Pardee Dam & Reservoir

Middle Bar Dam and Reservoir Construction

The Middle Bar Dam and Reservoir Construction alternative includes constructing a concrete arch dam (Middle Bar Dam) on the Mokelumne River upstream of the existing Pardee Reservoir. The project, as described in the Authority's water right applications involves construction of a 420-foot concrete arch dam and creation of a 434,000 acre-foot reservoir. If deemed cost effective and a FERC permit is granted, an 80-megawatt power plant could be included. Flows captured by the reservoir would be conveyed via the lower Mokelumne River to diversion points where the water would be diverted for beneficial use.

Mokelumne River Storage System Reoperation

This alternative includes reoperating Pardee Dam and Reservoir, Camanche Dam and Reservoir, and the Pacific Gas & Electric (PG&E) Project 137 system to generate additional water supply. It may be possible to redefine the flood control operating guidelines to allow capture of unappropriated flows in the system. By using updated hydrology and upgraded forecasting tools, opportunities may exist to modify the rule-curves to decrease flood control reservation space in the reservoirs. Flows captured by the reservoirs would be conveyed via the lower Mokelumne River to diversion points where the water would be diverted for beneficial use.

Devil's Nose Dam and Reservoir Construction

The Devil's Nose Dam and Reservoir Construction alternative includes construction of a new dam and reservoir (i.e., Devil's Nose Dam and Reservoir) on the Mokelumne River between Salt Spring's Reservoir and the Tiger Creek powerhouse. Previous proposals at the site have included a 475-foot high earthen dam. Unappropriated flows would be captured and conveyed via the Lower Mokelumne River to diversion points where the water would be diverted for beneficial use.

Off-Stream Storage Alternatives

Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion

This alternative includes capturing unappropriated flows at Pardee Reservoir on the Mokelumne River and conveying up to 1,000 cubic feet per second (cfs) via a gravity tunnel and pipeline to a new Duck Creek Reservoir on the Duck Creek drainage. An additional 620 cfs would be conveyed down the Mokelumne River for direct diversion for beneficial use, or released into Duck Creek, then Calaveras River or Mormon Slough, where it could be rediverted for beneficial use. The water held in the Duck Creek Reservoir would be conveyed to areas of beneficial use. As defined in the SWRCB water right application 29835, the proposed Duck Creek facilities would have a storage volume of up to 200,000 acre-feet and a total diversion capacity at Pardee Reservoir of up to 1,000 cfs.

Looking Upstream at Duck Creek

Duck Creek Dam and Reservoir Construction - Camanche Reservoir Diversion

This alternative includes capturing unappropriated flows at Camanche Reservoir on the Mokelumne River and conveying up to 1,000 cfs via pipeline to the new Duck Creek Reservoir on the Duck Creek drainage. Because of the elevation difference between Camanche Reservoir and Duck Creek Reservoir, a pump station at Camanche Reservoir would be required to convey flow into the pipeline.

Potential Duck Creek Reservoir Area

An additional 620 cfs would be conveyed down the Mokelumne River for direct diversion for beneficial use. The water held in the Duck Creek Reservoir would be conveyed via a pipeline to areas of beneficial use similar to the Pardee Dam and Reservoir Replacement/Enlargement alternative. As defined in the SWRCB water right application 29835, the proposed Duck Creek facilities would have a storage volume of up to 200,000 acre-feet and a total diversion capacity at Camanche Reservoir of up to 1,000 cfs.

New Hogan Reservoir Diversion with South Gulch Dam and Reservoir Construction Project

This alternative includes capturing flows from the Mokelumne River via diversion at Pardee Reservoir, conveyance to New Hogan Reservoir via tunnel, and re-diversion through a tunnel at New Hogan Reservoir to a new South Gulch Reservoir. Water would be conveyed from South Gulch Reservoir for beneficial use in the eastern groundwater basin and to Stockton East Water District (SEWD) using existing facilities (Calaveras River, Mormon Slough). Additional beneficial uses would be realized by connecting South Gulch Reservoir to the Upper Farmington Canal.

Direct Diversion Alternatives

Alliance Canal

The Alliance Canal (previously known as the Flat Leaky Canal) includes construction of an un-lined canal that would convey water from the Farmington Canal to Dry Creek, and vice versa, for beneficial use along its alignment. The project would include several recharge ponds along its course and convey up to 500 cfs. The project would logically be completed in three phases: 1) Farmington Canal to Calaveras River, 2) Calaveras River to Mokelumne River, and 3) Mokelumne River to Dry Creek.

The canal could potentially connect SEWD, South San Joaquin Irrigation District (SSJID), and Oakdale Irrigation District (OID) and accept direct diversions or stored water from any of the storage or additional diversion alternatives described in this chapter.

Lower Mokelumne River Diversions - Structural

This alternative, an alternative of the original SWRCB water right application, includes diverting flows using pump stations with or without modifiable dams located along the lower Mokelumne River from below Camanche Reservoir to Interstate 5. Flows would be diverted to areas of beneficial use.

Lower Mokelumne River Diversions - Non-Structural

This alternative includes diverting flows using existing structures such as EBMUD diversion at Pardee, the North San Joaquin Water Conservation District (NSJWCD) pumping facility, and/or the Woodbridge Irrigation District (WID) facility at Lodi. Flows would be diverted for beneficial use during periods when capacity exists.

Additional Diversion Alternatives

City of Stockton - Delta Diversion Modification

This alternative includes providing additional funds toward modifying the City of Stockton's proposed Delta Diversion project. Additional funds would allow increased diversion capability over and above Stockton's needs. The Authority's Mokelumne River water-right would be exercised at the location of the Delta Diversion Project. Flows generated as a result of the increased diversion capability would be conveyed via a pipeline for beneficial use.

Non-Structural Groundwater Management

EBMUD/San Joaquin County 10-Well Program

EBMUD and the County have attempted to negotiate a groundwater banking and conjunctive-use program in the past. Preliminary screening in the EBMUD Water Supply Management Plan identified an area of the County as the best location for the program. The Mokelumne River and EBMUD's Mokelumne Aqueduct crosses the area best suited for recharge. The area is also subject to severe groundwater overdraft problems. The conjunctive use plan would allow EBMUD to recharge as much water as possible during wet years. During drought years, EBMUD would be allowed to remove up to 50 percent of the water that was recharged. However, no agreement was reached between the County and EBMUD.

A variation of the original proposal would be for the Authority to jointly operate this alternative, recharging a portion of its Mokelumne River water rights in addition to EBMUD's water right.

Figure ES-1 depicts the general location of alternatives carried forward.

Initial Screening Process

The initial screening process eliminated any alternative that did not meet the purpose and need. Secondly, Mokelumne River alternatives being pursued by another entity, or some other effort were eliminated. Alternatives eliminated during the initial screening process include:

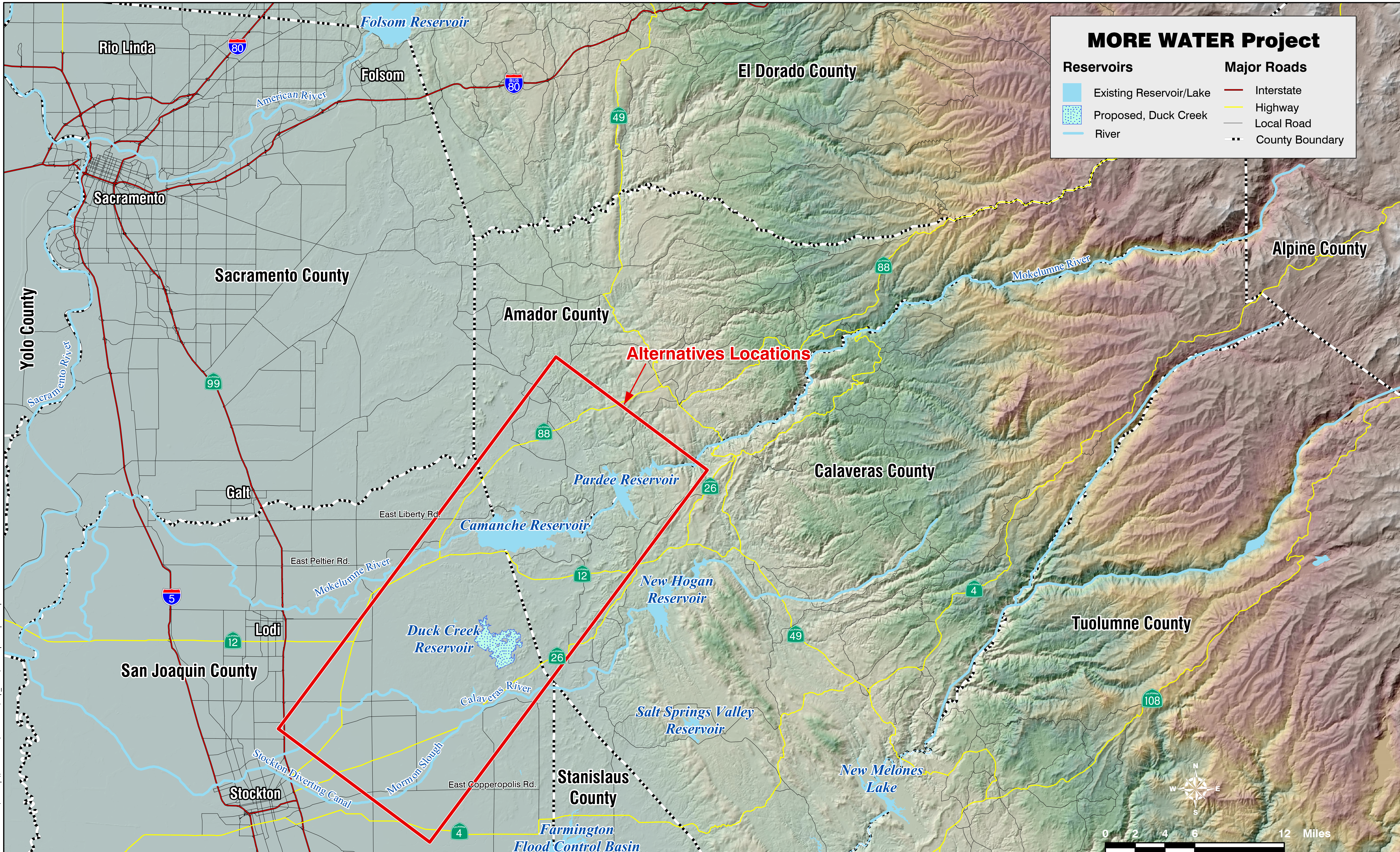
- EBMUD/San Joaquin County 10-Well Program
- Alliance Canal (Flat Leaky Canal)
- City of Stockton, Delta Diversion Modification

Secondary Screening Process

The remaining alternatives were evaluated based on engineering, environmental, regulatory, and political obstacles/considerations that could result in the infeasibility of an alternative. As a result, two additional alternatives were removed from consideration. The alternatives removed were: Middle Bar Dam and Reservoir Construction, and Devil's Nose Dam and Reservoir Construction.

Middle Bar Dam, an alternative included in the Authority's water right permit application, was considered infeasible because of environmental, regulatory, and political circumstances. Specifically, the Authority recognized that adverse impacts to recreational opportunities (whitewater kayaking and rafting) at the upstream end of the existing Pardee Reservoir would be unacceptable to many interests. Additionally, environmental damage to riverine, upland, and oak savannah habitat and the associated wildlife within the inundation area of the proposed reservoir pool was considered an unacceptable result of the alternative relative to other alternatives being considered. Therefore, the Middle Bar Dam and Reservoir Construction alternative was not carried forward for further consideration.

The Devil's Nose Dam and Reservoir Construction alternative was also considered currently infeasible. Historic activities have indicated that this alternative would result in political, environmental, and regulatory circumstances unacceptable to many members of the public.



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Location Map for Alternatives Carried Forward

FIGURE ES-1.

HDR ONE COMPANY | Many Solutions

Final Screening Process

To determine which alternatives had the greatest potential for implementation, weighting was assigned for each screening criteria category during a workshop with the Authority and key stakeholders. Table ES-1 provides a summary and rationale of the weighting criteria.

Table ES-2 provides the final relative ranking of alternatives based on the weighting factor and the designation of high, medium, or low for each screening criteria category. The process used to generate the relative ranking was 1) set a numerical value for the low, medium, and high ratings of 1, 2, and 3 respectively; 2) multiply that rating by the weighting factor to determine the final score for each alternative.

It should be noted here, that cost considerations, while designated as high, medium, or low, were not assigned a weighting factor and did not contribute to the score, as cost per acre-foot is too preliminary at this stage of the evaluation.

The alternative with the highest score was rated the most highly implementable alternative and the lowest score represents the least likely implementable alternative.

The two alternatives with scores less than 30 (i.e., New Hogan Reservoir Diversion with South Gulch Dam and Reservoir Construction, and Pardee Dam and Reservoir Replacement/Enlargement) were eliminated from consideration at this time as the Authority chooses to carry forward only the five highest ranked alternatives for consideration.

ES-10 Alternatives Carried Forward into Phase 2

Final screening determined the following five alternatives should be carried forward for further evaluation in subsequent phases of the MORE WATER Feasibility Analysis.

- Mokelumne River Storage System Reoperation
- Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion
- Duck Creek Dam and Reservoir Construction - Camanche Reservoir Diversion
- Lower Mokelumne River Diversions - Structural
- Lower Mokelumne River Diversions - Non-Structural

Table ES-1. Screening Criteria Categories, Rationale, and Associated Weighting Factor

Screening Criteria	Weight	Rationale
Cost per acre-foot	0	Cost data is too preliminary at this stage to adequately compare alternatives. To ensure the ranking outcome is not skewed, no weight was given to this criterion.
Regulatory Feasibility	3	Ability to obtain regulatory approval is necessary for successful implementation and lack of approval would halt any project.
Political Feasibility	3	Ability to obtain political support is necessary for successful implementation. Lack of support could ultimately halt implementation of a project.
Financial Feasibility	1	Ability to secure additional partners for financing is only marginally important for successful implementation. The Authority is in a position to fund a primary portion of any project resulting from the MORE WATER Feasiblity Analysis.
Environmental Feasibility	2	Ability to mitigate environmental impacts is required for successful implementation.
Water Quality	1	Operation of alternatives to capture unappropriated flow would cause little issue for downstream users because changes would be marginal and minimum water quality objectives would be maintained.
Benefits Achieved	5	Because of the extent of the water supply challenges facing the County, the degree of potential yield (acre-feet) was considered a significant concern for successful implementation.

Table ES-2. Weighted Screening Criteria and Evaluation Results

Weight	0	3	3	1	2	1	5		
ALTERNATIVE	**Cost per acre-foot**	**Regulatory Feasibility**	**Political Feasibility**	**Financial Feasibility**	**Environmental Feasibility**	**Water Quality**	**Benefits Achieved**	**Score**	**Relative Ranking**
Duck Creek Dam - Pardee Reservoir Diversion	L	M	M	H	M	H	H	37	1
Duck Creek Dam – Camanche Reservoir Diversion	L	M	M	H	M	H	H	37	2
Lower Mokelumne River Diversions-Non Structural	H	H	H	H	H	H	L	35	3
Lower Mokelumne River Diversion-Structural	H	M	H	M	M	H	M	34	4
Mokelumne River Storage System Reoperation	H	H	M	M	H	H	L	31	5
New Hogan Reservoir Diversion with South Gulch Dam and Reservoir Construction	L	L	M	M	M	H	M	29	6
Pardee Dam and Reservoir Replacement/Enlargement	M	L	L	M	L	H	H	28	7

Cost: Relative rating of the cost per acre-foot for each alternative. High = $ per acre-foot. Medium = $$ per acre-foot. Low = $$$ per acre-foot

Regulatory Feasibility: High: Good chance for regulatory support (i.e., regulatory agency concurrence). Medium: Moderate chance for legal support. Low: Low chance for support (i.e. regulatory agencies opposed).

Political Feasbility: High: Good chance for political support (i.e., elected officials/powerful interest groups in agreement). Medium: Moderate chance for political support. Low: Low chance for support (i.e. elected officials/powerful interest groups opposed).

Financial Feasibility: High: High chance for financing partners outside of the Authority. Medium: Moderate chance for partners. Low: Low chance for partners outside of the Authority.

Environmental Feasibility: High: Limited environmental impacts that can be mitigated to level of insignificance. Medium: Adverse environmental impacts that can be mitigated. Low: Adverse environmental impacts that cannot be mitigated.

Water Quality: High: No effect to downstream or County users. Medium: Potential effect to downstream users that can be mitigated. Low: Adverse effect to downstream or County users.

Benefits Achieved: High: Contribution to solving the County's water resource issues is highly valuable. Medium: Contribution to solving the County's water resource issues is moderately valuable. Low: Contribution to solving the County's water resource issues is minimally valuable

NOTE: Score = high, medium, low ranking of 3, 2, and 1 respectively, multiplied by weighted factor (ranging from 1 to 5) for each screening criterion.

ES-11 Preliminary Operations Study of Alternatives

Introduction

The operations study for the alternatives carried forward was conducted using two simulation models: the East Bay Municipal Utility District Simulation Model (EBMUDSIM) and the MORE Model.

The EBMUDSIM is the EBMUD Reservoir Operations Planning Model[1]. The model simulates EBMUD's Mokelumne River and East Bay water supply system and estimates water availability to EBMUD customers under current and assumed future conditions. One of the outputs of the model is the estimated release from EBMUD storage reservoirs on the Mokelumne River (Pardee and Camanche Reservoirs) to the lower Mokelumne River. This release includes water for downstream

1 EBMUDSIM Model Description, Assumptions, Verification, and Output. Testimony of John W. Skinner before the State Water Resources Control Board, June 1998.

users as well as flood control release and instream flow requirements.

The MORE Model is a custom-designed computer program developed specifically for the MORE WATER Feasibility Analysis. The model uses given time series of flood control releases to estimate water availability to County customers under different configurations.

Mokelumne River Hydrology

The amount of Mokelumne River water available to the project depends on hydrological conditions, operation of upstream water and power projects, upstream diversions, EBMUD demand, water rights and minimum instream flow requirements for the lower Mokelumne River watershed, and flood control rules. The Upper Mokelumne River Watershed is defined as the portion of the Mokelumne Basin upstream of Pardee Reservoir. The flow regime in this area is governed by the operation of PG&E Project 137 and diversions by Amador and Calaveras Counties.

ES-12 EBMUD Water Supply System

The EBMUD water supply system on the Mokelumne River consists of Pardee Reservoir and powerplant, Camanche Reservoir and powerplant, and the Mokelumne Aqueducts, which divert water from Pardee Reservoir and deliver water to the EBMUD service area. The operation of the EBMUD system is modeled within the EBMUDSIM model, to account for the gross storage capacity, operational requirements, etc., of the reservoirs (i.e., Pardee and Camanche Reservoirs) and associated powerplants.

ES-13 Flood Control Operations

Flood control operation is one of the most important factors in estimating the unappropriated water available to the County. The flood control operations for Pardee and Camanche Reservoirs are regulated by the Corps.

EBMUDSIM simulates these flood control operation rules, with some approximation subject to the limitations in the monthly time steps.

Lower Mokelumne River Watershed

The Lower Mokelumne River Watershed is defined as the portion of the Mokelumne Basin downstream of Camanche Reservoir. The flow regime in this area is governed by the need to supply water for downstream water users (diversions), channel losses and fish release requirements. This information was also incorporated into the modeling efforts.

The MORE Model is essentially a post processor of the results obtained from EBMUDSIM. The model uses the computed flood control release from Camanche Reservoir to simulate alternatives and compute the portion of the unappropriated water that could be diverted for storage and/or beneficial use. Finally, the model computes the remaining unappropriated flows in the lower Mokelumne River after diversions for the alternative. For this Reconnaissance Study the MORE Model was used to analyze the maximum demand annual yield and hydropower impact of alternatives.

As available yield is one of the outputs of the MORE Model, there is no distinction in the model results between the lower Mokelumne River Diversions - Structural Alternative, and the lower Mokelumne River Diversions - Non-Structural Alternative. Theoretically, both the structural and non-structural alternatives could provide 100 percent of available yield. However, in practice, with the lower Mokelumne River Diversions - Non-Structural alternative, capacity of existing structures and conveyance facilities would place limitations on the ability to capture 100 percent of the available yield. For this reason, relevant model results for the lower Mokelumne River diversions are presented as Lower Mokelumne River Diversion - Structural, rather than Non-Structural.

Alternatives Modeling

Three alternatives were studied: (1) Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion, (2) Duck Creek

Dam and Reservoir Construction-Camanche Reservoir Diversion, and (3) Lower Mokelumne River Diversion - Structural.

For the Duck Creek reservoir diversion alternatives, the water diverted is stored in the reservoir and then discharged to the County's service area for beneficial use. Water from the Lower Mokelumne River Diversions, on the other hand, is directly discharged to the area of beneficial use.

Results/

Results of the operations are presented in the report in terms of:

1. **The Maximum Demand (no-spill).** The maximum demand is the maximum required flow rate of the conveyance facility from Duck Creek Reservoir to the area of beneficial use in order to prevent Duck Creek reservoir spills.
2. **The Project Annual Yield.** Annual yield is the average supply of water to the County on an annual basis for the period of analysis. Annual yield is the sum of direct diversion and diversion to storage (in the case of Duck Creek Reservoir).
3. **Hydropower Impact.** Hydropower impact is the loss of generation to EBMUD due to implementation of an alternative. At present, EBMUD has the ability to pass a portion of its spills through the hydropower plants at Pardee and Camanche Reservoirs MORE WATER alternatives which divert upstream of one or both of these powerhouses would have to compensate for lost hydropower revenues.

For the purposes of this Executive Summary, available yield results are presented with the results of the cost effectiveness analysis.

ES-14 Cost Effectiveness Analysis

For this Reconnaissance Study, the cost of the alternatives carried forward for further analysis were compared using the benchmark of dollars per acre-foot ($/acre-foot) per year for the three selected alternatives. It should be noted that the cost effectiveness analysis was not conducted for either the Lower Mokelumne River Diversions-Non-Structural Alternative or the Mokelumne River Storage System Reoperation Alternative, as no new facilities are associated with these alternatives. Considerations were given to:

- Life-cycle costs for the project's capital and operation and maintenance expenditures on an annual basis over a 100-year period.
- The role of inflation – For purposes of developing the long-term cost effectiveness analysis and facilitating comparisons across alternatives, inflationary pressures on costs were not considered over the 100-year period.
- Annual discounted costs – The annual costs for each alternative were discounted to account for the "real" time value of money, unaffected by the rate of inflation. A discount rate of 3.0 percent was used. The annual discounted costs were summed over the 100-year period to determine the net present value cost of each alternative. The net present value cost was then expressed on an annual basis by amortizing this value over 100 years at the discount rate.

Cost Effectiveness Results

- The sum of the annualized life-cycle costs plus the annual foregone hydropower production (if appropriate) equals the annual equivalent cost of each alternative. This annual cost is divided by the annual yield of the alternative to determine the annual cost per acre-foot of the alternative.

Table ES-3 shows that the cost per acre-foot for the alternatives evaluated ranges from $123 (Lower Mokelumne River Diversions-Structural) to $334 (Duck Creek Dam and

Reservoir Construction-Camanche Diversion with no hydropower impacts). It is of interest to note that although the higher yields from Duck Creek Dam and Reservoir Construction-Camanche and Pardee Reservoir Diversions are accompanied by hydropower impacts, the overall cost per acre-foot is reduced. This is because the value of the additional yield to the project is proportionately more than the increase in costs associated with foregoing hydropower production. Alternatively stated, the average value of the hydropower produced, on a per acre-foot basis, is less than the cost of developing additional supply – one "averages down" the project cost by foregoing hydropower production.

Although these costs are competitive with what municipalities and other non-agricultural users pay for water, on a per acre-foot basis, the costs do not include facilities to re-regulate and convey the water for beneficial use. In other words, the yield estimates assume the water can be used at the time it is directly diverted or released from Duck Creek Reservoir, which is usually during the winter and spring months. This assumption gives an ideal picture of the cost per acre-foot and will be investigated more fully in the Engineering Feasibility Study.

Also, costs are only partially included to distribute the water beyond the river's edge for the direct diversion and beyond Duck Creek Dam and Reservoir for the Camanche and Pardee diversions. The costs associated with a main pipeline is included to convey the diverted water to an assumed central location within the area of beneficial use (5 miles for the direct diversion and 3 miles for the Duck Creek outlet), but no costs are included for the distribution, storage and recharge of water throughout the area of beneficial use. Hence, once those realities are dealt with in the Phase 2 Engineering Feasibility Study, the per acre-foot costs will rise substantially. The numbers shown in Table ES-3 are primarily for comparison purposes.

Table ES-3. Summary of Cost Effectiveness Analysis[a]

		Duck Creek Dam and Reservoir Construction			
		Camanche Reservoir Diversion		Pardee Reservoir Diversion	
	Lower Mokelumne River Diversions-Structural	**No Hydropower Impacts**	**Hydropower Impacts**	**No Hydropower Impacts**	**Hydropower Impacts**
Capital cost	$74,900,000	$368,000,000	$368,000,000	$412,000,000	$412,000,000
Annual Operation & Maintenance	$2,950,000	$14,400,000	$14,700,000	$5,480,000	$5,480,000
Present value life cycle costs (100 years)	$191,000,000	$868,000,000	$875,000,000	$626,000,000	$626,000,000
Annualized life cycle costs	$6,050,000	$27,500,000	$27,700,000	$19,800,000	$19,800,000
Plus forgone hydropower revenue	$0	$0	$124,000	$0	$468,000
Total annual equivalent cost	$6,050,000	$27,500,000	$27,800,000	$19,800,000	$20,300,000
Annual project yield (acre-feet)[b]	49,200	82,300	90,300	82,300	90,300
Annual cost per acre-foot[c]	$123	$334	$308	$241	$225

a All costs are 2004 dollars (without inflation) and have been rounded to three significant figures.

b Annual yield estimates assume an ideal user. That is, the water can be fully beneficially used immediately upon diversion. In reality, much of the diversion would occur in the winter and early spring months when demands are minimal. This issue will be investigated more fully in the Phase 2 Engineering Feasibility Study.

c Cost per acre-foot does not include costs for the distribution, storage and recharge of water throughout the beneficial use area.

1. INTRODUCTION AND BACKGROUND

1.1 MORE WATER Feasibility Analysis

The principal goal of the Mokelumne River Regional Water Storage and Conjunctive Use (MORE WATER) Feasibility Analysis is to identify opportunities to capture unappropriated flows from the Mokelumne River for storage and beneficial use consistent with water supply and quality needs identified in the San Joaquin County Water Management Plan (WMP) and in accordance with the California State Water Resources Control Board (SWRCB) Water Right Applications 29835 and 29855. A multi-phase approach is being undertaken as part of the Feasibility Analysis – the first of which is a reconnaissance study and the subject of this report.

In early 2003, under the direction of the Mokelumne River Water and Power Authority (Authority) and in coordination with the County of San Joaquin (County), HDR was tasked with completion of a reconnaissance study focused on identifying the appropriate environmental processes and range of alternatives for capturing and impounding unappropriated flows from the Mokelumne River. These flows would provide water for beneficial use within the county. The goals of this Reconnaissance Study are:

- Establish the purpose and need for the project.
- Determine the lead and cooperating agencies.
- Establish an environmental process with potential lead agencies.
- Identify agency and key stakeholders issues.
- Identify an adequate and appropriate range of project alternatives meeting the purpose and need for the project.
- Refine the list of alternatives to carry into subsequent phases.
- Refine the scope for subsequent phases based on information learned during the Reconnaissance Study (The scope for Phases 2 and 3 are provided separately from this Reconnaissance Study).

As HDR proceeded with the Reconnaissance Study, technical memoranda were prepared summarizing activities and identifying future study needs. This report summarizes the efforts of the project team in conducting the Reconnaissance Study and provides recommendations for creation of a project and alternatives to develop unappropriated flows on the Mokelumne River for storage and beneficial use. Subsequent phases of the MORE WATER Feasibility Analysis are discussed in Chapter 3 and include the following:

- Phase 2: East Basin Groundwater Management Plan/Programmatic California Environmental Quality Act (CEQA) Compliance and MORE WATER Engineering Feasibility Study.
- Phase 3: Project-Specific CEQA/National Environmental Policy Act (NEPA) and Permitting Compliance.

1.2 History of Water Right Applications 29835 and 29855

On October 4, 1990, the Authority filed Water Right Application 29835 with the SWRCB for the direct diversion off the Mokelumne River of 110,000 acre-feet per year and storage of up to 434,000 acre-feet per year, with a diversion period from December through June (Limitations on diversion months could be changed through an amended water right application, thus resulting in increased diversions). Several points of diversion and additional storage alternatives were proposed in the application that included new facilities located at Middle Bar on the Mokelumne River upstream from Pardee Reservoir, a new facility on Duck Creek and direct diversions downstream from Camanche Dam and the Bellota Weir along the Calaveras River and Mokelumne Slough.

Water Right Application 29855 was also filed with the SWRCB in late 1990 for the power generated from reservoir releases which could occur as a result of the Middle Bar Dam and Reservoir project.

The application was publicly noticed on September 27, 1996 and protests and comments were received from affected agencies and individuals.

The FERC permit application was publicly noticed in July 2003 with notice closing on September 22, 2003. A number of agencies requested intervention status with FERC. On January 22, 2004, the Authority received an issuance of preliminary permit from FERC. Subsequent activities will include: Stage 1 (commencing in early Spring 2004) which includes preparing the initial consultation package, conducting a joint public meeting and site visit, and responding to resource agency and non-governmental agency comments. Stages 2 and 3 will include the development of detailed study plans, completion of all necessary studies, development of the draft and final license application, resource descriptions and proposed mitigations. The information will be sufficiently detailed to prepare the project NEPA and CEQA documents for final issuance of the license by FERC.

Both the water right application and FERC Preliminary Permit are in good standing, therefore the Authority is an active, legal participant, whose agreement must be sought by any party seeking to utilize water or produce power on the Mokelumne River.

In early 2003, the SWRCB requested further information regarding the Authority's intention to pursue a project on the Mokelumne River. To demonstrate its commitment, the Authority is undertaking the MORE WATER Feasibility Analysis including this Reconnaissance Study, and subsequent engineering feasibility study and environmental documentation activities in accordance with the SWRCB and the FERC for the completion of the studies needed to secure both permits.

In a letter to the SWRCB dated March 2, 2004, the Authority demonstrated its commitment to the development of a new storage facility by addressing the status of current tasks being performed by the Authority that were outlined in the 2003 Work Plan for the MORE WATER Project. Discussed were:

- Project development activities that were required for Application 29835.
- Preparation of a water availability analysis that measured water availability in terms of timing and amounts.
- Progress on the Environmental Impact Report/Statement.
- Status of Protest Negotiations and actions being taken to resolve all issues addressed by protestants.
- Land access issues.
- Progress in obtaining a FERC preliminary permit.

1.3 Water Resources in San Joaquin County

San Joaquin County is growing rapidly, with a population of nearly 600,000 in 2002, projected to double by 2040 (CDM 2001). Water resources necessary to adequately sustain the diverse economy and environment of the county will be required. There are a number of existing water resource management challenges in the county that are becoming more difficult as demands grow and the location and pattern of demand changes. While growth in urban demand will largely be offset by urbanization of agricultural lands, the differing water quality and demand pattern needs of this growth will add to currently stressed resources.

The county is currently reliant on groundwater for about 60 percent of its supplies. The remaining 40 percent is made up of primarily surface water (Authority/County 2003). In the eastern portion of the county, the eastern San Joaquin sub-basin groundwater is overdrafted at a rate of about 150,000 to 200,000 acre-feet per year, putting the basin and the City of Stockton's drinking water supply in jeopardy of saline intrusion (CDM 2001). The cause and source of this saline intrusion has not been definitively determined. However, the County is currently coordinating with the United States Geological Survey (USGS), DWR, and the Groundwater Banking Authority to study this issue. (It should be noted that both the Mokelumne Aquifer Recharge and Storage Project (MARS) and the WMP estimated future groundwater recharge needs using different methodologies. See Appendix A for a summary of the methodologies used in each report.)

Surface water supplies also present challenges for the county. In the south Delta area, water quantity and quality is often inadequate for some agricultural uses, limiting the types of crops that can be grown and reducing crop yields of those that are grown. The north Delta region faces possible changes in operation of the Delta Cross-Channel that could adversely affect water quality by requiring more frequent closure of the Cross-Channel gates, further degrading surface water supplies available in the South Delta. In the southwest area of the county, urban growth is increasing demands on a limited supply.

In addition to local threats to water supplies, the county has been adversely affected by changes in federal and state policy which erode existing supplies and have upset longstanding plans to bring new supplies to the region. Beginning in 1955, the County was directed by the SWRCB to consider the American River for meeting its supplemental water needs. Efforts to appropriate water from the American River were then subsequently denied by the State in 1958 (SWRCB Decision 893). The County was then encouraged to seek a Central Valley Project water contract from the Auburn-Folsom South Unit of the U.S. Bureau of Reclamation (Reclamation). Between 1967 and 1971, draft contracts were sent from Reclamation's Mid-Pacific Region office to Reclamation's Headquarters in Washington D.C., but were never approved. The County continued to work with Reclamation consistent with SWRCB Decision 1400 regarding the Auburn-Folsom South Unit.

In the past, the County has supported a multi-purpose Auburn Dam as a means to help develop a supply from the American River; however, Congress has not authorized such a project and the primary congressional proponent has laid aside plans to pursue this project.

Passage of the Central Valley Project Improvement Act of 1992 and subsequent operational decisions regarding New Melones Reservoir have increased demands on scarce water supplies to provide for environmental needs. Consequently, water supplies the County had been expecting through the construction of New Melones Reservoir are now dedicated to achieving water quality objectives in the Bay-Delta and lower San Joaquin River. Finally, decisions by water users upstream relative to complying with flow objectives on the San Joaquin River have shifted reservoir releases previously experienced in summer and fall months to springtime for fishery purposes, in turn lowering water quality for south Delta users in summer and fall.

1.4 Water Management Plan

Recognizing that the county has growing water resource management problems, the Flood Control and Water Conservation District commissioned development of the WMP in April of 2000 to array the county's needs, identify possible solutions and develop a consensus on actions necessary to address the identified needs. The WMP was developed with a local, state, federal and community interest stakeholder committee formally and informally represented by 40 participants throughout its 16-month development process.

The following mission statement was established: Develop a comprehensive plan to provide reliable water supplies for sustaining the county's current and future economic, social and environmental viability. Three major goals were established in pursuit of this mission:

- Minimize social impacts
- Protect and enhance economic viability
- Protect and enhance environmental resources

A further set of detailed water management planning goals was established as criteria to develop options for addressing management problems. These goals were:

- Be equitable
- Use affordable approaches
- Maintain existing supply and develop new supply for the southwestern area of the county
- Minimize biological resource impacts
- Minimize community impacts
- Minimize land use impacts
- Minimize cultural resource impacts
- Protect and preserve water rights and area of origin rights
- Protect water quality
- Provide reliable supplies
- Restore and maintain eastern county groundwater resources
- Support beneficial water conservation programs

Current and projected water demands were quantified and a need for development of 200,000 acre-feet of new supply was identified, primarily recognizing the current groundwater overdraft (CDM 2001). The WMP ultimately identified numerous management options (referred to herein as, "alternatives") (e.g., in-lieu recharge, water transfer reoperation, existing facilities and capturing unappropriated flows) that collectively address the planning goals while performing acceptably under a set of common screening criteria. The WMP Steering Committee ultimately determined that it was necessary to screen all of the potentially feasible alternatives for prioritization. The alternatives were screened using the following criteria:

- Cost per acre-foot of new supplies
- Legal feasibility
- Political feasibility
- Financial feasibility
- Environmental feasibility
- Water quality
- Benefits achieved (i.e., potential to address identified problems)

Through this screening process, alternatives that were deemed not likely to perform acceptably according to all the criteria were eliminated from further evaluation. Remaining alternatives were prioritized into three tiers based on: Alternatives that performed well according to the WMP's objectives (Tier I Alternatives); alternatives for which some of the WMP's objectives were met, but for which implementation is of a lower priority than Tier I Alternatives (Tier II alternatives); and alternatives that meet few of the WMP's objectives and are considered low priority (Tier III Alternatives). Alternatives were not ranked within each tier.

The status of Tier I Alternatives and the respective lead agencies and partners, is presented in Table 1-1.

One of the Tier II alternatives is development of unappropriated flows on the Mokelumne River (referenced as flood flows to Middle Bar Reservoir in the WMP) and is the subject of the MORE WATER Feasibility Analysis and more specifically, this Reconnaissance Study.

Although the MORE WATER Feasibility Analysis is a Tier II Alternative, and would generally be considered a lower priority for implementation than Tier I Alternatives, it is moving forward due to its broad support among the WMP stakeholders and its potential for great flexibility in meeting a large portion of unmet water needs in the county. Further, it is important to note that the Mokelumne River option was initiated prior to the WMP development by the filing of the water right applications in 1990. The 2001 WMP simply confirmed the need for the MORE WATER Feasibility Analysis.

The 1990 filing proposed the Middle Bar Dam and Reservoir as the project to capture and store unappropriated Mokelumne River flows. However, in response to public concerns regarding the potential effects of building a dam on the Mokelumne River (e.g., flooding of riparian habitat and loss of a whitewater recreational area), the Authority determined that further examination of alternatives to the Middle Bar Dam and Reservoir were warranted. This report is a reconnaissance-level examination of potential alternatives to the Middle Bar Dam and Reservoir.

1.5 Greater Regional Benefit

While a project to capture unappropriated flows on the Mokelumne River is currently being designed to meet the needs of the County users, there are other potential regional benefits that could result including groundwater banking and enhancement of the CALFED Bay-Delta Program to provide flows in the Delta to enhance fisheries and maintain Delta water quality and flow standards for agricultural use. As East Bay Municipal Utilities District (EBMUD) currently operates Pardee and Camanche Reservoirs, additional on-stream or off-stream storage could be operated to enhance supply yield or to provide water for fishery obligations. As opportunities for partnering are identified, they will be evaluated and proposed as appropriate.

Table 1-1. Status of San Joaquin County Water Management Plan Tier I Options/Alternatives[a]

Tier I Options/Alternatives	Water Source	Status					
		Lead Agency	**Partners**	**NEPA/CEQA**	**Status of Implementation**	**Completion Target**	**Average Supply Yield (taf)**
Exercise Full New Melones Rights	Stanislaus River	SEWD and CSJWCD	SEWD, CSJWCD and San Joaquin County	Pre-NEPA/CEQA	Seeking legal resolution	Unknown	18
WID Transfer to SEWD	Mokelumne River	WID and City of Lodi	WID and City of Lodi	Pre-CEQA	Contract executed	2004	6
Farmington Groundwater Recharge and Wetlands	Littlejohn's Creek	SEWD and Corps	SEWD, Corps, DWR, NSJWCD, CSJWCD, San Joaquin County	Negative Declaration for Peters Pipeline	Pilot project operating	2010 Pending funding of full scale project	9.8 initially, 35 ultimately
SSJID/OID Transfers to SEWD	Stanislaus River	City of Stockton, SEWD, San Joaquin County, SSJID, OID	Lead and CSJWCD	EIR; in challenge	Construction pending CEQA litigation	Pending litigation (±2006)	23
South County Water Supply Project	Stanislaus River	SSJID	Cities of Escalon, Manteca, Lathrop, Tracy	EIR complete	Final Design	2005 operation	44
City of Stockton Delta Diversion Modification	San Joaquin River	City of Stockton	None	EIR in progress through 2005	Feasibility Study complete	2009	30 taf from 2009-2015. Increasing to 126 taf over 50 years
Urban Water Conservation	Conservation	County Urban Purveyors	Purveyors and DWR	N/A	Implementation	Ongoing	20 (demand reduction)
New Hogan Reoperation	Calaveras River	SEWD, Corps	SEWD, Corps, and Calaveras County	Pre-CEQA	Reconnaissance	Unknown	23
NSJWCD Groundwater Recharge Project	Mokelumne River	NSJWCD	CALFED	Pre-CEQA	Planning; pending funding election Prop 218	±2007	11
Agricultural Water Conservation	Conservation	Agricultural Parties	DWR	Most exempt	Various by project	Various by project	20-40
EBMUD Freeport Regional Water Project	Sacramento/ American Rivers	EBMUD, Sacramento County Water Agency, City of Sacramento, Reclamation	Leads and possibly San Joaquin County for interconnection	In progress	Planning	2010	28-40
Urban Wastewater Recycling	Water Reclamation	Cities of, Stockton, Lodi, Manteca, Lathrop, Tracy	Lead and CSJWCD	Pre-CEQA	Reconnaissance; conflicts with Stockton Delta Diversion	N/A	N/A

a Includes projects which have physical components only
taf = thousand-acre-feet

2. STATEMENT OF PURPOSE AND NEED

2.1 Background

During the initial stages of this Reconnaissance Study, a range of alternatives were considered which could potentially meet the overall water resource needs of the county. As more information was obtained about the water right applications the Authority has on file with the SWRCB, and as input was received from agencies, it was determined that the MORE WATER Feasibility Analysis should focus on alternatives that would benefit from the opportunities available through the water right applications specifically. As a result, the purpose and need for a project resulting from the MORE WATER Feasibility Analysis has been more specifically defined than the purpose and need initially developed and informally discussed with agencies (see Chapter 4). The purpose and need presented below was developed in accordance with the water right applications that the Authority holds and is specific to capturing unappropriated flows on the Mokelumne River. As a result of this revision to the purpose and need, several alternatives that were considered in the initial stages of this Reconnaissance Study are no longer being considered, but are addressed as part of the WMP (See Chapter 5 for a more complete discussion).

2.2 Purpose and Need

The purpose of a project resulting from the MORE WATER Feasibility Analysis is to capture unappropriated flows on the Mokelumne River for storage and beneficial use within San Joaquin County. The need for the project is as an element in fulfilling the mission of the County's WMP, that is, as an element in providing reliable water supplies for sustaining the county's current and future economic, social and environmental viability.

2.3 Modification of Purpose and Need

While a project resulting from the MORE WATER Feasibility Analysis is anticipated to meet the needs of the county, there are other potential project beneficiaries of greater regional nature, which may be invited to participate as a project develops in the future. Therefore, possible expansion of the purpose and need may be further evaluated in subsequent phases of the Feasibility Analysis.

3. ENVIRONMENTAL REGULATORY STRATEGY

3.1 Rationale for Environmental Regulatory Strategy

Originally, the scope of work for the MORE WATER Feasibility Analysis was to be divided into four phases including: Phase I - a Reconnaissance Study; Phase II - an Engineering Feasibility Study; Phase III - Corps Section 404(b)(1) Analysis; and Phase IV - a Project Specific NEPA/CEQA analysis for the preferred project alternative. This approach was initially recommended because the Mokelumne River project was initiated prior to the development of the WMP. However, this approach raised concerns because the WMP identified a wide-ranging suite of water supply actions necessary to correct the groundwater overdraft condition in San Joaquin County. Further, the County did not prepare a programmatic CEQA document, or any other CEQA document, to support the approval of the WMP. The lack of CEQA documentation could provide an opportunity for project opponents to assert that the purpose and need of a project resulting from the MORE WATER Feasibility Analysis could be served by other less damaging actions presented in the WMP or even by other actions not currently contemplated. It is possible that a carefully worded purpose and need statement could survive such a challenge. However, based on preliminary discussions with affected water agencies, a challenge can be expected. In addition, the Corps and the USEPA will likely carefully scrutinize the purpose and need to ensure it is written to allow for a full range of alternatives to be considered.

The proposed regulatory strategy, described in detail in this chapter, presents a more conservative approach to satisfying the environmental and regulatory requirements necessary for project approval. This approach includes three phases:

- Phase 1 - Reconnaissance Study
- Phase 2 - East Basin Groundwater Management Plan/Programmatic CEQA Compliance and MORE WATER Engineering Feasibility Study.
- Phase 3 - Project-Specific CEQA/NEPA and Permitting Compliance.

The primary difference between the present approach herein and the initial approach is the East Basin Groundwater Management Plan/Programmatic CEQA Compliance component and the inclusion of an East Basin Groundwater Management Plan as a technical appendix to the programmatic document. The technical appendix is needed to refine water supply and groundwater management actions. This work will draw heavily from the San Joaquin County Water Management Plan, but will go further in refining conservation and wastewater reuse, and will identify alternative strategies to be compared in the PEIR. The results will be included in the PEIR.. The WMP would be refined to integrate three elements, the first of which is the grouping of water management options into approximately three alternatives. These alternatives could be based on different themes, for example, one alternative could be developed around the MORE WATER Project and another alternative may be developed around maximum use of existing facilities. Each alternative would provide a regional approach to meeting the County's water needs. Secondly, preparation of the East Basin Groundwater Management Plan would allow further development of the following common elements under each alternative: water conservation (i.e., demand management) programs and water recycling projects. Finally, the East Basin Groundwater Management Plan would integrate a general implementation schedule for the programs tied to the forecasted needs of the County.

Following preparation of the East Basin Groundwater Management Plan, a Program Environmental Impact Report (EIR) would be prepared and the document including the technical appendix would serve as the roadmap for implementing the projects needed to provide the County with a reliable water supply.

A Program Environmental Impact Statement (EIS) could be prepared jointly with a Program EIR if a federal agency participates in funding the effort.

3.2 Regulatory Strategy

The proposed regulatory strategy provides a phased approach to comply with the CEQA, NEPA, and other state and federal regulatory requirements in implementing a East Basin Groundwater Management Plan. Three phases in the regulatory process have been identified as appropriate for the County/Authority to proceed with identifying alternatives to addressing water resource concerns. Each phase includes recommendations which are intended to help keep the project on schedule and help to develop legally defensible environmental documents. These phases are:

- Phase 1: Reconnaissance Study (*Completed 03/04*).
- Phase 2: East Basin Groundwater Management Plan/Programmatic CEQA Compliance and MORE WATER Engineering Feasibility Study.
- Phase 3: Project-Specific CEQA/NEPA and Permitting Compliance.

Each of these phases are described in more detail below.

3.3 Phase 1: Reconnaissance Study

As stated in Chapter 1, the goals of this Reconnaissance Study are:

- Establish the purpose and need for the project.
- Determine the lead and cooperating agencies.
- Establish an environmental process with potential lead agencies.
- Identify agency and key stakeholder issues.
- Identify an adequate and appropriate range of project alternatives meeting the purpose and need for the project.
- Refine the list of alternatives to carry into subsequent phases.
- Refine and revise the scope for subsequent phases based on information learned during the Reconnaissance Study.

This report summarizes the efforts of the project team in conducting the Reconnaissance Study and makes recommendations for future regulatory steps toward creation of a project and alternatives to develop unappropriated flows on the Mokelumne River and an associated storage facility for beneficial use.

3.4 Phase 2: East Basin Groundwater Management Plan/Programmatic CEQA Compliance and MORE WATER Engineering Feasibility Study

The second Phase of the regulatory strategy includes the preparation of a East Basin Groundwater Management Plan and a Program EIR to support the approval and implementation of the East Basin Groundwater Management Plan. The CEQA program approach (i.e., a Program EIR) would support the implementation of future site-specific projects by:

- Allowing proper consideration of the broader scale impacts, alternatives and mitigation criteria of the East Basin Groundwater Management Plan than would be possible in an individual site-specific Project EIR.
- Focusing on the cumulative and growth-inducing impacts of implementation of the East Basin Groundwater Management Plan.
- Addressing policy, design and management issues at the program level rather than repeated consideration at the project level.
- Considering broad policy alternatives and programmatic mitigation measures at an early stage in the development of the East

Basin Groundwater Management Plan when policy flexibility is greatest.

- Conserving resources by encouraging the reuse of data.

The Program EIR will also analyze the potential environmental effects of the East Basin Groundwater Management Plan objectives and assumptions, policy alternatives to achieving identified objectives, broad-scale impacts, and establish mitigation criteria for the overall plan.

For the East Basin Groundwater Management Plan, four stages of the regulatory process have been identified. These stages include:

- Draft East Basin Groundwater Management Plan
- Scoping
- Draft Program EIR
- Final East Basin Groundwater Management Plan/Program EIR

These stages are discussed in more detail below. To comply with CEQA, a Program EIR will be prepared. The regulatory strategy for the Program EIR is presented in 3.4.3 below.

While preparation of the East Basin Groundwater Management Plan is underway, an engineering feasibility study will be undertaken to more fully examine the alternatives carried forward as a result of this Reconnaissance Study. The results on the Engineering Feasibility Study will be incorporated as appropriate into the East Basin Groundwater Management Plan.

3.4.1 Draft East Basin Groundwater Management Plan

Under this phase, a technical appendix will be prepared to establish an implementation schedule and prioritization of projects to meet the overall water resources requirements of the County using a regional approach which incorporates common elements. Water management options will be grouped into alternatives of varying themes (e.g., MORE WATER Project, or water transfers) and will include common elements such as recycling and conservation. The East Basin Groundwater Management Plan, once approved by the County, will serve as the roadmap for implementing the water resource projects needed to provide reliable water supplies to the county. The East Basin Groundwater Management Plan would include:

- Introduction
- Existing System Supplies & Operations
- Projected Water Demands
- Water Supply Opportunities
- Water Resource Strategies
- Alternative Formulation
- Alternative Screening
- Implementation Plan

3.4.2 Scoping and Public Participation

The Scoping and Public Participation stage begins with the preparation of the Notice of Preparation (NOP) for circulation to responsible and trustee agencies and interested individuals for a 30-day comment period. At this stage, there should be enough information to describe the scope of the East Basin Groundwater Management Plan.

A major objective of the East Basin Groundwater Management Plan will be to maximize agency and community participation. Toward this end, this regulatory strategy recognizes that developing community consensus regarding important, yet sometimes controversial water resources issues will be essential to the success of the East Basin Groundwater Management Plan and associated future projects. Agencies and the public should be given the opportunity to provide input at each stage of the process.

It is recommended that the following principles be used to guide the public participation program:

- Involve the Authority throughout the process. The Authority shall be the primary conduit of information to the public.
- Provide the public with clearly understandable information and "hands-on" experience. State candidly the disadvantages, as well as the advantages, of proposed plans and policies.
- Provide ongoing and visible two-way communication between the public, agency staff, and consultants throughout the process.

To help minimize delays in the regulatory process, the following activities should be completed during the Scoping Phase.

- Publish NOP.
- Conduct scoping meetings with the regulatory agencies, identify their issues and concerns, determine how the agencies' specific rules will apply to the Program EIR, and discuss the overall plan schedule.
- Prepare a Scoping Report for the administrative record. Legal challenges to the environmental process based on alleged lack of public involvement can be avoided with a well-documented record of scoping activities.
- Involve regulatory agencies in public scoping meetings to the extent possible to help inform the public of the extent of coordination required for project activities. Agency involvement also helps to identify the information that should be included in the environmental document.
- Develop an agency, public, stakeholder distribution list.
- Key outreach points at scoping alternative formulation, alternative screening stages, and Draft Program EIR.

3.4.3 Programmatic CEQA Compliance - Draft Program EIR

The Draft Program EIR stage begins with the Lead Agency's release of the Draft Program EIR for public and agency review (see Chapter 4 for a discussion of potential Lead Agencies). To help minimize delays in the regulatory process, the following activities should be accomplished during the Draft Program EIR stage.

- Send the Draft Program EIR to the regulatory agencies by certified mail so as to document when the agencies receive them. This provides proof for the administrative record that all potential regulatory agencies received the Draft Program EIR for review.
- Monitor whether regulatory agencies have reviewed the Draft Program EIR and document inactions as part of the administrative record. To minimize late submittals of significant comments and to avoid legal challenges that an agency was not given an opportunity to comment, contact agencies which have not provided written comments on the Draft Program EIR to determine if they are planning to do so.

By the end of the Draft Program EIR stage, the Lead Agency should have: 1) identified any potential conflicts with the programmatic schedule which could cause delays in the final approval of the document; and 2) received all of the comments on the Draft Program EIR.

3.4.4 Final Refined Water Management Plan/Program EIR

The Final Refined Water Management Plan/Program EIR stage begins immediately following the end of the agency and public review of the Draft Program EIR. During this stage of the regulatory process, agency and public comments on the Draft Program EIR will be responded to in writing. Next, the Final Program EIR, including responses to comments, will be prepared and sent to each agency which commented on the Draft Program EIR. In addition, the Draft East Basin Groundwater Management Plan would be finalized based on comments received during the review process. Finally, draft environmental notices [(i.e., the Notice of Determination (NOD) and Record of Decision (ROD)] will be prepared.

To minimize delays in the Final Program EIR process,

- The Final Program EIR should be sent to the regulatory agencies which commented on the Draft Program EIR by certified mail to establish when the agencies received them. This provides proof for the administrative record that all the commenting regulatory agencies received the Final Program EIR.

By the end of this phase, the Lead Agency should have: 1) a Certified/Adopted Final Program EIR; and 2) filed an NOD and a ROD.

3.5 Phase 3: Project-Specific CEQA/NEPA Compliance

3.5.1 Overview

It is assumed that a Federal nexus (funding or permitting) will necessitate a joint CEQA/NEPA document at the project level.

Ideally, permit compliance is accomplished concurrently with CEQA/NEPA timelines and review periods. Future CEQA/NEPA documents (e.g., EIR/EIS, Negative Declarations/Findings of No Significant Impact (FONSIs), and Exemptions/Exclusions) will be directed by the State and Federal Lead Agencies, with input from the public and permitting agencies. The Authority and the Federal Lead Agencies should approach this process as a whole, and prepare for CEQA/NEPA review by determining and integrating necessary permit requirements into the process early.

3.5.2 Permit Process

In California, the permit process for development projects is coordinated with the environmental review processes required under CEQA and NEPA. Development projects not exempt from CEQA/NEPA must be analyzed by the Lead Agencies to determine the potential environmental effects of the project.

Once the Lead Agencies is/are identified, all other involved agencies with resource management or permitting responsibilities, whether federal, state, or local, become responsible (i.e., CEQA Guidelines Section 15381), cooperating (i.e., Council of Environmental Quality's NEPA Regulations Section 1508.5), or trustee (i.e., CEQA Guidelines Section 15386) agencies. Responsible, cooperating, and trustee agencies must consider the environmental document prepared by the Lead Agencies in their review of the permit/approval application, but do not, except in rare instances, prepare their own environmental documents. The procedure for issuing each required permit is governed by the particular law which establishes the permit authority and by the Permit Streamlining Act of California. Appendix B summarizes the Federal and State permits that may be required for a project designed to capture unappropriated flows on the Mokelumne River.

3.5.3 Regulatory Approach

Five primary stages in the regulatory process have been identified for Project-Specific CEQA/NEPA Compliance for a Mokelumne River Project. Each stage includes recommendations which are intended to help keep the project on schedule and help to develop a legally defensible final environmental document. The five stages are:

- Pre-CEQA/NEPA
- Scoping
- Draft EIR/EIS
- Final EIR/EIS
- Permit Completion

Pre-CEQA/NEPA Stage

The first stage in the Project-Specific CEQA/NEPA Compliance process involves the structuring of the regulatory review process and preparation of notices to initiate the CEQA/NEPA process. To effectively reduce the time required for the CEQA/NEPA review process, the following activities and products need to be drafted before the process is formally initiated with public notices:

- Prepare project description/purpose and need statement;
- Identify project and non-project alternatives;
- Identify stakeholders
- Begin developing mailing list;
- Conduct preliminary consultations with key land management, regulatory, and resources agencies (e.g., U.S. Army Corps of Engineers (Corps), U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA) Fisheries (formerly National Marine Fisheries Service), California Department of Fish and Game (CDFG).
- Prepare a critical path schedule for the proposed project;
- Develop Memorandum of Understanding (MOU) with state and federal lead agencies on joint CEQA/NEPA process. The MOU should identify the roles and responsibilities of each agency, expected schedule, other expectations regarding the preparation of the environmental document (including assumptions regarding impact analysis), and dispute resolution procedures; and
- Prepare a NOP and a Notice of Intent (NOI) to initiate the environmental process and announce scoping meetings.

Scoping

The Scoping stage begins when the Lead Agencies publicly notice the start of the CEQA/NEPA process through the publication of an NOI in the *Federal Register* and the circulating of a NOP to affected agencies. At this point, there should be enough information to describe the scope of the project.

During this stage, the Draft EIR/EIS will be prepared concurrently with initial permitting activities. The primary objectives of this stage are to collect as much background information as possible, identify permitting agencies, enter into MOUs with selected permitting agencies, complete the permit/approval applications, and prepare the Draft EIR/EIS.

To help minimize delays in the regulatory process, the following activities should be completed during the Scoping stage.

- Conduct scoping meetings with the regulatory agencies, discuss how the agencies' specific rules will apply to the project, and determine timelines for submitting, processing, and issuing of permits. Scoping meetings provide a forum for introducing the project to the regulatory agencies and for identifying specific permit/approval processing requirements.
- Prepare a Scoping Report for the administrative record. Legal challenges to the environmental process based on alleged lack of public involvement can be avoided with a well-documented record of scoping activities.
- Identify the types of information and the criteria that the permitting agencies will use in evaluating permit applications. With this information, it will be possible to determine which permits/approvals can be filed in the Draft EIR/EIS Stage, and which permits/approvals must be filed in the Final EIR/EIS Stage when more site specific information is necessary.
- Involve regulatory agencies in public scoping meetings to the extent possible to help inform the public of the extent of coordination required for project activities. Agency involvement also helps to identify the information that should be contained in the regulatory documents.

Once the Scoping stage has been completed, the Lead Agencies should have: 1) a good understanding of the detailed project information required by the permitting agencies; 2) a probable list of regulatory agencies and their authority; 3) an indication of the level of environmental analysis which will be performed; and 4) entered into MOUs with selected permitting agencies. This information will lead to a more defined CEQA/NEPA process and reduce the potential for unanticipated requirements that might cause delays late in the CEQA/NEPA and permitting processes.

Draft EIR/EIS Stage

The Draft EIR/EIS Stage begins with the Lead Agencies' release of the Draft EIR/EIS for public and agency review and the filing of the permit/approval applications with the regulatory agencies identified in the Scoping stage. Each of these agencies would review the permit/approval application to determine if it is complete concurrent to their review of the environmental document. If the application is determined to be incomplete, the regulatory agency must identify the deficiencies and ways to correct them.

To help minimize delays in the regulatory process, the following activities should be accomplished during the Draft EIR/EIS stage.

- Encourage regulatory agencies to process the permit/approval applications concurrently with their review of the environmental document. By keeping in contact with the appropriate staff at the regulatory agencies, delays in the processing of permit/approval applications can be minimized. Also, deficiencies in a permit application could be identified and resolved early.
- Send the Draft EIR/EIS and permit/approval applications to the regulatory agencies by certified mail so as to document when the agencies receive them. This provides proof for the project administrative record that all potential regulatory agencies received the Draft EIR/EIS for review and therefore establishes the beginning of the statutory limit time for review of the permit/approval applications.
- Prompt the regulatory agencies to act (approve or deny) on the permit/approval application within statutory time limits. For example, most state and local agencies in California must approve or deny the permit/approval application within 30 days of receipt, or it is deemed complete. In reality, however, complex projects take longer to review, so it is important to facilitate responsiveness where possible.
- Monitor whether regulatory agencies have reviewed the Draft EIR/EIS and document inactions as part of the administrative record. To minimize late submittals of significant comments and to avoid legal challenges that an agency was not given an opportunity to comment, contact agencies which have not provided written comments on the Draft EIR/EIS to determine if they are planning to do so.

By the end of the Draft EIR/EIS stage, the Lead Agencies should have: 1) a timetable identifying when permitting agencies would review and act upon the permit applications; 2) identified any potential conflicts with the project schedule which could cause delays in the project's final approval; and 3) received all of the comments on the Draft EIR/EIS.

Final EIR/EIS Stage

The Final EIR/EIS stage begins immediately following the end of the agency and public review of the Draft EIR/EIS. By the beginning of this stage, most of the permit/approval applications should have been accepted, and the review of these applications started. During this stage of the regulatory process, agency and public comments on the Draft EIR/EIS will be responded to in writing. Next, the Final EIR/EIS, including responses to comments, will be prepared and sent to each agency which commented on the Draft EIR/EIS. Finally, draft environmental notices (i.e., the NOD and ROD) will be prepared.

To minimize delays in the Final EIR/EIS process:

- Send the Final EIR/EIS to the regulatory agencies which commented on the Draft EIR/EIS by certified mail to establish when the agencies received them. This provides proof for the administrative record that all the commenting regulatory agencies received the Final EIR/EIS.
- Monitor permitting agencies' processing of the permit/approval applications. By keeping in contact with the appropriate staff at the regulatory agencies, delays in the processing of permit/approval applications can be minimized.

By the end of the application phase, the Lead Agencies should have: 1) a Certified/Adopted Final EIR/EIS; 2) filed an NOD and a ROD; and 3) a refined permit completion schedule.

Permit Completion Stage

The Permit Completion stage begins immediately after the CEQA NOD and the NEPA ROD are filed. During this stage, regulatory agencies complete their review of the permit/approval applications, which leads to public hearings, followed by a written decision by the agency or its designated officer. Typically, a project is approved, denied, or approved subject to specified conditions.

To minimize delays in permit completion, the following activities should be performed:

- Ensure that each regulatory agency acts (approves or denies) on their respective permit/approval within statutory time limits. For example, most state and local agencies in California must approve or deny permit/approval within 180 days of the final project approval (NOD/ROD), or it may be deemed complete.
- Consult with regulatory agencies to identify feasible mitigation measures. By working with the regulatory agency staff, infeasible or impracticable mitigation measures can be addressed before the final permit/approval is issued.

4. AGENCY AND KEY STAKEHOLDER ISSUES AND CONSIDERATIONS

4.1 Introduction

Early identification of agency and stakeholder issues and concerns is critical to the development and successful implementation of water resource projects. As part of this reconnaissance study, an effort was made by the MORE WATER project team to gather information from agencies and interested stakeholders through preliminary meetings and presentations concerning the MORE WATER Feasibility Analysis. The purpose of this approach was to identify key agency and stakeholder concerns early in the process so that, where possible, a collaborative effort could be used to address concerns or adjust processes where necessary. This chapter provides a summary of those concerns identified by agencies and interested stakeholders.

4.2 Agency Issues and Considerations

Agency issues were identified during the July 10, 2003, regulatory partnering meeting. The venue for the meeting was the Corps Regulatory Division monthly pre-application meeting. The pre-application meeting is typically reserved for project proponents actively pursuing a Clean Water Act Section 404 permit and Section 404(b)(1) determination. Corps staff felt the complexity of the MORE WATER Feasibility Analysis warranted early coordination and therefore included it on the July 10, 2003 agenda.

Agencies invited to the July 10 meeting included:

- Corps-Regulatory Branch
- USFWS
- CDFG – Environmental Services
- RWQCB – Region 5 (Central Valley)
- Reclamation
- U.S. Environmental Protection Agency (USEPA)– Region 9 Wetlands Division
- NOAA Fisheries – Endangered Species Office
- State Historic Preservation Office
- California State Lands
- State Water Resources Control Board

During the meeting, regulatory agencies were provided a brief presentation of the current water supply issues facing the county and background information on the MORE WATER Feasibility Analysis. Numerous concerns and issues were raised by regulatory agency representatives, specifically with regard to the draft purpose and need statements and the project-specific approach. Following consideration of agency concerns as well as the risks and benefits associated with a project-specific NEPA/CEQA approach, the Authority determined that a programmatic approach (as described in Chapter 3) would be most appropriate. A programmatic approach that is refining the WMP and conducting CEQA compliance through a Program EIR (or a Joint Program EIR/EIS if there is federal participation), will address or eliminate many of the issues presented by the regulatory agency representatives at the July 10, 2003 meeting. For background and documentation purposes, following is a summary of the topics discussed with the agencies. Appendix C, Table C-1 lists the names and representative agencies of meeting attendees.

4.2.1 Identification of Federal Lead Agency

The Federal agency with the primary responsibility for complying with NEPA is designated the Federal “Lead Agency”. For a project resulting from the MORE WATER Feasibility Analysis, there are three agencies with the highest probability of being designated as the “Lead Agency”. These potential lead agencies include, in order of preference:

1. Reclamation
2. Corps
3. FERC

A brief explanation of each agency's jurisdiction and potential role is described below. However, it should be noted that there are other Federal agencies that could be designated as the "Lead Agency", these agencies include the USFWS, NOAA Fisheries, and USEPA. These agencies would have a very low probability of being designated as a Lead Agency.

U.S. Bureau of Reclamation (Reclamation)

Reclamation could have jurisdiction because there is a potential for Federal authorization of funds for the project via its budget, its mission statement (which includes water supply/storage projects in the Central Valley), and because of its expertise with water storage projects in the Central Valley. By virtue of Reclamation's ownership and operation of the State's largest water project, the Central Valley Project, Reclamation's Mid-Pacific Region is a key to ensuring regional water reliability and quality within the Central Valley. Because the MORE WATER Feasibility Analysis considers new water supply, Reclamation is a potential Lead Agency for a resulting project. Also, Reclamation was directed in the 2003 Omnibus Bill (House Joint Resolution 2) to participate in "an investigation of resource problems and needs in the Mokelumne River watershed." Congress directed $300,000 be expended for the effort. However, budget shortfalls and funding uncertainties create some uncertainty as to the long-term feasibility of Reclamation's involvement, as this effort has not been funded to date.

Reclamation is also initiating an Integrated Resource Plan (IRP) for the Stockton East Water District and CEntral San Joaquin Water Conservation District, covering a significant portion of the east San Joaquin County groundwater basin. Congress appropriated $800,000 for this effort in 2003.. These IRP's will evaluate water resources/supply needs on the eastern drainages. The IRP will likely include efforts that relate directly to a project resulting from the MORE WATER Feasibility Analysis. The two efforts could be coordinated allowing Reclamation to provide technical support and funding.

Assuming Reclamation is provided funds to proceed with the subsequent studies and design, the Regional Director would determine the area of program responsibility. In this case, that would likely be the Central California Area Office (area office). The area office is given first right of refusal as the project lead. If the area office does not take the lead, the next likely program responsibility area would be within the Planning Division at Mid-Pacific Region.

It is anticipated that Reclamation's Mid-Pacific Region Planning Division would engage in a project resulting from the MORE WATER Feasibility Analysis, although full engagement would not occur until Reclamation released funds. If ultimately Reclamation does not obtain funding to participate, the Corps would be the Lead Agency for those portions of the project affected by Section 404 and/or Section 10. The following section discusses the Corps' potential role.

If a project goes forward and Reclamation does not take a Lead Agency position, it would be considered a cooperating agency because of its mission and area of expertise for NEPA purposes. As a result, the Federal and local lead agencies would have to ensure that Reclamation is engaged on a regular basis.

U.S. Army Corps of Engineers – Sacramento District (Corps)

The Corps will likely have jurisdiction for a project resulting from the MORE WATER Feasibility Analysis under Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act of 1899, and as a part of preparing the USEPA's 404(b)(1) analysis. Because the Corps is responsible for regulating the discharge of dredge or fill materials into waters of the United States (Section 404) and ensuring no obstruction to navigable waterways, it would likely have significant permitting purview over a project designed to capture unappropriated flows on the Mokelumne River.

If the Corps is the Federal Lead Agency it would act as the primary decision-maker during NEPA environmental study and documentation. NEPA documentation may be completed by a third party contractor at the cost of the applicant, (i.e., the Authority) under direction of the Corps. With input from the local Lead Agency, the Corps would recommend a contractor to complete the environmental documentation. The applicant is required to contract with the Corps' selected firm while engaging the Corps in the process.

Federal Energy Regulatory Commission (FERC)

Generally, the principal trigger for FERC involvement is when a change in a license is required to accommodate operational changes to a FERC licensed facility (such as Camanche or Pardee Reservoirs), or when there is a hydropower component to a project and a new application for power development is necessary.

FERC has the legal and programmatic capacity and proclivity to "consult" in the development of project alternatives—providing input on potential re-licensing/license amendment issues. (However, staffing and staff resources can be a limiting factor.)

FERC would be the NEPA Lead Agency if operational changes to Camanche or Pardee Reservoirs beyond the ranges already licensed take place (i.e., potentially resulting in water management and ecological impacts), or if a new hydropower component is pursued. It is anticipated that FERC staff would coordinate/consult informally as early as practicable (when there is potential impact to the license parameters).

4.2.2 Biological Considerations

A summary of the methods used for an informal Phase I Biological Assessment of the area considered as part of the MORE WATER Feasibility Analysis was provided to the agencies. The regulatory agencies agreed that the appropriate level of effort had been completed to date. The Corps stated that project specific wetlands delineations and special-status species surveys would be needed when the alternatives are further defined. As a Mokelumne River project progresses, and as part of the permit application process, the regulatory agencies will require a detailed schedule that delineates when and how special-status species surveys will be completed.

Regulatory agency representatives noted that likely species in the area considered as part of the MORE WATER Feasibility Analysis include California tiger salamander, California red legged frog and giant garter snake. The USFWS representative also suggested that the project proponents (i.e., the Authority) consider "non-listed" species and habitat, as there may be issues with species not yet listed.

The NOAA Fisheries representative stated that no anadromous fish or essential fish habitat (EFH) existed above Camanche Reservoir. NOAA Fisheries will expect to see an analysis of both direct and indirect impacts to fisheries associated with any alternative.

Appendix D provides a summary of the potentially occurring proposed species, candidate species, species of concern and species with critical habitat proposed or designated.

Regulatory agencies stressed the importance of hydraulic modeling for alternatives carried forward. Agency representatives pointed out that FERC and EBMUD both have models for water diversion impacts on the lower Mokelumne River below Camanche Reservoir. Additionally, The Nature Conservancy has an analysis of how species have adapted to and use flood flows.

4.2.3 Key Permitting Issues

The regulatory agency representatives (Corps, USEPA, and USFWS) expressed concern regarding completion of a project-level NEPA document without first completing a programmatic document to capture cumulative impacts.

The Corps representative suggested that the project resulting from the MORE WATER Feasibility Analysis be characterized as a stand-alone project from the WMP. The fact that a Mokelumne River Project was initiated prior to the WMP is important to articulate. The WMP simply confirmed the need for the MORE WATER Feasibility Analysis.

The Corps representative noted that if the environmental document culminated with project-specific alternatives then the project would definitely require a Clean Water Act Section 404 Individual Permit. Individual permits are generally more difficult to obtain, requiring significant work efforts.

The USEPA and Corps representatives noted that the alternatives analysis for the 404(b)(1) permit process is more rigorous than the NEPA analysis. Developing 404(b)(1) alternatives solely from the NEPA document is a concern because both agencies will expect a broad range of alternatives to be considered; that is, alternatives outside of the Mokelumne watershed.

Regulatory agencies requested that the 404(b)(1) analysis be initiated during the project-level environmental documentation phase. Essentially, the agencies cannot participate in any analysis until after public scoping has been completed and a Section 404 permit application filed. The project proponent (i.e., the Authority) must have a proposed alternative prior to application filing.

Permitting coordination required to comply with Federal and State regulatory agencies is outlined in Appendix B.

As stated above, preparation of a Program EIR (or a joint Program EIR/EIS if there is federal participation) would address many of the agency's concerns.

4.2.4 Purpose and Need Statement

The USEPA representative stressed that the purpose and need statement of a project resulting from the MORE WATER Feasibility Analysis will be highly scrutinized. The USEPA will object to looking solely at Mokelumne River alternatives to solve the "water quantity" problems of San Joaquin County. Corps representatives noted that the purpose and need statement may be different for the 404(b)(1) permit process and the NEPA document, although the NEPA process often includes the 404(b)(1) permit application as an appendix. Agency representatives agreed that the Authority should further develop the purpose and need statement once a Federal Lead Agency is determined.

The agencies agreed that the purpose and need statement should include the WMP process and findings. The agencies emphasized that a description of the WMP process was important to "tell the story" of the collaborative public outreach that has already taken place. The regulatory agencies cautioned that past WMP collaboration efforts would not likely meet the procedural public participation requirements of NEPA. As a result, the MORE WATER Feasibility Analysis alternatives could not "tier" from the WMP process.

The Corps representative reiterated that although the WMP could be incorporated into the project description, preparing "tiered" documents based upon the WMP would be difficult because no formal EIS/EIR documents were associated with it.

4.3 Key Stakeholder Issues and Concerns

This section summarizes comments and suggestions the MORE project team received in meetings with interested project stakeholders including the Mokelumne River Association (Association), Contra Costa Water District (CCWD), EBMUD, The State Water Contractors (SWC) and CALFED Integrated Storage Investigations staff (i.e., DWR and Reclamation). Appendix C, Table C-2 provides the names and affiliations of those who participated in stakeholder outreach meetings held during July 2003.

4.3.1 Mokelumne River Association (Association)

Association members were concerned about the amount of flood flow diversion proposed and questioned its availability, especially since Mokelumne River water has been fully allocated for some time. MORE Team Members reemphasized that the diversion was for unappropriated flows only, that is, water typically lost during flood events, and that no water would be diverted until all senior allocation commitments were met.

Additional Association Member concerns included the modeling accuracy for estimating potential downstream-reduced flow impacts and cumulative impacts of other proposed projects on the Mokelumne River. Another comment was whether the resulting Mokelumne River project would be in full compliance with AB 3030 and AB 1938. MORE Team Members explained that the purpose of the presentation purpose was to initiate the ongoing outreach necessary to gather such information. During the meeting with the Association, an inquiry was made, and EBMUD representatives responded, as to why their agency had not proposed a Mokelumne River project. They stated that EBMUD's preference was for the Freeport Project instead.

4.3.2 Contra Costa Water District (CCWD)

CCWD indicated that water quality and water supply impacts to water diverted to its Los Vaqueros Reservoir, both in the current configuration and in the potential expanded version under study within CALFED, were primary concerns. CCWD diverts both Central Valley Project contract water and surplus flows under its own rights at two diversion points in the western Delta. Modeling approaches were discussed and CCWD indicated that they preferred use of the Fischer Delta model, a proprietary model, to any publicly available model. However, CCWD representatives indicated that, given the nature of the MORE WATER Feasibility Analysis (i.e., capturing of unappropriated flows), diversion periods could first be compared with operation studies being conducted for CALFED to see if diversions conflicted. When and if the conflict occurred, the level of surplus conditions could be compared to overall diversions to see if a shortage of available water resulted. It was felt that it is likely that the diversions would only coincide when the Delta was in gross surplus and no conflicts would arise. To the extent that conflicts are found to exist, CCWD will not want to have its water rights affected. An issue then for the MORE WATER Feasibility Analysis will be the Authority's ability to claim superior rights to surplus Mokelumne River water before it reaches the Delta and whether CCWD can claim a portion of this flow as being appropriated through a Delta surplus. Absent demonstration of a superior claim by the Authority by virtue of diverting water before it is in the Delta, CCWD will have a superior claim simply based on filing dates.

CCWD staff also noted that care should be taken in any EIR/EIS to utilize or compare cumulative impact analyses with regard to flow and water quality. It was noted that there are many projects (i.e., Sites Reservoir, expanded Los Vaqueros, San Joaquin etc.) that are targeting surplus flows and that their cumulative effects should be addressed. This comment extended as well to other projects discussed in the WMP as well.

4.3.3 East Bay Municipal Utility District

A key point made by EBMUD staff was the need to verify the level of overdraft, from the 150,000-200,000 acre-feet as stated in the WMP, to something less, perhaps as low as 70,000 acre-feet as presented in the MARS report (EBMUD interpretation).

The difficulty of underpinning a purpose and need for a project resulting from the MORE WATER Feasibility Analysis in the absence of rigorous conservation and recycling efforts was noted, in particular the lack of meters in Lodi. While it was noted that the Authority lacks the ability to implement such water management measures directly, through the County, with its police powers, waste can be addressed as well as pursuing direct actions. It was suggested that the project may need to include definitive conservation and recycling elements to meet a Clean Water Act 404 (b) (1) test. At a minimum, a redefined baseline (i.e., 150,000-200,000 acre-feet overdraft, less additional conservation and recycling) would be prudent. In other words, increase the reliance on conservation and recycling to meet the overdraft gap as was discussed in the WMP.

Additional discussion surrounded the relationship of the MORE WATER Feasibility Analysis to the Freeport Project. It was noted that by upsizing the Freeport diversion and storing water in the county, EBMUD could solve many of the concerns by stakeholders opposing Freeport. EBMUD suggested that the County could comment on the EIR suggesting the wet year diversion/storage option as an alternative (since the meeting with EBMUD, it has been learned that opponents to the EBMUD Freeport project have reached a tentative settlement with EBMUD, lessening but not eliminating EBMUD's potential incentive to partner with the County).

4.3.4 State Water Contractors (SWC)

SWC representatives indicated that a project capturing unappropriated Mokelumne River flows would likely take some water away from the State Water Project, but that SWC policy to date did not oppose such diversions from area of origin counties, per the original understanding when the area of origin statutes were adopted at the time of the SWP authorization. The approach to modeling was briefly discussed.

Partnership possibilities were raised, especially with respect to a joint project with EBMUD. To the extent the County could offer storage services to the exporters, a three-way benefit among the Authority, EBMUD and the exporters could be conceived. The success of the Kern Water Bank in this regard as a now local project was discussed.

4.3.5 CALFED Integrated Storage Investigations

Much discussion occurred with CALFED representatives regarding the purpose and need being purely water supply and how that did not fit well with CALFED projects that were multiple objective storage projects. Additionally, it was emphasized how difficult it is to meet Clean Water Act 404 (b)(1) requirements due to the difficulty of measuring conservation and recycling in a comparable basis with a reservoir yield project. It was suggested that identifying purposes for a project resulting from the MORE WATER Feasibility Analysis beyond yield that could only be served by a storage project would enhance its viability. An example would be to seek a partner who had a surface diversion that if left undiverted and served by the project would provide environmental enhancement in a water feature of biological importance, e.g., rewatering a stream section where salmon could run.

Briefings with other stakeholders and a summary of comments of the others were discussed. CALFED staff again emphasized the need to broaden the purposes and seek partnerships to enhance the potential for project success. CALFED staff indicated they would consider opportunities for partnership or benefits the project might create such as for the Environmental Water Account.

5. RANGE OF PROJECT ALTERNATIVES

5.1 Identification of Alternatives

This section describes alternatives developed in accordance with the 1) Authority's water right applications, 2) the WMP, and 3) feedback received during the alternatives identification workshop held on June 24, 2003, with primary area stakeholders. All alternatives described are intended to capture unappropriated flows on the Mokelumne River for beneficial use in San Joaquin County.

As stated in Chapter 2, as a result of the narrowing of the purpose and need (that is, to specifically capitalize on the opportunities available through the Authority's water right permit applications), several alternatives that were considered in the initial stages of this Reconnaissance Study are no longer being considered as part of the MORE WATER Feasibility Analysis. However, these alternatives are included in the WMP and would undergo further consideration in the East Basin Groundwater Management Plan. These alternatives include:

- New Hogan Dam and Reservoir Reoperation
- Auburn Dam and Reservoir Construction
- EBMUD Freeport Regional Water Project
- San Joaquin County Freeport Interconnect
- South Fork American River Diversion to County Line Reservoir
- American River Diversion to Clay Station Reservoir
- Regulatory Fee Assessment
- Joint Use Program
- Desalination of Connate Groundwater

Twelve initial alternatives considered as part of the MORE WATER Feasibility Analysis, grouped into five categories, are described below. The five categories include 1) on-stream storage, 2) off-stream storage, 3) direct diversions, 4) additional diversions, and 5) non-structural groundwater management.

5.1.1 On-Stream Storage Alternatives

Pardee Dam and Reservoir Replacement/Enlargement

The Pardee Dam and Reservoir Replacement/Enlargement alternative would involve constructing a new concrete dam three-quarters of a mile downstream and 42 feet higher (i.e., crest elevation of 617 feet versus 575 feet) than the existing dam.

This alternative would allow capturing unappropriated Mokelumne River flows for potential use in direct diversion for beneficial use. The captured flows would be diverted from the reservoir or conveyed down the Mokelumne River to diversion points located along the lower Mokelumne River from below Camanche Reservoir to Interstate 5 where the water would be diverted for beneficial use.

Pardee Dam & Reservoir

Middle Bar Dam and Reservoir Construction

The Middle Bar Dam and Reservoir Construction alternative includes constructing a concrete arch dam (Middle Bar Dam) on the Mokelumne River upstream of the existing Pardee Reservoir. The project, as described in the Authority's water right applications involves construction of a 420-foot concrete arch dam and creation of a 434,000 acre-foot reservoir. If deemed cost effective and a FERC permit is granted, an 80-megawatt power plant could be included. Flows captured by the reservoir would be conveyed via the lower Mokelumne River to diversion points where the water would be diverted for beneficial use.

Mokelumne River Storage System Reoperation

This alternative includes reoperating Pardee Dam and Reservoir, Camanche Dam and Reservoir, and the PG&E Project 137 system to generate additional water supply. It may be possible to redefine the flood control operating guidelines to allow capture of unappropriated flows in the system. By using updated hydrology and upgraded forecasting tools, opportunities may exist to modify the rule-curves to decrease flood control reservation space in the reservoirs. Flows captured by the reservoirs would be conveyed via the lower Mokelumne River to diversion points where the water would be diverted for beneficial use.

Devil's Nose Dam and Reservoir Construction

The Devil's Nose Dam and Reservoir Construction alternative includes construction of a new dam and reservoir (i.e., Devil's Nose Dam and Reservoir) on the Mokelumne River between Salt Spring's Reservoir and the Tiger Creek powerhouse. Previous proposals at the site have included a 475-foot high earthen dam. Unappropriated flows would be captured and conveyed via the Lower Mokelumne River to diversion points where the water would be diverted for beneficial use.

5.1.2 Off-Stream Storage Alternatives

Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion

This alternative includes capturing unappropriated flows at Pardee Reservoir on the Mokelumne River and conveying up to 1,000 cfs via a gravity tunnel and pipeline to a new Duck Creek Reservoir on the Duck Creek drainage. An additional 620 cfs would be conveyed down the Mokelumne River for direct diversion for beneficial use. The water held in the Duck Creek Reservoir would be conveyed to areas of beneficial use, or released into Duck Creek, then Calaveras River or Mormon Slough, where it could be re-diverted for beneficial use. As defined in the SWRCB water right application 29835, the proposed Duck Creek facilities would have a storage volume of up to 150,000 acre-feet and a total diversion capacity at Pardee Reservoir of up to 1,620 cfs. (All references to Duck Creek Reservoir capacities and quantities were taken from San Joaquin County proposed Duck Creek Project Reconnaissance level design and cost estimate.)

Looking upstream at Duck Creek

Duck Creek Dam and Reservoir Construction - Camanche Reservoir Diversion

This alternative includes capturing unappropriated flows at Camanche Reservoir on the Mokelumne River and conveying up to 1,000 cfs via pipeline to the new Duck Creek Reservoir on the Duck Creek drainage. Because of the elevation difference between Camanche Reservoir and Duck Creek Reservoir, a pump station at Camanche Reservoir would be required to convey flow into the pipeline.

Potential Duck Creek Reservoir Area

An additional 620 cfs would be conveyed down the Mokelumne River for direct diversion for beneficial use. The water held in the Duck Creek Reservoir would be conveyed via a pipeline to areas of beneficial use similar to the Pardee Dam and Reservoir Replacement/Enlargement alternative. As defined in Dam and Reservoir Replacement/Enlargement, the SWRCB water right application 29835, the proposed Duck

Creek facilities would have a storage volume of up to 200,000 acre-feet and a total diversion capacity at Pardee Reservoir of up to 1,000 cfs.

New Hogan Reservoir Diversion with South Gulch Dam and Reservoir Construction Project

This alternative includes capturing flows from the Mokelumne River via diversion at Pardee Reservoir, conveyance to New Hogan Reservoir via tunnel, and re-diversion through a tunnel at New Hogan Reservoir to a new South Gulch Reservoir. Water would be conveyed from South Gulch Reservoir for beneficial use in the eastern groundwater basin and to Stockton East Water District (SEWD) using existing facilities (Calaveras River, Mormon Slough). Additional beneficial uses would be realized by connecting South Gulch Reservoir to the Upper Farmington Canal.

5.1.3 Direct Diversion Alternatives

Alliance Canal

The Alliance Canal (previously known as the Flat Leaky Canal) includes construction of an un-lined canal that would convey water from the Farmington Canal to Dry Creek, and vice versa, for beneficial use along its alignment. The project would include several recharge ponds along its course and convey up to 500 cfs. The project would logically be completed in three phases: 1) Farmington Canal to Calaveras River, 2) Calaveras River to Mokelumne River, and 3) Mokelumne River to Dry Creek.

The canal could potentially connect SEWD, South San Joaquin Irrigation District (SSJID), and Oakdale Irrigation District (OID) and accept direct diversions or stored water from any of the storage or additional diversion alternatives described in this chapter.

Lower Mokelumne River Diversions - Structural

This alternative, an alternative of the original SWRCB water right application, includes diverting flows using pump stations with or without modifiable dams located along the lower Mokelumne River from below Camanche Reservoir to Interstate 5. Flows would be diverted to areas of beneficial use.

Lower Mokelumne River Diversions - Non-Structural

This alternative includes diverting flows using existing structures such as EBMUD diversion at Pardee, the NSJWCD pumping facility or the Woodbridge Irrigation District (WID) facility at Lodi. Flows would be diverted for beneficial use during periods when capacity exists.

5.1.4 Additional Diversion Alternatives

City of Stockton - Delta Diversion Modification

This alternative includes providing additional funds toward modifying the City of Stockton's proposed Delta Diversion project. Additional funds would allow increased diversion capability over and above Stockton's needs. The Authority's Mokelumne River Water Right would be exercised at the location of the Delta Diversion Project. Flows generated as a result of the increased diversion capability would be conveyed via a pipeline for beneficial use along the lower Mokelumne River.

5.1.5 Non-Structural Groundwater Management

EBMUD/San Joaquin County 10-Well Program

EBMUD and the County have attempted to negotiate a groundwater banking and conjunctive-use program in the past. Preliminary screening in the EBMUD Water Supply Management Plan identified an area of the County as the best location for the program. The Mokelumne River and EBMUD's Mokelumne Aqueduct crosses the area best suited for recharge. The area is also subject to severe groundwater overdraft problems. The conjunctive use plan would allow EBMUD to recharge as much water as possible during wet years. During drought years, EBMUD would be allowed to remove up to 50 percent of the water that was recharged. However, no agreement was reached between the County and EBMUD.

A variation of the original proposed would be for the Authority to jointly operate this alternative, recharging a portion of the Mokelumne River water right in addition to EBMUD's water right

6. ALTERNATIVES SCREENING PROCESS

6.1 Introduction

This section provides a discussion of the alternatives screening process that was used to determine which of the 12 preliminary alternatives would be carried forward for further consideration.

The section presents 1) the initial screening process used to determine if the basic purpose and need was met, 2) a narrative description of the screening criteria evaluation components for the remaining alternatives, and 3) the process used to determine which of the remaining alternatives would be retained for further consideration in Phase 2.

Ultimately, five alternatives were retained for further consideration including:

- Mokelumne River Storage System Reoperation.
- Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion.
- Duck Creek Dam and Reservoir Construction - Camanche Reservoir Diversion.
- Lower Mokelumne River Diversions - Structural.
- Lower Mokelumne River Diversions - Non-Structural.

Table 6-2 depicts the general location of alternatives carried forward. (See Chapter 5 for a description of these alternatives and Appendix E for preliminary engineering layouts.)

6.2 Initial Screening Process

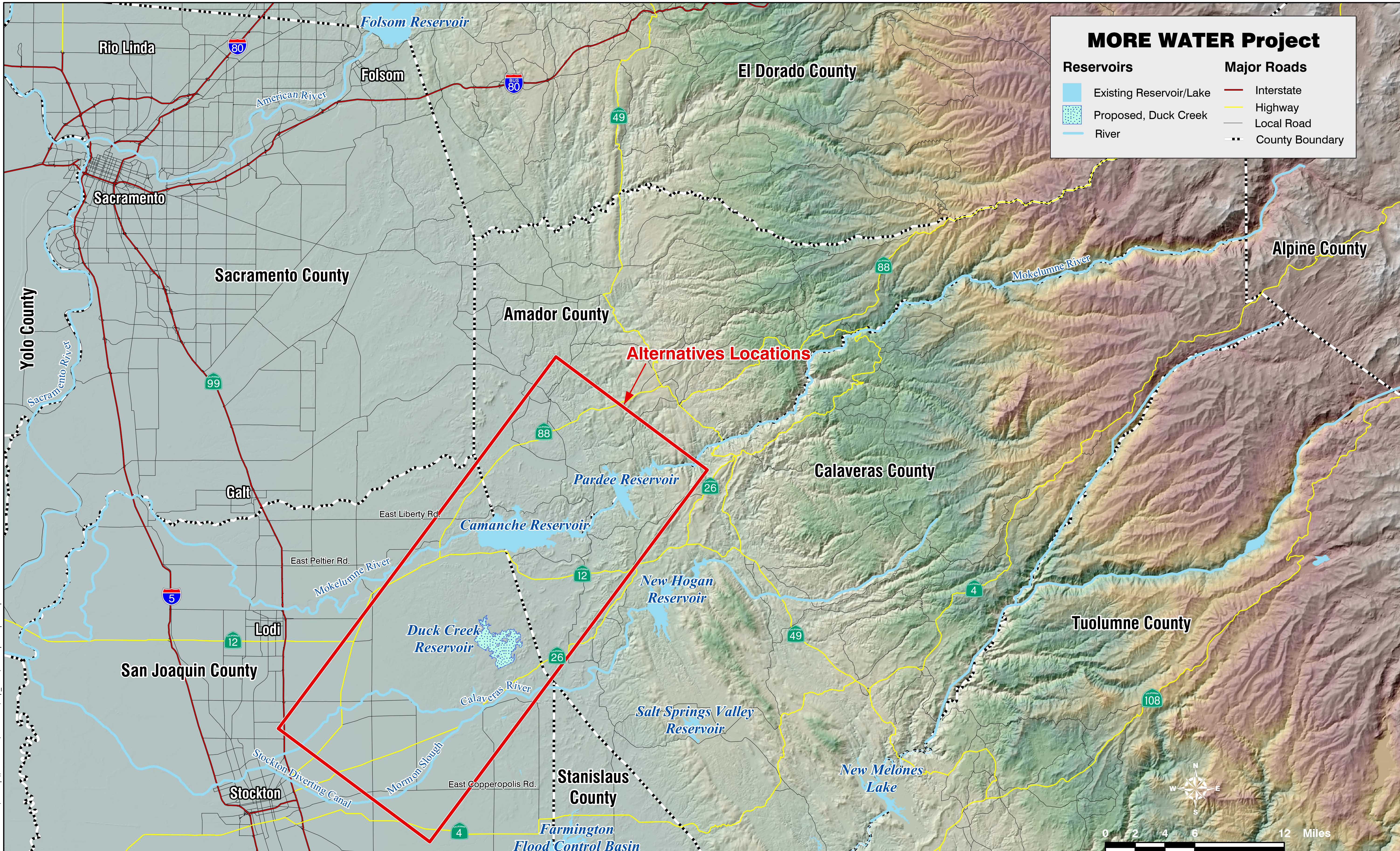
The planning and engineering team along with input from local experts developed a screening process that considered a broad range of projects that could meet the water supply and quality concerns identified in the WMP. However, as the purpose and need for the project narrowed, the screening process was necessarily revised. Therefore, the screening process described herein and depicted in Table 6-3, focuses only on projects that could capture unappropriated flows on the Mokelumne River. As shown on Table 6-3, the initial screening process eliminated any alternative that did not meet the purpose and need. Secondly, Mokelumne River alternatives being pursued by another entity, or some other effort were eliminated.

There is a potential that partnerships; for example Cities of Stockton and Lodi, SEWD, EBMUD, or another regional partner, could be created that would combine the project resulting from the MORE WATER Feasibility Analysis with alternatives being considered by other entities. As the Feasibility Analysis progresses into follow-on phases, opportunities for partnering will be evaluated and proposed as appropriate.

The rationale for eliminating alternatives during the initial screening process are shown in Table 6-1.

Table 6-1. Alternatives Eliminated During Initial Screening

Alternative	Reason for Elimination
Alliance Canal (Flat Leaky Canal)	Being pursued by the Eastern Water Alliance.
City of Stockton, Delta Diversion Modification	Being pursued by the City of Stockton.
EBMUD/San Joaquin County 10-Well Program	Being considered by EBMUD and San Joaquin County Groundwater Banking Authority.



Source: USGS NED, 1999 | \\hdr-m3647:\3322Mokel\Map_Docs\BaseMap.mxd | Last Updated : 6-1-04

Location Map for Alternatives Carried Forward

FIGURE 6-1.

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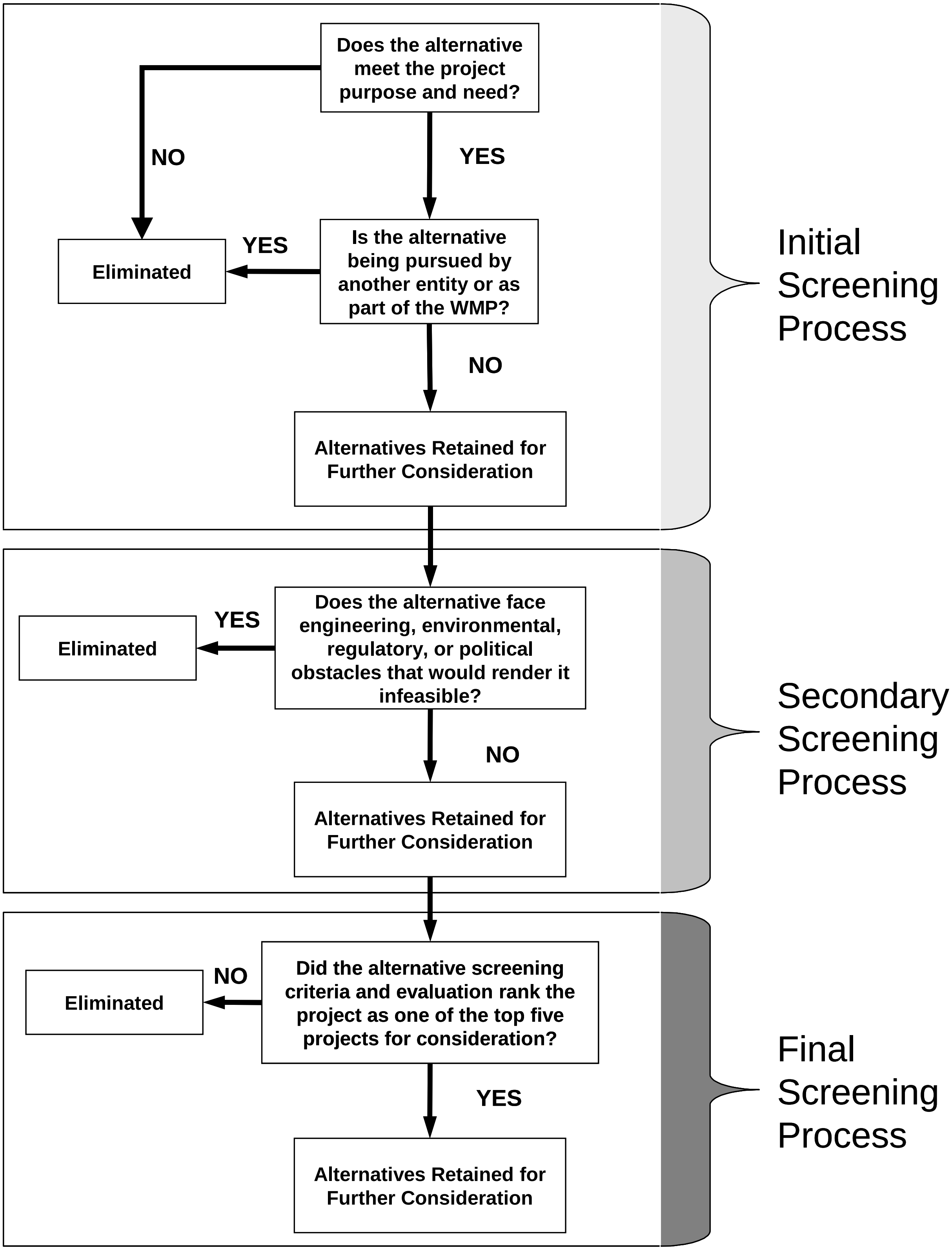

Summary of Alternatives Screening Process

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P:\07549\3322\Reports\Final\075493322.024\Figure 6-2 Decision Tree.doc

Figure 6-2.

6.3 Secondary Screening Process

The remaining alternatives were evaluated based on engineering, environmental, regulatory, and political obstacles/considerations that could result in the infeasibility of an alternative. As a result, two additional alternatives were removed from consideration. The alternatives removed were: Middle Bar Dam and Reservoir Construction, and Devil's Nose Dam and Reservoir Construction.

Middle Bar Dam, an alternative included in the Authority's water right permit application, was considered infeasible because of environmental, regulatory, and political circumstances. Specifically, the Authority recognized that adverse impacts to recreational opportunities (whitewater kayaking and rafting) at the upstream end of the existing Pardee Reservoir would be unacceptable to many interests. Additionally, environmental damage to riverine, upland, and oak savannah habitat and the associated wildlife within the inundation area of the proposed reservoir pool was considered an unacceptable result of the alternative relative to other alternatives being considered. Therefore, the Middle Bar Dam and Reservoir Construction alternative was not carried forward for further consideration.

The Devil's Nose Dam and Reservoir Construction alternative was also considered currently infeasible. Historic activities have indicated that this alternative would result in political, environmental, and regulatory circumstances unacceptable to many members of the public. Table 6-4 summarizes the rationale used to eliminate alternatives during the secondary screening process.

Table 6-4. Alternatives Eliminated During Secondary Screening

Alternative	Reason for Elimination
Middle Bar Dam & Reservoir Construction	Unacceptable recreation and environmental adverse impacts
Devil's Nose Dam & Reservoir Construction	Alternative has historically been challenged and is considered currently infeasible

6.4 Final Screening Process

The screening criteria used to evaluate water supply alternatives is generally consistent among water supply projects. The criteria used for the final screening process for this analysis incorporated these common criteria and considered the feedback from county stakeholders.

The criteria used for the final screening process follows:

- Cost ($ per acre-foot): Does not include cost of new or improved water delivery, distribution, or treatment infrastructure required for implementation.
- Regulatory feasibility: Includes the implementation potential for the Authority or other interest groups and agencies including obtaining both State and Federal regulatory permits and capability to address potential legal concerns and challenges.
- Political feasibility: Considers the political controversy and opportunities for support on a local, State, and Federal level.
- Financial feasibility: Considers the cost to Authority stakeholders and communities and the availability of regional, State, or Federal funding sources.
- Environmental feasibility: Considers potential adverse impact to environmental resources for example: fisheries, wildlife, vegetation, historic resources, water quality, and air quality.
- Benefits achieved (degree to which problems addressed): Considers the potential to improve water resource issues within the county.

Table 6-5 summarizes the evaluation of alternatives using the above criteria by providing a high, medium, or low rating for each alternative. The alternatives represent three general themes for creating supply: on-stream storage, off-stream storage, and direct diversions.

Table 6-5. Summary of Final Screening Criteria and Evaluation of Remaining Alternatives

ALTERNATIVE	Cost per acre-foot	Regulatory Feasibility	Political Feasibility	Financial Feasibility	Environmental Feasibility	Water Quality	Benefits Achieved
ON-STREAM STORAGE							
Pardee Dam and Reservoir Replacement/Enlargement	M	L	L	M	L	H	H
Mokelumne River Storage System Reoperation	H	H	M	M	H	H	L
OFF-STREAM STORAGE							
Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion	L	M	M	H	M	H	H
Duck Creek Dam and Reservoir Construction - Camanche Reservoir Diversion	L	M	M	H	M	H	H
New Hogan Reservoir Diversion with South Gulch Dam and Reservoir Construction	L	L	M	M	M	H	M
DIRECT DIVERSIONS							
Lower Mokelumne River Diversions - Structural	H	M	H	M	M	H	M
Lower Mokelumne River Diversions - Non-Structural	H	H	H	H	H	H	L

Cost: Relative rating of the cost per acre-foot for each alternative. High = $ per acre-foot. Medium = $$ per acre-foot. Low = $$$ per acre-foot

Regulatory Feasibility: High: Good chance for regulatory support (i.e., regulatory agency concurrence). Medium: Moderate chance for regulatory support. Low: Low chance for support (i.e. regulatory agencies opposed).

Political Feasbility: High: Good chance for political support (i.e., elected officials/powerful interest groups in agreement). Medium: Moderate chance for political support. Low: Low chance for support (I.e. elected officials/powerful interest groups opposed).

Financial Feasibility: High: High chance for financing partners outside of the Authority. Medium: Moderate chance for partners. Low: Low chance for partners outside of the Authority.

Environmental Feasibility: High: Limited environmental impacts that can be mitigated to level of insignificance. Medium: Adverse environmental impacts that can be mitigated. Low: Adverse environmental impacts that cannot be mitigated.

Water Quality: High: No effect to downstream or County users. Medium: Potential effect to downstream users that can be mitigated. Low: Adverse effect to downstream or County users.

Benefits Achieved: High: Contribution to solving the County's water resource issues is highly valuable. Medium: Contribution to solving the County's water resource issues is moderately valuable. Low: Contribution to solving the County's water resource issues is minimally valuable

NOTE: High = Good

To determine which alternatives had the greatest potential for implementation, weighting was assigned for each screening criteria category during a workshop with the Authority and key stakeholders. Table 6-6 provides a summary and rationale of the weighting criteria.

Table 6-7 provides the final relative ranking of alternatives based on the weighting factor and the designation of high, medium, or low for each screening criteria category. The process used to generate the relative ranking was 1) set a numerical value for the low, medium, and high ratings of 1, 2, and 3 respectively; 2) multiply that rating by the weighting factor; and calculate to determine the final score for each alternative.

It should be noted here, that cost considerations, while designated as high, medium, or low, were not assigned a weighting factor and did not contribute to the score, as cost per acre-foot is too preliminary at this stage of the evaluation.

The alternative with the highest score was rated the most highly implementable alternative and the lowest score represents the least likely implementable alternative.

The two alternatives with score less than 30 (i.e., New Hogan Reservoir Diversion with South Gulch Dam and Reservoir Construction, and Pardee Dam and Reservoir Replacement/Enlargement) were eliminated from consideration at this time as the Authority chooses to carry forward only the five highest ranked alternatives for consideration.

6.5 Alternatives Carried Forward into Phase 2

Final screening determined the following five alternatives should be carried forward for further evaluation in Phase 2 of the MORE WATER Feasibility Analysis.

- Mokelumne River Storage System Reoperation
- Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion
- Duck Creek Dam and Reservoir Construction - Camanche Reservoir Diversion
- Lower Mokelumne River Diversions - Structural
- Lower Mokelumne River Diversions - Non-Structural

Table 6-6. Screening Criteria Categories, Rationale, and Associated Weighting Factor

Screening Criteria	Weight	Rationale
Cost per acre-foot	0	Cost data is too preliminary at this stage to adequately compare alternatives. To ensure the ranking outcome is not skewed, no weight was given to this criterion.
Regulatory Feasibility	3	Ability to obtain regulatory approval is necessary for successful implementation and lack of approval would halt any project.
Political Feasibility	3	Ability to obtain political support is necessary for successful implementation. Lack of support could ultimately halt implementation of a project.
Financial Feasibility	1	Ability to secure additional partners for financing is only marginally important for successful implementation. The Authority is in a position to fund a primary portion of any project resulting from the MORE WATER Feasiblity Analysis.
Environmental Feasibility	2	Ability to mitigate environmental impacts is required for successful implementation.
Water Quality	1	Operation of alternatives to capture unappropriated flow would cause little issue for downstream users because changes would be marginal and minimum water quality objectives would be maintained.
Benefits Achieved	5	Because of the extent of the water supply challenges facing the County, the degree of potential yield (acre-feet) was considered a significant concern for successful implementation.

Table 6-7. Weighted Screening Criteria and Evaluation Results

Weight	0	3	3	1	2	1	5		
ALTERNATIVE	Cost per acre-foot	Regulatory Feasibility	Political Feasibility	Financial Feasibility	Environmental Feasibility	Water Quality	Benefits Achieved	Score	Relative Ranking
Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion	L	M	M	H	M	H	H	37	1
Duck Creek Dam and Reservoir Construction – Camanche Reservoir Diversion	L	M	M	H	M	H	H	37	2
Lower Mokelumne River Diversions-Non-Structural	H	H	H	H	H	H	L	35	3
Lower Mokelumne River Diversions-Structural	H	M	H	M	M	H	M	34	4
Mokelumne River Storage System Reoperation	H	H	M	M	H	H	L	31	5
New Hogan Reservoir Diversion with South Gulch Dam and Reservoir Construction	L	L	M	M	M	H	M	29	6
Pardee Dam and Reservoir Replacement/Enlargement	M	L	L	M	L	H	H	28	7

Cost: Relative rating of the cost per acre-foot for each alternative. High = $ per acre-foot. Medium = $$ per acre-foot. Low = $$$ per acre-foot

Regulatory Feasibility: High: Good chance for regulatory support (i.e., regulatory agency concurrence). Medium: Moderate chance for legal support. Low: Low chance for support (i.e. regulatory agencies opposed).

Political Feasbility: High: Good chance for political support (i.e., elected officials/powerful interest groups in agreement). Medium: Moderate chance for political support. Low: Low chance for support (i.e. elected officials/powerful interest groups opposed).

Financial Feasibility: High: High chance for financing partners outside of the Authority. Medium: Moderate chance for partners. Low: Low chance for partners outside of the Authority.

Environmental Feasibility: High: Limited environmental impacts that can be mitigated to level of insignificance. Medium: Adverse environmental impacts that can be mitigated. Low: Adverse environmental impacts that cannot be mitigated.

Water Quality: High: No effect to downstream or County users. Medium: Potential effect to downstream users that can be mitigated. Low: Adverse effect to downstream or County users.

Benefits Achieved: High: Contribution to solving the County's water resource issues is highly valuable. Medium: Contribution to solving the County's water resource issues is moderately valuable. Low: Contribution to solving the County's water resource issues is minimally valuable

NOTE: Score = high, medium, low ranking of 3, 2, and 1 respectively, multiplied by weighted factor (ranging from 1 to 5) for each screening criterion.

7. ALTERNATIVES CARRIED FORWARD

7.1 On-Stream Alternatives

This section presents a summary project description for alternatives carried forward for further analysis and provides the rationale for ranking presented in Table 6-7.

7.1.1 Mokelumne River Storage System Reoperation

This alternative includes reoperating Pardee Dam and Reservoir, Camanche Dam and Reservoir, and the PG&E Project 137 system to generate additional water supply. It may be possible to redefine the flood control operating guidelines to allow capture of unappropriated flows in the system. By using updated hydrology and upgraded forecasting tools, opportunities may exist to modify the rule-curves to decrease flood control reservation space in the reservoirs. Flows captured by the reservoirs would be conveyed via the lower Mokelumne River to diversion points where the water would be diverted for beneficial use.

Cost per Acre Foot

Costs for this alternative would not include any construction costs, except for lower river diversions. The Authority would incur cost to analyze the new hydrology to determine the available yield. Costs for this alternative would be relatively low.

Regulatory Feasibility

State and Federal regulatory permits, because these are existing facilities would be less difficult to secure. Regulatory agencies would be concerned with downstream impacts due to changes in release patterns and timing. EBMUD concurrence is required and FERC licensing issues are possible if any changes are made to the hydropower generation operating guidelines. Concurrence from the Corps would also be required for any changes to the flood control rule curves.

Political Feasibility

Reoperation is a viable and potentially politically satisfactory alternative if EBMUD and PG&E agree with the conditions. Local, State, and Federal support could be generated. State and Federal support would be increased if the alternative could help to solve Delta water quality and supply issues.

Financial Feasibility

Financial responsibilities would fall to the Authority and its partners unless a benefit can be secured for EBMUD and PG&E. Federal and State cost-share funds could be secured if a connection is made to improving water supply, habitat, or water quality problems in the Delta. There would be additional hydroelectric benefits generated by higher head in the reservoirs.

Environmental Impacts

Environmental impacts associated with larger conservation pools and modified downstream releases could be expected; however, these impacts are not anticipated to be adverse. Downstream effects could include fewer pulse flows or flows later in the season causing a change to fisheries habitat. Upstream effects to vegetation and wildlife habitat could occur if inundation periods are longer than current trends.

Beneficial impacts may occur to recreation and fisheries due to the longer availability of water in the reservoirs and potentially expanded cold water pools which could be managed for fish migration.

Water Quality

County interests and downstream users could see change in water quality once construction is complete, although minimum instream flows and flows required to meet Delta water quality objectives would have to be maintained. Best management practices (BMPs) would be implemented to ensure little or no adverse effects during construction.

Benefits Achieved

Modeling was not available to the project team to analyze potential yield from this alternative but it is speculated that the yield would be small.

7.2 Off-Stream Storage Alternatives

This section presents a summary project description for Off-Stream Storage Alternatives carried forward for further analysis and provides the rationale for ranking presented in Table 6-5.

7.2.1 Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion

This alternative includes capturing unappropriated flows at Pardee Reservoir on the Mokelumne River and conveying up to 1,000 cfs via a pipeline and gravity tunnel to a new Duck Creek Reservoir on the Duck Creek drainage. An additional 620 cfs would be conveyed down the Mokelumne River for direct diversion for beneficial use or, released into Duck Creek, then Calaveras River or Mormon Slough, where it could be rediverted for beneficial use. The water held in the Duck Creek Reservoir would be conveyed to areas of beneficial use or released to Duck Creek, then Calaveras River or Mormon Slough for rediversion for beneficial use. As defined in the SWRCB water right permit application 29835, the proposed Duck Creek facilities would have a storage volume of up to 150,000 acre-feet and a total diversion capacity at Pardee Reservoir of up to 1,000 cfs.

Proposed Duck Creek Reservoir Site

Cost per Acre Foot

Costs for this alternative would compare favorably with other alternatives with a high yield.

Regulatory Feasibility

State and Federal regulatory permits would be moderately difficult to secure. Meeting 404(b)(1) requirements would be more difficult than alternatives with less area of impact. The inundation pool is at least partially covered by a CDFG conservation easement. It is unclear at this time what restrictions may be in place due to this easement. Follow-on phases of this analysis will take into consideration conservation easement special conditions. Because this facility is an off-stream reservoir, opposition will not be as strong as for an on-stream facility.

Political Feasibility

Local, State, and Federal support could be generated. Because of structural changes required at Pardee Dam, EBMUD would need to be supportive. State and Federal support would be increased if the alternative could help to solve Delta water quality and supply issues.

Financial Feasibility

Financial responsibilities would fall to the Authority and its partners unless a benefit can be secured for EBMUD. Federal and State cost-share funds could be secured if a connection is made to improving water supply, habitat, or water quality problems in the Delta. There would be additional hydroelectric benefits generated by higher head in the reservoirs.

Environmental Impacts

Construction of a new dam and conveyance facilities would result in adverse environmental impacts during construction and potentially during operations. Impacts to special-status species, essential fish habitat, wildlife, vegetation, aesthetics, agricultural resources, cultural resources, recreation, geology/soils, and land use could be adverse because of dam construction and diversions from the lower Mokelumne River.

The Duck Creek area slated for reservoir development has been used for grazing for many years. As a result the area does not represent undisturbed/pristine habitat. It is likely that impacts to environmental resources could be mitigated. There is also a potential for vernal pool habitat and designated critical habitat in the vicinity of the reservoir pool.

Water Quality

Minor change to downstream water quality would be realized during high flow months. Efforts would be made to prevent or reduce impacts to water quality during construction through the implementation of BMPs.

Benefits Achieved

Water resource deficits would be significantly alleviated with implementation of this alternative, relative to other alternatives.

7.2.2 Duck Creek Dam and Reservoir Construction - Camanche Diversion

This alternative includes capturing unappropriated flood flows at Camanche Reservoir on the Mokelumne River and conveying up to 1,000 cfs via pipeline to the new Duck Creek Reservoir on the Duck Creek drainage. Because of the elevation difference between Camanche Reservoir and Duck Creek Reservoir, a pump station at Camanche Reservoir would be required to convey flow into the pipeline.


Camanche Reservoir looking south

An additional 620 cfs would be conveyed down the Mokelumne River for direct diversion for beneficial use. The water held in the Duck Creek Reservoir would be conveyed via a pipeline to areas of beneficial use similar to the Pardee Dam and Reservoir Replacement/Enlargement alternative. As defined in the SWRCB water right permit application, the proposed Duck Creek facilities would have a storage volume of up to 150,000 acre-feet and a total diversion capacity at Camanche Reservoir of up to 1,000 cfs.

Cost per Acre Foot

Costs for this alternative would be relatively high in comparison with other alternatives with a high yield. For this alternative the greatest uncertainty in costs is associated with the diversion from Camanche. The alternative would require a pump station due to the difference in head between Camanche Reservoir and the proposed Duck Creek Reservoir. The average pool elevation of Camanche Reservoir from December through June based on EBMUD gage data is 209 feet, while the average pool elevation of Duck Creek would be 288 feet. The pump station would be required to pump 1,000 cfs during high flow events to divert the full allowable amount according to the Authority's storage water right application, plus potentially another 620 cfs if this were the chosen location for direct diversion. Construction costs for this pump station would be very high.

Regulatory Feasibility

Similar to the Duck Creek with a Pardee Reservoir diversion alternative, State and Federal regulatory permits would be moderately difficult to secure, meeting 404(b)(1) requirements would be more difficult than alternatives with less area of impact, and consideration would be given to the CDFG conservation easement.

Political Feasibility

Local, State, and Federal support could be generated. Because of changes required at Camanche Dam, EBMUD would need to be supportive. State and Federal support would be increased if the alternative could help to solve Delta water quality and supply issues.

Financial Feasibility

Financial responsibilities would fall to the Authority and its partners unless a benefit can be secured for EBMUD. Federal and State cost-share funds could be secured if a connection is made to improving water supply, habitat, or water quality problems in the Delta. There would be additional hydroelectric benefits generated by higher head in the reservoirs.

Environmental Impacts

Impacts relating to the Duck Creek Reservoir, Camanche Diversion, are similar to that of the Duck Creek Reservoir, Pardee Diversion as the areas that would be impacted are nearly exact. The majority of impacts would be related to construction of a new dam and reservoir.

Water Quality

Minor change to downstream water quality would be realized during high flow months. Efforts would be made to prevent or reduce impacts to water quality during construction through the implementation of BMPs.

Benefits Achieved

Water resource deficits would be significantly alleviated with implementation of this alternative, relative to other alternatives.

7.3 Direct Diversion Alternatives

This section presents a summary project description for Direct Diversion Alternatives carried forward for further consideration and provides the rationale for ranking presented in Table 6-5.

7.3.1 Lower Mokelumne River Diversions - Structural

This alternative, an alternative of the original SWRCB water right permit application, includes diverting unappropriated flows using pump stations with or without modifiable dams located along the lower Mokelumne River from below Camanche Reservoir to Interstate 5. Flows would be diverted for beneficial use.

Cost per Acre Foot

Cost per acre foot for upgrading the existing lower river diversions or constructing new diversions would be relatively low compared to other alternatives. The uncertainty in costs would be the sizing of the diversion(s), need for dams and fish screens, and distribution to beneficial use areas. The yield available to the County could potentially be high, but only available infrequently.

Regulatory Feasibility

State and Federal regulatory permits will be moderately difficult to receive because of designated EFH below Camanche Dam. If existing structures are upgraded only, permitting may be less difficult. Changes to existing structures could cause new restrictions on diversions, consistent with current fisheries protection laws.

Political Feasibility

Opportunities exist to upgrade existing structures and therefore provide downstream users a benefit. Opposition from downstream users concerned about water right security is likely.

Financial Feasibility

Financial responsibilities would fall to the Authority and its partners.

Environmental Impacts

This alternative would result in moderate adverse environmental impacts during construction and operation. Impacts to special-status species, EFH, wildlife, and vegetation could be adverse. EFH is designated in the Mokelumne River below Camanche Dam and could therefore be affected by lower river diversions.

Water Quality

County interests and downstream users could see change in water quality during high flow months once construction is complete, although minimum instream flows and flows required to meet Delta water quality objectives would have to be maintained. To ensure little or no adverse effects occur during construction, BMPs would be implemented.

Benefits Achieved

Water resource deficits would be minimally to moderately relieved with implementation of this alternative, relative to other alternatives.

7.3.2 Lower Mokelumne River Diversions - Non-Structural

This alternative includes diverting unappropriated flows using existing structures such as EBMUD diversion at Pardee, the NSJWCD pumping facility, or the WID facility at Lodi. Flows would be diverted for beneficial use during periods when capacity exists.

Cost per Acre Foot

Costs per acre foot would be low compared to other alternatives.

Regulatory Feasibility

State and Federal regulatory permits will be minimally difficult to receive. Presence of designated EFH below Camanche Dam could require special consideration and coordination with NOAA Fisheries.

Political Feasibility

Political support should be good for this alternative, as long as EBMUD, SSJWCD, and/or WID were to benefit from the project.

Financial Feasibility

Financial responsibilities would fall to the Authority and its partners.

Environmental Impacts

This alternative would likely result in minimal adverse environmental impacts during construction and operation. Potential impacts to designated EFH could require special coordination with NOAA Fisheries.

Water Quality

County interests and downstream users would see minimal change in water quality.

Benefits Achieved

Implementation of this alternative would minimally alleviate the water supply deficit as identified by the County, relative to other alternatives.

8. PRELIMINARY OPERATIONS STUDY OF ALTERNATIVES

8.1 Introduction

The operations study for the alternatives carried forward was conducted using two simulation models: EBMUDSIM and the MORE Model.

The EBMUDSIM is the EBMUD Reservoir Operations Planning Model[2]. The model simulates EBMUD's Mokelumne River and East Bay water supply system and estimates water availability to EBMUD customers under current and assumed future conditions. One of the outputs of the model is the estimated release from EBMUD storage reservoirs on the Mokelumne River (Pardee and Camanche Reservoirs) to the lower Mokelumne River. This release includes water for downstream users as well as flood control release and instream flow requirements.

The MORE Model is a custom-designed computer program developed specifically for the MORE WATER Feasibility Analysis. The model uses given time series of flood control releases to estimate water availability to County customers under different configurations.

8.2 Mokelumne River Hydrology

The amount of Mokelumne River water available to the project depends on hydrological conditions, operation of upstream water and power projects, upstream diversions, EBMUD demand, water rights and minimum instream flow requirements for the lower Mokelumne River watershed, and flood control rules. The following sections describe these constraints as simulated in the operations study as well as the logic and assumptions used in the MORE Model, alternatives studied, and results.

2 EBMUDSIM Model Description, Assumptions, Verification, and Output. Testimony of John W. Skinner before the State Water Resources Control Board, June 1998.

8.3 Upper Mokelumne River Watershed

The Upper Mokelumne River Watershed is defined as the portion of the Mokelumne Basin upstream of Pardee Reservoir. The flow regime in this area is governed by the operation of PG&E Project 137 and diversions by Amador and Calaveras Counties, as follows:

8.3.1 PG&E System (Project 137)

The PG&E system consists of seven reservoirs having a combined capacity of about 220 taf, various tunnels, stream diversions, canals, regulating reservoirs, and four powerhouses with a total capacity of about 194 megawatts.

The operation of PG&E's system is not explicitly simulated in the study. Instead, flow regulated by this system is implicit in the assumptions used by the EBMUDSIM model, in two ways:

1. It uses flows at the Mokelumne Hill Gage, downstream of PG&E's system, in computing EBMUD system inflow. Flow at this point already reflects regulation by PG&E upstream reservoirs in accordance with the Lodi Decrees; and
2. It uses the historic available space in PG&E's reservoirs to compute the portion of Pardee and Camanche flood control space that can be "transferred" to PG&E's system. This "transferable" amount reduces the space requirements in Pardee and Camanche Reservoirs, thus increasing allowable storage amounts in EBMUD's system (see also 8.5).

8.3.2 Diversions

Diversions to Amador and Calaveras Counties depend on the level of development studied (i.e., current 1995 conditions or development at 2020). The annual diversion amounts in taf, as assumed in EBMUDSIM, are summarized in Table 8-1 below. These diversions are appropriated in the model among various agencies that operate within each county.

Table 8-1. Annual Upstream Diversions

User	Level of Development (taf)		
	Current (1995)	2020	Max
Amador County	17.4	20.0	20
Calaveras County	4.0	11.7	27
Total	21.4	31.7	47

The flow, after being regulated by PG&E's system and reduced by the upstream diversions, becomes the inflow to Pardee Reservoir. The flow is measured at the USGS station Mokelumne Hill Gage (near Highway 49 Bridge).

In simulating future conditions on the river, EBMUDSIM uses historical flow at the gage adjusted for the difference between the historical upstream diversion and newly projected diversions.

Appendix F, Figure F-1 is a flow-duration curve at the gage showing the percent of time the annual flow in the river equaled or exceeded given historical conditions.

The period selected for the operations study was 1921 to 1995, corresponding to the data set currently being used in EBMUDSIM modeling.

In addition, EBMUDSIM uses a synthetic year with annual runoff of 185 taf that replaces the historical flow in 1978. This enables EBMUD to assess its water supply under drought conditions that could have occurred if the 1976-77 drought had continued for an additional year.

8.4 EBMUD Water Supply System

The EBMUD water supply system on the Mokelumne River consists of Pardee Reservoir and powerplant, Camanche Reservoir and powerplant, and the Mokelumne Aqueducts, which divert water from Pardee Reservoir and deliver water to the EBMUD service area. The operation of the EBMUD system is modeled within the EBMUDSIM model, as follows:

8.4.1 Pardee Reservoir and Powerplant

Pardee Reservoir has a gross storage capacity of about 198 taf. It fills up and draws down to target storage levels using forecasting procedures that minimize reservoir spills. This mode of operation takes into account delivery of water to EBMUD customers via the Mokelumne Aqueducts, releases to Camanche Reservoir in order to supply lower Mokelumne River flow requirements, and if necessary, to maintain cold hypolimnetic volume in Camanche Reservoir for water quality considerations.

Pardee powerplant is situated at the base of Pardee Dam and contains three Francis turbines with a total generating capacity of 28,650 kilowatts. The total rated flow for the plant is 1,100 cfs. EBMUDSIM assumes that Pardee powerplant is operating at a uniform flow rate governed by water supply and flood control rules (no peaking).

EBMUD demands of 220 mgd were used for this analysis, as it most accurately represents the near term level of demand in the basin. Both with- and without-hydropower impact scenarios were considered. Hydropower impacts would occur if the MORE WATER project were to divert water upstream of the Pardee and Camanche powerplants, if those powerplants would have passed all or part of the flood releases through the turbines. However, as data available from EBMUD was limited to 220 mgd without-hydropower impact scenario, and to 325 mgd with- and without-hydropower impacts scenarios, the 220 mgd scenario with-hydropower impacts was synthesized from these data sets.

8.4.2 Camanche Reservoir and Powerplant

Camanche Reservoir has a gross storage capacity of about 417 taf. It provides releases to meet flow requirements for the lower

Mokelumne River, including: water demands by downstream diverters, releases to offset channel depletion (loss), fish release requirements, and provides releases to maintain flood control space in the system.

Camanche powerplant is situated at the base of Camanche Dam and contains three Kaplan turbines with a total generating capacity of 10,680 kilowatts. The total rated flow for the plant is 1,200 cfs. EBMUDSIM assumes that Camanche powerplant is operating at a uniform flow rate (no peaking).

8.5 Flood Control Operations

Flood control operation is one of the most important factors in estimating the unappropriated water available to the County. The flood control operations for Pardee and Camanche Reservoirs are regulated by the Corps and can be described as follows:

Flood control storage space can be coordinated between these two reservoirs. A combined 200,000 acre-feet of flood storage space is required in Pardee Reservoir and Camanche Reservoir from November 15 until March 15. However, if PG&E's Salt Springs and Lower Bear Reservoirs are sufficiently drawn down, EBMUD can reduce the amount of space it must provide to a minimum of 130,000 acre-feet. For the period after March 15, flood storage space requirements are based on rainfall and snow pack estimates, and the reservoirs can be completely filled at the end of May in dry years and by July 15 in wet years. No flood control storage is required from July 15 to November 15. When inflow is adequate, Camanche Reservoir is operated to reach full capacity by July 15. Operational requirements of Camanche Reservoir do not allow storage of inflows after July 15; therefore, releases are made to meet instream flow requirements for the lower Mokelumne River and storage is gradually reduced to the flood control requirement by November 15 (Reclamation 2003).

EBMUDSIM simulates the above-mentioned flood control operation rules, with some approximation subject to the limitations in the monthly time steps.

8.6 Lower Mokelumne River Watershed

The Lower Mokelumne River Watershed is defined as the portion of the Mokelumne Basin downstream of Camanche Reservoir. The flow regime in this area is governed by the need to supply water for downstream water users (diversions), channel losses and fish release requirements, as described below.

8.6.1 Diversions

Diversions to downstream users depend primarily on the hydrologic conditions. Table 8-2 provides a summary of the annual diversions off the lower Mokelumne River.

Table 8-2. Annual Downstream Diversions

User	Amount (taf)	Comments
Riparian and Senior Appropriators	20	When TNF[a] is greater than 250 taf.
	16.1	In dry years, diversion amount in July, August and September are reduced to 50%.
NSJWCD	20	In normal years.
	0	When Camanche Reservoir storage is in deficit.
WID	60	When Pardee inflow is greater than 375 taf.
	39	When Pardee inflow is less than 375 taf.
City of Lodi	3.6	All years.

[a] TNF is the True Natural Flow computed at the Mokelumne Hill Gage. TNF is defined as the flow in the river in absence of any storage regulations or diversions.

8.6.2 Fish Release Requirements

Fish release requirements are the minimum flows that must be released to the lower Mokelumne River for fisheries purposes. In general, EBMUDSIM provides the fish flow requirements agreed upon in the 1997 Joint Settlement Agreement. The Agreement approved by EBMUD, USFWS, and CDFG prescribes minimum release requirements below Camanche Reservoir in different year types and subject to meeting minimum flow conditions below Woodbridge Diversion Dam. In other words, if the minimum release required from Camanche Reservoir does not result in flow below Woodbridge Diversion Dam as prescribed in the schedule, Camanche releases must be increased accordingly.

The annual fish release requirements are summarized in Table 8-3 below. Monthly fish release requirements are included in Appendix F.

Table 8-3. Fish Release Requirements

Requirements (cfs)	Year Type	Annual (taf)
Minimum Camanche Reservoir Release	Normal	194
	Below Normal	154
	Dry	130
	Critical	80
Expected Flow below Woodbridge Diversion Dam	Normal	86
	Below Normal	73
	Dry	52
	Critical	34

8.6.3 Channel Losses

EBMUDSIM incorporates a component of loss to the system called channel losses. Channel losses (from unlined channels) to the groundwater basin occur in the lower Mokelumne River. EBMUD, under water right agreements with other water users, is obligated to release sufficient water to ensure that entitlements are delivered to the users at the point of take-out or use. Because channel losses deplete the amount of water in the river, EBMUD is required to increase the releases from Camanche Reservoir to compensate for the losses.

Channel losses in the model depend on the total release from Camanche Reservoir as illustrated in Appendix F.

8.6.4 EBMUDSIM Model and MORE Model Description

The EBMUDSIM Model is a proprietary simulation tool held by EBMUD that simulates the operation of the Mokelumne River system. Analyses for this study were performed by EBMUD staff in coordination with HDR. Results of several model runs were post-processed using the MORE Model. The MORE Model is a custom-designed computer program developed specifically for the MORE WATER Feasibility Analysis. The model is capable of simulating alternative configurations consisting of diversion to storage (either on-stream or off-stream reservoirs), direct diversion, or a combination of the two.

The MORE Model is essentially a post processor of the results obtained from EBMUDSIM. The model uses the computed flood control release from Camanche Reservoir to simulate alternatives and compute the portion of the unappropriated water that could be diverted for storage and/or direct beneficial use (delineated on Figure 8-1 as “Diversion to Storage” and “Direct Diversion”). Finally, the model computes the remaining unappropriated flows in the lower Mokelumne River after diversions for the alternative. More information about the methodology and assumptions used in the study is provided in Appendix F, Preliminary Study-Methodology and Assumptions.

The MORE Model was used to analyze the maximum demand annual yield and hydropower impact of alternatives. Section 8.7.3 provides a description of the alternatives studied, and the results of the operations study.

As available yield is one of the outputs of the MORE Model, there is no distinction in the model results between the lower Mokelumne River Diversions - Structural Alternative, and the lower Mokelumne River Diversions - Non-Structural Alternative. Theoretically, both the structural and non-structural alternatives could provide 100 percent of available yield. However, in practice, with the lower Mokelumne River Diversions - Non-Structural alternative, capacity of existing structures and conveyance facilities would place limitations on the ability to capture 100 percent of the available yield. For this reason, relevant model results for the lower Mokelumne River diversions are presented as Lower Mokelumne River Diversion - Structural, rather than Non-Structural.

8.7 Alternatives Modeling

Three alternatives were studied: (1) Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion, (2) Duck Creek Dam and Reservoir Construction-Camanche Reservoir Diversion, and (3) Lower Mokelumne River Diversion - Structural.

Figure 8-1 depicts a schematic diagram of alternatives studied. For the Duck Creek reservoir diversion alternatives, the water diverted is stored in the reservoir and then discharged to the County's service area for beneficial use. Water from the Lower Mokelumne River Diversions, on the other hand, is directly discharged to the area of beneficial use. Additional specifics regarding the alternatives modeling is provided in the sections below.

8.7.1 Lower Mokelumne River Diversions - Structural

The Lower Mokelumne River Diversion - Structural alternative was analyzed in two ways: (1) as a stand alone project, and (2) in conjunction with a Duck Creek Reservoir alternative.

For sensitivity analysis purposes, the alternatives were analyzed in different ways by changing the following parameters:

- The impact to hydro (With and Without)
- The maximum diversion to storage rates, and
- The maximum direct diversion rates

The Lower Mokelumne River Diversions - Structural Alternative was modeled from an unspecified point below Camanche Reservoir. Water available for direct diversion is assumed to be from the dataset for the case With Hydro Impact since it represents all the flood flow released from Camanche Reservoir without any hydropower constraints.

As mentioned above, this alternative was modeled as a standalone project and in conjunction with the Duck Creek alternatives. Under the latter, it is assumed that diversion to Duck Creek Reservoir take precedence over the lower Mokelumne River Diversion. In other words, diversion to Duck Creek Reservoir is maximized first, the remaining water is then available for diversion downstream.

8.7.2 Duck Creek Dam and Reservoir Construction - Pardee and Camanche Reservoir Diversions

For modeling purposes, Duck Creek Reservoir was assumed to have a storage capacity of 150 taf requiring an estimated right-of-way 4,500 acres (including freeboard). The elevation-area-capacity used in the model is shown in Figure F-3 of Appendix F (Hanson 1993).

Reservoir evaporation is based on evaporation rates typical to this region as shown on Figure F-4 in Appendix F.

Two diversion options were considered:

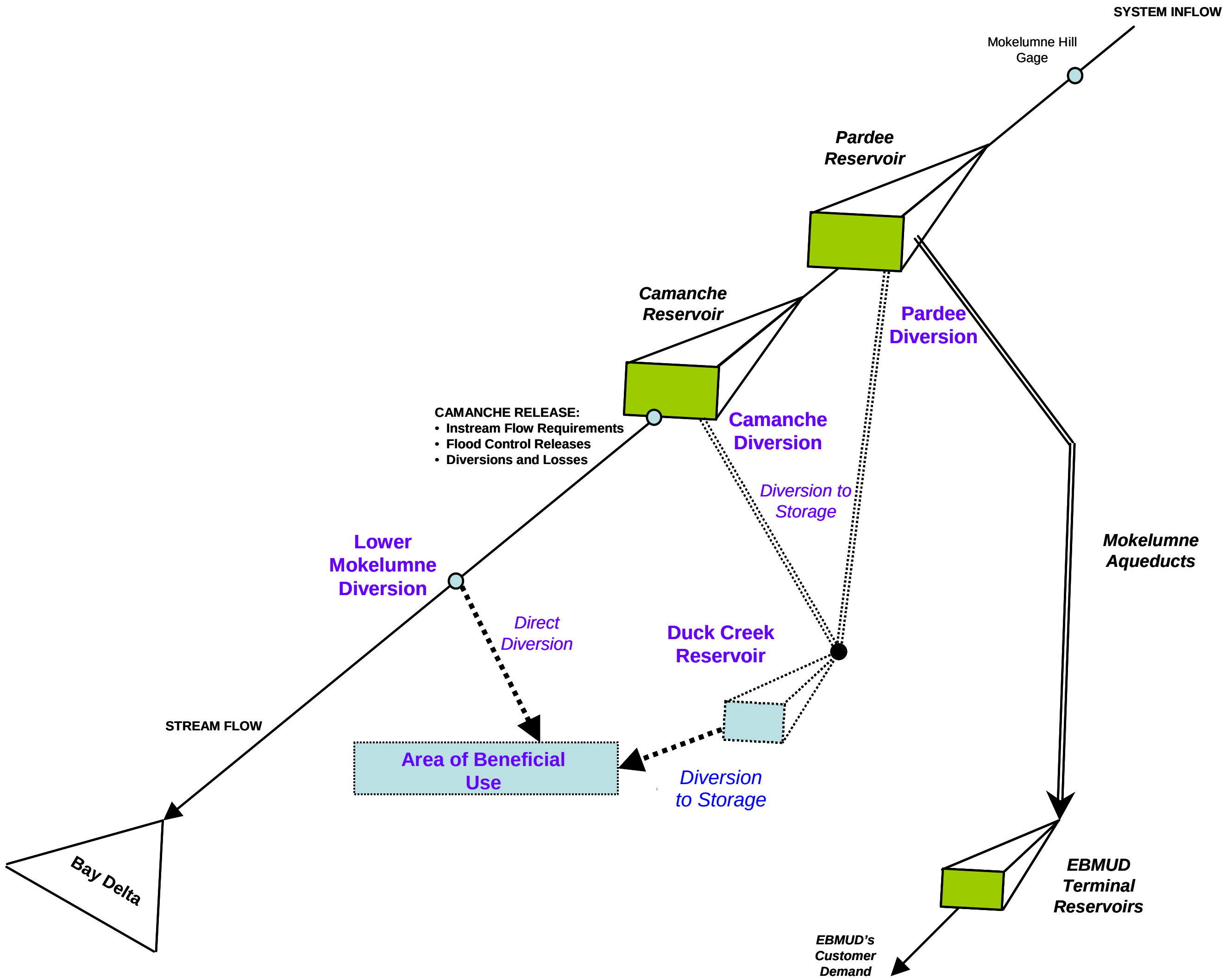
- Diversion from Pardee Reservoir.
- Diversion from Camanche Reservoir.

For purposes of modeling, the two options do not differ in terms of yield. The only difference is in the potential impact to hydro. Under the Pardee Reservoir Diversion Alternative, water diverted is bypassing both Pardee and Camanche powerplants, while under the Camanche Reservoir Diversion Alternative, water diverted bypasses only the Camanche powerplant.

It should be noted that diverting from Camanche Reservoir will require pumping because of the insufficient head differential between Camanche and Duck Creek Reservoirs. However, energy associated with pumping was not incorporated in the modeling.

Because of the relevance of hydro impacts to the cost effectiveness analysis, results of the impact to hydro (with and without) are also presented in Chapter 9.

Figure 8-1. Schematic Diagram of the MORE Model for Alternatives Carried Forward



8.7.3 Results

Results of the operations are presented in terms of:

3. **The Maximum Demand (no-spill).** The maximum demand is the maximum required flow rate of the conveyance facility from Duck Creek Reservoir to the area of beneficial use in order to prevent Duck Creek reservoir spills.

4. **The Project Annual Yield.** Annual yield is the average supply of water to the County on an annual basis for the period of analysis. Annual yield is the sum of direct diversion and diversion to storage (in the case of Duck Creek Reservoir).

5. **Hydropower Impact.** Hydropower impact is the loss of generation to EBMUD due to implementation of an alternative. At present, EBMUD has the ability to pass a portion of its spills through the hydropower plants at Pardee and Camanche Reservoirs MORE WATER alternatives which

divert upstream of one or both of these powerhouses would have to compensate for lost hydropower revenues.

The conversion factors used to convert loss of water to loss in generation was 0.10 mega-watt hours per acre-feet for Camanche Reservoir and 0.28 mega-watt hours per acre-feet for Pardee Reservoir (not including Camanche). The cost of energy used was 40 $/mega-watt hours and is based on estimated average short-run avoided costs prices for peak and off-peak energy.

The study results are presented in three tables:

1. Table 8-4: This table shows various project configurations for a combination of Duck Creek Reservoir and Direct Diversion off the lower Mokelumne River. Parameters that differentiate the cases (input columns) are: whether or not there is an impact to EBMUD hydro generation and the capacity of the diversion to Duck Creek. Results (output columns) show the Max Demand, Annual Yield and Hydropower Impact.
2. Table 8-5: This table shows the sensitivity of the results presented in Table 8-9 to the reduction in the direct diversion rate from 620 cfs to 300 cfs.
3. Table 8-6: This table shows various project configurations for the Lower Mokelumne River Direct Diversion - Structural Alternative only. Parameters that differentiate the cases are: Point of diversion (i.e., upper Mokelumne or lower Mokelumne) and diversion capacities. All the cases analyzed in this table are assuming no impact to hydropower.

Table 8-4. MORE Model Results for Various Diversion Rates to Duck Creek and a Single Direct Diversion Rate on the Lower Mokelumne River

	Input						Output											
Alternative	**Hydro Impact**	**Diversion to Storage**		**Direct Diversion (Lower Mok.)**		**Reservoir Size**	**Max Demand (no-spill)**	**Annual Yield**			**Hydro Impact (water)**	**Hydro Impact (Energy)**			**Hydro Impact (Money)**			
								Reservoir	**Direct Div.**	**Total**	**Total**	**Pardee**	**Camanche**	**Total**	**Pardee**	**Camanche**	**Total**	**$/AF**
		(cfs)	Period	(cfs)	Period	(TAF)	(cfs)	(TAF)	(TAF)	(TAF)	(TAF)	(GWh)	(GWh)	(GWh)	($1000)	($1000)	($1000)	
Duck Creek	No	1000	Dec-Jun	620	Dec-Jun	150	411	37.6	44.7	82.3								
Duck Creek	Yes	1000	Dec-Jun	620	Dec-Jun	150	633	68.7	21.6	90.3	31.1	8.6	3.1	11.7	$ 342	$ 125	$ 467	$ 15.03
Duck Creek	No	500	Dec-Jun	620	Dec-Jun	150	171	23.0	46.0	69.0								
Duck Creek	Yes	500	Dec-Jun	620	Dec-Jun	150	193	39.3	33.2	72.5	16.3	4.5	1.6	6.1	$ 179	$ 66	$ 245	$ 15.03
Duck Creek	No	250	Dec-Jun	620	Dec-Jun	150	30	11.0	46.9	57.9								
Duck Creek	Yes	250	Dec-Jun	620	Dec-Jun	150	51	19.4	40.3	59.7	-19.9	-5.5	-2.0	-7.5	$ (219)	$ (80)	$ (300)	$ 15.03
Duck Creek	No	0	Dec-Jun	620	Dec-Jun				49.2	49.2	-11.0	-3.0	-1.1	-4.1	$ (121)	$ (44)	$ (165)	$ 15.03

Table 8-5. MORE Model Results for a Single Diversion Rate to Duck Creek and Various Direct Diversion Rates on the Lower Mokelumne

	Input						Output											
Alternative	**Hydro Impact**	**Diversion to Storage**		**Direct Diversion (Lower Mok.)**		**Reservoir Size**	**Max Demand (no-spill)**	**Annual Yield**			**Hydro Impact (water)**	**Hydro Impact (Energy)**			**Hydro Impact (Money)**			
								Reservoir	**Direct Div.**	**Total**	**Total**	**Pardee**	**Camanche**	**Total**	**Pardee**	**Camanche**	**Total**	**$/AF**
		(cfs)	Period	(cfs)	Period	(TAF)	(cfs)	(TAF)	(TAF)	(TAF)	(TAF)	(GWh)	(GWh)	(GWh)	($1000)	($1000)	($1000)	
Duck Creek	No	1000	Dec-Jun	300	Dec-Jun	150	411	37.6	24.8	62.4								
Duck Creek	Yes	1000	Dec-Jun	300	Dec-Jun	150	633	68.7	11.9	80.6	31.1	8.6	3.1	11.7	$ 342	$ 125	$ 467	$ 15.03
Duck Creek	No	500	Dec-Jun	300	Dec-Jun	150	171	23.0	25.2	48.2								
Duck Creek	Yes	500	Dec-Jun	300	Dec-Jun	150	193	39.3	18.2	57.5	16.3	4.5	1.6	6.1	$ 179	$ 66	$ 245	$ 15.03
Duck Creek	No	250	Dec-Jun	300	Dec-Jun	150	30	11.0	25.7	36.7								
Duck Creek	Yes	250	Dec-Jun	300	Dec-Jun	150	51	19.4	21.7	41.1	8.4	2.3	0.8	3.1	$ 92	$ 34	$ 126	$ 15.03
Duck Creek	No	0	Dec-Jun	300	Dec-Jun				27	27								

Table 8-6. MORE Model Results for Various Direct Diversion Rates on the Upper and Lower Mokelumne

Alternative	Input Direct Diversion (cfs)	Input Direct Diversion Period	Direct Div. (taf)	Total (taf)
Direct Diversion Only (Lower Mokelumne)	620	Dec-Jun	49.2	49.2
Direct Diversion Only (Lower Mokelumne)	450	Dec-Jun	38.1	38.1
Direct Diversion Only (Lower Mokelumne)	300	Dec-Jun	27.0	27.0
Direct Diversion Only (Upper Mokelumne)	620	Dec-Jun	28.9	28.9
Direct Diversion Only (Upper Mokelumne)	450	Dec-Jun	22.7	22.7
Direct Diversion Only (Upper Mokelumne)	300	Dec-Jun	16.4	16.4

Notes:
a) Assumes hydropower demand is met
b) "Lower Mokelumne River" refers to Camanche Reservoir. "Upper Mokelumne River" refers to at, or above, Pardee Reservoir.

9. COST EFFECTIVENESS ANALYSIS

9.1 Introduction

A cost effectiveness analysis expresses the long-run cost of an alternative on a consistent basis using common benchmarks. For this Reconnaissance Study, the cost of the alternatives carried forward for further analysis were compared using the benchmark of dollars per acre-foot ($/acre-foot) per year for three alternatives: (1) Duck Creek Dam and Reservoir Construction - Pardee Reservoir Diversion with Lower Mokelumne River Diversion - Structural; (2) Duck Creek Dam and Reservoir Construction - Comanche Reservoir Diversion with Lower Mokelumne River Diversion - Structural; and (3) Lower Mokelumne River Diversion - Structural. (It should be noted that the cost effectiveness analysis was not conducted for either the Lower Mokelumne River Diversions-Non-Structural Alternative or the Mokelumne River Storage System Reoperation Alternative as no new facilities are associated with these alternatives.)

The following procedure, consistent with standard methods used by federal agencies for water project evaluation as described in the Water Resources Council's "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (Principles and Guidelines), was used to determine this measure:

- Life-cycle costs for the project's capital and operation and maintenance expenditures are developed on an annual basis over a 100-year period.
- The total costs for each year are discounted to present-day (2004) dollars using an appropriate discount rate.
- These annual discounted costs are summed over the 100-year period to determine the net present value cost of each alternative.
- This net present value cost is then expressed on an annual basis by amortizing this value over 100 years at the discount rate.
- This annualized value is divided by the average annual acre-foot yield to determine the annual average cost per acre-foot.

The following sections provide greater detail for each of the points above.

9.2 Life-Cycle Cost Estimates

Baseline capital and operation and maintenance costs were initially developed by HDR. Appendix G contains the baseline cost estimates for each alternative carried forward for further analysis, including up-front capital costs and annual operation and maintenance costs. These costs are expressed in 2004 dollars.

9.2.1 Role of Inflation

For purposes of developing the long-term cost effectiveness analysis and facilitating comparisons across alternatives, inflationary pressures on costs are not considered over the 100-year period. This is consistent with procedures described in the Principles and Guidelines.

9.2.2 Life-Cycle Costs

A 100-year period of record is considered for the cost effectiveness analysis. This lengthy period of time is required to fully consider the full useful life and replacement cost of the facilities in question. However, since the initial cost estimates only account for constructing, building and operating, estimated cost for each of the 100 years need to be explicitly considered.

Several assumptions were made to extend the cost estimates included in Appendix G over a longer period of time. The main assumptions are as follows:

- Construction costs fall into a number of categories, including pumping stations, piping, highway and stream crossings, and an off-channel reservoir. Cost items differ by alternative, and the Duck Creek Dam and Reservoir Construction-Camanche Reservoir and Pardee Reservoir Diversion alternatives include an off-channel reservoir. It is assumed that initial construction costs will be incurred over a three-year period, with 20 percent of the cost for each item applied to the first year and 40 percent to the second and third years. A number of items will require replacement during the 100-year period. With the exception of tunneling, the life of pumping station items is assumed to be 25 years. Piping replacement costs are required every 50 years. Similarly, it is assumed that highway and stream crossing costs will be incurred every 50 years. Replacement costs are assumed to be equal to construction costs and are incurred over a two-year period with the cost divided equally between the two years.

- Construction and replacement costs have a capital cost contingency of 30 percent. Additional costs for engineering and other services are calculated as a percentage of the total construction cost (equal to the total capital cost plus the 30 percent contingency). The additional costs (and their corresponding percentages) include engineering (10 percent), administration/legal (5 percent), finance (3 percent), construction management (10 percent), and environmental (10 percent). In total, 38 percent of the total construction cost is added to each project alternative for these services. These fees apply to years during which construction or replacement occurs.
- Land acquisition costs are applied to the first year of the project and are a one-time cost. Cost items include land for the reservoir (not applicable to the Lower Mokelumne River Diversions-Structural Alternative), 50-foot right-of-way for the piping, land for the intake and pump station, reservoir surveying, and boundary surveying (noted simply as surveying). Current land uses are assumed to be natural, with no agricultural impacts.
- Annual costs include operation and maintenance costs, pumping energy costs, and purchase of water, as appropriate for each of the three alternatives. Operation and maintenance costs are calculated as a percentage of construction costs estimated for three categories: pipeline and distribution operation and maintenance (1.5 percent), dam and reservoir operation and maintenance (1.5 percent), and intake, fish screen and pump station operation and maintenance (5.0 percent). Annual costs are applied equally each year following the initial three-year construction. Average annual pumping energy costs are estimated at 10.5 cents per kilowatt-hour, which is computed from the horse-power requirements and average annual yields. Standby energy costs are estimated at $23.5 per kilowatt (pump capacity) per month. The energy costs represent a significant portion of the annualized life-cycle costs for the Lower Mokelumne and Camanche Diversion alternatives.

9.2.3 Annual Discounted Costs

The annual costs for each alternative must be discounted to account for the “real” time value of money, unaffected by the rate of inflation. The federal Office of Management and Budget annually prescribes a discount rate for evaluating public infrastructure projects. For 2003-04, the office of management and budget recommends a discount rate of 5.625 percent; however, this rate includes inflation. An inflation-free discount rate of 3.0 percent was estimated for this study. The sum of the annual discounted costs over the period 2004-2103 is the present value of the total life cycle cost of the project over 100 years, including capital costs, operation and maintenance, and periodic replacements.

Table 9-1 summarizes: the up-front capital cost of the alternatives, the annual operation and maintenance costs, and the present value of the life-cycle costs. The present value of the life-cycle costs are then expressed on an annual basis by amortizing the total costs over 100 years at a discount rate of 3.0 percent.

For the Duck Creek Dam and Reservoir Construction-Camanche Reservoir and Pardee

Reservoir Diversion Alternatives, there are two options considered for each: without a hydropower impact and with a hydropower impact. Each option has a specific water yield and a quantity of foregone hydropower production (i.e., loss of revenue due to reduction in hydropower generation). Therefore, in addition to the annualized life cycle costs, the value of any foregone hydropower production is considered as an annual cost. This value is also shown in Table 9-1.

The sum of the annualized life-cycle costs plus the annual foregone hydropower production equals the annual equivalent cost of each alternative. This annual cost is divided by the annual yield of the alternative to determine the annual cost per acre-foot of the alternative.

9.3 Cost Effectiveness Results

Table 9-1 shows that the cost per acre-foot for the alternatives evaluated ranges from $123 (Lower Mokelumne River Diversions-Structural) to $334 (Duck Creek Dam and Reservoir Construction-Camanche Diversion with no hydropower impacts). It is of interest to note that although the higher yields from Duck Creek Dam and Reservoir Construction-Camanche and Pardee Reservoir Diversions are accompanied by hydropower impacts, the overall cost per acre-foot is reduced. This is because the value of the additional yield to the project is proportionately more than the increase in costs associated with foregoing hydropower production. Alternatively stated, the average value of the hydropower produced, on a per acre-foot basis, is less than the cost of developing additional supply – one "averages down" the project cost by foregoing hydropower production.

Although these costs are competitive with what municipalities and other non-agricultural users pay for water, on a per acre-foot basis, the costs do not include facilities to re-regulate and convey the water for beneficial use. In other words, the yield estimates assume the water can be used at the time it is directly diverted or released from Duck Creek Reservoir, which is usually during the winter and spring months.

Also, costs are only partially included to distribute the water beyond the river's edge for the direct diversion and beyond Duck Creek Reservoir for the Camanche and Pardee diversions. The costs associated with a main pipeline is included to convey the diverted water to an assumed central location within the area of beneficial use (five miles for the direct diversion and three miles for the Duck Creek outlet), but no costs are included for the distribution, storage and recharge of water throughout the area of beneficial use. Hence, once those realities are dealt with in Phase 2, the per acre-foot costs will rise substantially. The numbers shown in Table 9-1 are primarily for comparison purposes.

Table 9-1. Summary of Cost Effectiveness Analysis[a]

	Lower Mokelumne River Diversions-Structural	Duck Creek Dam and Reservoir Construction			
		Camanche Reservoir Diversion		Pardee Reservoir Diversion	
		No Hydropower Impacts	Hydropower Impacts	No Hydropower Impacts	Hydropower Impacts
Capital cost	$74,900,000	$368,000,000	$368,000,000	$412,000,000	$412,000,000
Annual Operation & Maintenance	$2,950,000	$14,400,000	$14,700,000	$5,480,000	$5,480,000
Present value life cycle costs (100 years)	$191,000,000	$868,000,000	$875,000,000	$626,000,000	$626,000,000
Annualized life cycle costs	$6,050,000	$27,500,000	$27,700,000	$19,800,000	$19,800,000
Plus forgone hydropower revenue	$0	$0	$124,000	$0	$468,000
Total annual equivalent cost	$6,050,000	$27,500,000	$27,800,000	$19,800,000	$20,300,000
Annual project yield (acre-feet)[b]	49,200	82,300	90,300	82,300	90,300
Annual cost per acre-foot[c]	$123	$334	$308	$241	$225

a) All costs are 2004 dollars (without inflation) and have been rounded to three significant figures.

b) Annual yield estimates assume an ideal user. That is, the water can be fully beneficially used immediately upon diversion. In reality, much of the diversion would occur in the winter and early spring months when demands are minimal. This issue will be investigated more fully in the Phase 2 Engineering Feasibility Study.

c) Cost per acre-foot does not include costs for the distribution, storage and recharge of water throughout the beneficial use area.

10. REFERENCES

Water Resources Council, Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, March 10, 1983.

(CDM 2001) Camp Dresser & McKee, San Joaquin County Flood Control and Water Conservation District, Water Management Plan, Phase 1 - Planning, Analysis, and Strategy.

(Authority/County 2003) Mokelumne River Water & Power Authority/San Joaquin County, MORE WATER Project Brochure, 2003

(Reclamation 2003) Draft Environmental Statement for the Freeport Regional Water Project, August 2003. East Bay Municipal Utility District and United States Bureau of Reclamation.

(Hanson 1993) San Joaquin County Proposed Duck Creek Project. February 1993. James C. Hanson, Consulting Civil Engineer.

Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, March 10, 1983.

(Authority/County 2003) Mokelumne River Watershed Power Authority/San Joaquin County, MORE WATER Project Brochure, 2003.

(Montgomery Watson 1996) Montgomery Watson Americas, Inc. in association with CH2M Hill, 1996. Mokelumne Aquifer Recharge and Storage Project. Montgomery Watson, Sacramento, CA. Prepared for East Bay Municipal Utilities District and the Eastern San Joaquin Parties.

APPENDIX A

MARS AND WATER MANAGEMENT PLAN DEMAND SEPTEMBER 2003 CALCULATIONS

Both the Mokelumne Aquifer Recharge and Storage Project (MARS) and the San Joaquin County Water Management Plan (WMP) project future water demands as part of their analysis. Each report summarizes the water budget for San Joaquin County differently. The MARS report considers the budget as satisfying a hydraulic condition to prevent saline intrusion. The WMP conducts an actual water balance, considering the geology and hydrogeology of the area to calculate groundwater overdraft. This appendix summarizes and compares the methodologies used in each report.

SAN JOAQUIN COUNTY WATER MANAGEMENT PLAN

The WMP identifies regional water supply and quality concerns present within the county. The county is reliant primarily on groundwater pumping for both urban and agricultural water supply, creating a groundwater overdraft. Water quality concerns are a result of reduced San Joaquin River flows caused by upstream development and increased salt load, primarily from the west side of the San Joaquin Valley. The WMP evaluates the region's geology and stratigraphy, soil distribution, hydrogeology, aquifer hydraulic properties, groundwater flow patterns, and groundwater level trends. Based on this analysis, an assessment of the water balance was presented in the WMP and is repeated in the Table 1 below.

An Integrated Groundwater Surface Water Model (IGSM) was used to analyze a baseline condition defined as continued use of the Eastern San Joaquin County Groundwater Basin without any countywide integrated management or basin restoration measures. The baseline condition is referred to as the "unrestricted" mode where groundwater pumping continues without restrictions. The model was also used to evaluate potential alternatives and their effect on the groundwater overdraft issue.

Table A-1. Average Existing and Predicted Water Budgets Based on Geographic Analysis and Groundwater Modeling - Eastern San Joaquin County

Groundwater Flow Component	Estimated Current Value (1996-2000)	Estimated Future Values (2020-2030)
	Inflows	
Deep Percolation	542 taf	542 taf
Other Recharge	42 taf	42 taf
Lateral Inflow	112 taf	112 taf
Gain from streams	39 taf	39 taf
Total Inflows (taf)	735 taf	735 taf
	Outflows	
Agricultural Groundwater Pumping	837 taf	777 taf
Municipal Groundwater Pumping	60 taf	119 taf
Total Groundwater Pumping	897 taf*	896 taf
Discharge to Surface Water	35 taf	35 taf
Total Outflows (taf)	932 taf*	931 taf
Change in Storage/Deficit (taf)	-197 taf*	-198 taf

taf = thousand acre-feet

Note: Numbers adjusted from those presented in the Water Management Plan to correct mathematical errors are noted with an asterisk (*).

MARS REPORT

The IGSM model was also used in the MARS report to investigate the effectiveness of potential strategies for controlling the inflow of poor quality water along the western boundary of the City of Stockton and to estimate the recoverable yield in dry years from a wet-year-only recharge program. Model results indicated that approximately 16,200 acre-feet/year of water flows laterally from west of the San Joaquin River to the City of Stockton as a result of groundwater level decline from excessive pumping in the county. The calibrated model was used to evaluate future groundwater elevations at projected 2030 level of water demand and land use conditions.

Various recharge scenarios were run to determine the effectiveness of creating a high water table barrier to poor quality water inflow or to fill in the pumping depression so as to cause reversal of the flow gradient. The scenarios analyzed included: 1) 100 year of recharge in the City of Stockton, 2) 200 year recharge in the City of Stockton, 3) 50 year recharge along the western boundary of the City of Stockton, and 4) 300 year of recharge in the Stockton East Water District (SEWD). In each case, the recharge amount listed is the target amount, which is subject to shortages in dry or high groundwater years; therefore, the average recharge would be a lesser amount.

Table A-2. IGSM Model Results

Scenario	Recharge Area	Maximum Annual Recharge (taf)	Average Annual Recharge (taf)	Inflow from West
1	City of Stockton	100	84	Reduced from 13.5 taf/year to 1,160 af/year
2	City of Stockton	200	130	Net outflow of 1,700 af/year
3	Western Boundary	50	27	Reduced from 13.5 taf/year to 7.1 taf/year
4	SEWD	300	283	Reduced from 13.5 taf/year to 6.4 taf/year and reduced depression from 80 feet below mean sea level to 20 feet below the ground surface

(Montgomery Watson 1996)

Not all applied water was recharged due to high groundwater levels in certain years. Model results indicated that a recharge program spreading 100 taf/year over the City of Stockton (average annual recharge of 84 taf/year) would essentially eliminate the lateral inflow of poor quality water and recharge the groundwater levels. This analysis provided estimates of how much water is needed to prevent poor water quality intrusion and raise groundwater levels; however, it did not calculate the quantity of water to balance the groundwater budget.

APPENDIX B

Table B-1. Federal and State Regulatory Agency Coordination

Agency	Agency Contact	Permit Required	Why Permit is Required	Timing
Corps	Mike Jewell Nancy Haley	Section 404 Clean Water Act	Dredge or discharge into waters of the U.S including jurisdictional wetlands and vernal pools	Permit issued after receipt of: BO from USFWS and NOAA Fisheries 401 Water Quality Certification Section 106 NHPA Concurrence
		Section 10 Rivers and Harbors Act	Obstruction of a navigable waterway (the Mokelumne River is considered navigable from the mouth to Frandy Gage)	Processed concurrently with 404 permit
USEPA	Kathleen Dady	Part of Section 404 Clean Water Act action	Clean Water Act Oversight – Review/Veto Power over Corps decision to grant permit	Generally comments once Corps releases public notice of project
USFWS – Endangered Species	Jan Knight Susan Jones Adam Zirrenen	Endangered Species Section 7	Adverse effects to federally listed species	BO – (Includes Incidental Take Permit) Provided for final EIS/EIR Final BO required prior to 404 permit
USFWS – Ecological Services	Mark Littlefield	Fish and Wildlife Conservation Act Compliance	Required to ensure conservation of fish and wildlife resources by preventing loss or damage and developing or improving the resources	Coordination occurs parallel with project planning, design, and construction Coordination Act Report included in final document
NOAA Fisheries	Mike Aceituno Madeline Martinez	Endangered Species Section 7 and EFH Determination	Adverse effects to federally listed species or fisheries habitat	BO – (Includes Incidental Take Permit) Provided for Final EIS/EIR Final BO required prior to 404 permit

Agency	Agency Contact	Permit Required	Why Permit is Required	Timing
CDFG	Rosie Bjornsen	1601 Streambed Alteration Agreement	Modifications to the stream channel/bed	Initiate processing with draft document
CDFG	Terry Roscoe	Section 2080.1 State Endangered Species	Adverse effects to State listed species or fisheries habitat	Initiate processing with draft document. Consistency with BO from NOAA Fisheries and USFWS required Consistency Determination Granted Incidental Take Permit Granted
RWQCB	Pat Gillum	401 Water Quality Certification	Water quality reduced to levels violating State water quality standards	Initiate processing with draft document Required prior to 404 permit
SHPO	Knox Mellon	Section 106 of the NHPA	Adverse effects to cultural resources within project area	Initiate with draft document MOA or concurrence with finding of no effect
State Reclamation Board	Steve Bradley	Encroachment Permit	Any adverse effect to designated flood control structures or floodways	Initiate with draft EIS/EIR document
U.S. Coast Guard	Jerry Olmes	Section 10 Rivers and Harbors Act	Obstruction of a navigable waterway (the Mokelumne River is considered navigable from the mouth to Frandy Gage)	Initiate with draft EIS/EIR document
State Lands	Unknown at this time	State Lands Commission Lease	Any adverse effect to land under sovereign ownership by the State of California (includes beds of rivers and streams)	Initiate with draft EIS/EIR document
SWRCB	Unknown at this time	Waste Discharge, NPDES, Water Reclamation Permit	Primary responsibility for the protection of water quality	Initiate with draft EIS/EIR document

APPENDIX C

Table C-1. Regulatory Partnering Meeting July 10, 2003 Meeting Attendees

Name	Company/Agency
Nancy Haley	Corps
Erin Foresman	USEPA
Mike Jewell	Corps
Shelly Hatleberg	HDR
Larry Butcher	USFWS
Tanya Hong Moreno	San Joaquin County
Sue Fry	HDR
Mel Lytle	San Joaquin County
Erin Strange	NOAA Fisheries
Cori Nagasawa	Corps
Ron Milligan	Reclamation
Camille Remy	HDR

Table C-2. Stakeholder Outreach Participants

Date	Company Organization	Name
07/11/03	▪ Alpine County Board of Supervisors ▪ San Joaquin County Board of Supervisors ▪ Amador Water Agency ▪ EBMUD ▪ Calaveras County Water District ▪ Calaveras Public Utility District ▪ Central Sierra R C & D Area Council ▪ Sierra Pacific Industries ▪ Calaveras County Board of Supervisors ▪ PG&E ▪ Amador County Board of Supervisors ▪ Jackson Valley Irrigation District ▪ City of Lodi ▪ Stockton East Water District ▪ U.S. Bureau of Land Management ▪ Mountain Counties Water Resources Association ▪ U.S. Forest Service ▪ NSJWCD ▪ WID	
07/15/03	▪ CCWD	Lisa Holm Jeff Quimby

Date	Company Organization	Name
07/21/03	▪ EBMUD	John Lampe Gary Darling John Skinner Lena Tam Mike Tognolini Gerald Schwartz
07/24/03	▪ State Water Contractors	Terry Erliwine David Schuster David Fullerton James Roberts Nancy Quan
07/25/03	▪ CALFED	Dave Robinson
07/25/03	▪ USBR	Julie Carpenter Nate Wales
07/25/03	▪ DWR	Jeremy Arrich Steve Chipperman Waiman Yip Eric Hong Sean Sou Steve Roberts

APPENDIX D

Table D-1. Potentially Occurring Proposed Species, Candidate Species and Species of Concern

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
INVERTEBRATES				
Vernal pool fairy shrimp	*Branchinecta lynchi*	Threatened	None	Vernal pool habitats
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Threatened	None	Obligate species associated with valley elderberry plants (Sambuca mexicana)
Vernal pool tadpole shrimp	*Lepidurus packardi*	Endangered	None	Vernal pool habitats
FISH				
Delta smelt	*Hypomesus transpacificus*	Threatened	Threatened	Found in the lower reaches of the Sacramento River below Isleton, the San Joaquin River below Mossdale, through the Delta and into Suisun Bay; occur in open surface waters and shoal areas; ideal spawning areas are those with moderate to fast flows (including tidal action) and thriving aquatic vegetation.
Central Valley steelhead	*Oncorhynchus mykiss*	Threatened	Threatened	Reproducing runs of steelhead in the Central Valley restricted to the Sacramento River and accessible tributaries; require cool, deep pools for holding through the summer, prior to spawning in the winter. Generally found in shallow areas, with cobble or boulder bottoms at the tails of pools.

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
Central Valley spring-run chinook salmon	*Oncorhynchus tshawytscha*	Threatened	Threatened	Adults reportedly enter the Sacramento River during the period late March - July, with peak abundance in the Delta and lower Sacramento River April - June; spawning occurs primarily upstream of Red Bluff Diversion Dam and in several upper Sacramento River tributaries (e.g., Mill, Deer, and Butte Creeks).
Winter-run chinook salmon	*Oncorhynchus tshawytscha*	Endangered	Endangered	Adults spend 1-3 years in the ocean. Immigration through the Delta and into the lower Sacramento River occurs December - July; adults primarily spawn in the mainstem Sacramento River between Keswick Dam and Red Bluff Diversion Dam between late-April and mid-August.
AMPHIBIANS				
California red-legged frog	*Rana aurora draytonii*	Threatened	None	Prefers permanent water source with extensive vegetation. Requires 11-20 weeks of permanent water for larval development.
REPTILES				
Giant garter snake	*Thamnophis gigas*	Threatened	Threatened	Found in Central Valley wetlands; inhabits marshes, sloughs, ponds, small lakes, low gradient streams, other waterways and agricultural wetlands such as irrigation and drainage canals and rice fields, and the adjacent uplands.

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
BIRDS				
Swainson's hawk	*Buteo swainsoni*	None	Threatened	Foraging habitat consists of relatively open stands of grass-dominated vegetation, sparse shrublands, and even croplands; migrate long distances and tend to nest almost exclusively in large, sparsely vegetated flatlands characterized by valleys, plateaus, broad floodplains, and large expanses of desert.
Greater sandhill crane	*Grus Canadensis tabida*	None	Threatened	Breeding habitat in wetlands and foraging habitat consits of meadows, irrigated pastures, grain fields, bogs, fens, marshes and nearby fields.
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Endangered	Typically nests in large trees within short distance of rivers and lakes with abundant fish.
MAMMALS				
Riparian (San Joaquin Valley) woodrat	*Neotoma fuscipes riparia*	Endangered	None	The only subspecies found in the Central Valley, it is restricted to small remnant patches of riparian forest along the Stanislaus River.
Riparian brush rabbit	*Sylvilagus bachmani riparius*	Endangered	Endangered	Historically occurred in riparian forests along the San Joaquin and Stanislaus Rivers in Stanislaus and San Joaquin Counties. Today, the largest remaining fragment of habitat and only extant population are found along the Stanislaus River in Caswell Memorial State Park, San Joaquin County, California.

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
PLANTS				
Ione manzanita	*Arctostaphylos myrtifolia*	Threatened	None	Occur primarily on outcrops of the Ione Formation in Amador County. A few disjunct populations occur in Calaveras County. Populations range in elevation from 190 to 1,900 feet.
Succulent (=fleshy) owl's clover	*Castilleja campestris ssp. succulenta*	Threatened	None	Found only in vernal pools along the lower foothills and valleys of eastern San Joaquin Valley. Currently known from 36 sites in eastern Merced, southeastern Stanislaus, Madera, San Joaquin and northern Fresno Counties.
INVERTEBRATES				
Midvalley fairy shrimp	*Branchinecta mesovallensis*	Species of Concern	None	Vernal pool habitats
California linderiella fairy shrimp	*Linderiella occidentalis*	Species of Concern	None	Vernal pool habitats
FISH				
Green sturgeon	*Acipenser medirostris*	Candidate	None	Occur in the Sacramento and Feather Rivers and San Francisco Estuary (and potentially in the San Joaquin River).
River lamprey	*Lampetra ayresi*	Species of Concern	None	Occur in the lower Sacramento and San Joaquin Rivers, especially the Stanislaus and Tuolumne Rivers, and the Delta.
Kern brook lamprey	*Lampreta hubbsi*	Species of Concern	None	Endemic to the east side of the San Joaquin Valley (found in the lower Merced, Kaweah, Kings, and San Joaquin Rivers).
Pacific lamprey	*Lampreta tridentate*	Species of Concern	None	Occur in the Sacramento and San Joaquin Rivers but cannot move upstream of Friant Dam.

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
Central Valley fall/late fall run chinook salmon	*Oncorhynchus tshawytscha*	Candidate	None	Upstream-migrating adults enter the Sacramento River August - December and spawn October - January.
Longfin smelt	*Spirinchus thaleichthys*	Species of Concern	None	Occur in San Francisco Estuary and are rarely found upstream of Rio Vista or Medford Island in the Delta.
AMPHIBIANS				
California tiger salamander	*Ambystoma californiense*	Proposed Threatened	None	Need underground refuges, especially ground squirrel burrows and vernal pools or other seasonal water sources for breeding.
Foothill yellow-legged frog	*Rana boylii*	Species of Concern	None	Inhabits partly shaded shallow streams with cobble substrate, occurs in foothills surrounding the Central Valley.
Western spadefoot toad	*Spea hammondii*	Species of Concern	None	Inhabits grasslands with vernal pools, which are essential for breeding and egg-laying.
REPTILES				
Silvery legless lizard	*Anniella pulchra pulchra*	Species of Concern	None	Inhabits sandy or loose soils and deep leaf litter.
Northwestern pond turtle	*Clemmys marmorata marmorata*	Species of Concern	None	Requires basking sites (partially submerged logs, vegetation mats, or open mud banks) near slow moving water, lakes or ponds.
Southwestern pond turtle	*Clemmys marmorata pallida*	Species of Concern	None	See Northwestern pond turtle.
California horned lizard	*Phrynosoma coronatum frontale*	Species of Concern	None	Inhabits sandy washes, floodplains and windblown deposits; forages in open areas between shrubs.
BIRDS				
Tricolored blackbird	*Agelaius tricolor*	Species of Concern	None	Breeds in freshwater marshes, croplands, often near or over water. Resident species.

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
Bell’s sage sparrow	*Amphispiza belli belli*	Species of Concern	None	Found in “hard” chaparral habitats dominated by dense stands of chamise.
Western burrowing owl	*Athene cunicularia hypugaea*	Species of Concern	None	Subterranean nester, dependent upon burrowing mammals, most notably the California ground squirrel.
Oak titmouse	*Baeolophus inornatus*	Species of Local Concern	None	Fairly common in mixed oak woodlands in California.
Aleutian Canada goose	*Branta Canadensis leucopareia*	Delisted	None	Uses pastures and grain fields in California's Central Valley during winter migration.
Ferruginous hawk	*Buteo regalis*	Species of Concern	None	Occur in semiarid grasslands with scattered trees, rocky mounds or outcrops, and shallow canyons that overlook open valleys. They may occur along streams or in agricultural areas in migration.
Costa’s hummingbird	*Calypte costae*	Species of Concern	None	Commonly found in the far west region of the US and Mexico with a northern limit of central California. Typically found in desert habitats.
Lawrence’s goldfinch	*Carduelis lawrencei*	Species of Concern	None	Breeds in a variety of habitats ranging from pinyon-juniper to arid oak woodlands with available water nearby.
Vaux’s swift	*Chaetura vauxi*	Species of Concern	None	Fairly rare in the Sierra; nests in natural tree cavities in coniferous and mixed oak-coniferous forests.
Mountain plover	*Charadrius montanus*	Proposed Threatened	None	Winter in California, principally in the San Joaquin Valley, in grassland habitats.
White-tailed (=black shouldered) kite	*Elanus leucurus*	Species of Concern	None	Breeds in savannas, riparian woodlands, grassy foothills.

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
Little willow flycatcher	*Empidonax traillii brewsteri*	None	None	Requires dense willow thickets for nesting/roosting; low, exposed branches are used for singing posts/hunting perches.
American peregrine falcon	*Falco peregrinus anatum*	Delisted	None	Nests on high, usually isolated cliffs, usually near water.
Loggerhead shrike	*Lanius ludovicianus*	Species of Concern	None	Inhabits areas of open country especially meadows, pastures, thickets and hedges. Breeding habitat consits of open fields and woodlands with scattered trees.
Lewis' woodpecker	*Melanerpes lewis*	Species of Concern	None	Breeding habitat can be found in a number of different types of habitats that have an open canopy, a brushy understory offering ground cover and abundant insects, dead or downed woody material, available perches and lots of insects.
Long-billed curlew	*Numenius americanus*	Species of Concern	None	Inhabits tidal flats and other coastal habitats and on inland grassland and agricultural habitats including the Central Valley of California. Breeding habitat consists of short-grass communities, preferring native prairies and grazed mixed grass communities and scrub prairie.
Nuttall's woodpecker	*Picoides nuttallii*	Species of Local Concern	None	Inhabits oak woodlands, deciduous trees alongside streams in arid areas and in oak scrublands and chaparral.
White-faced ibis	*Plegadis chihi*	Species of Concern	None	Found in freshwater marshes, rice fields, ponds, river and swamps.

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
Rufous hummingbird	*Selasphorus rufus*	Species of Concern	None	Inhabits mountain meadows, and forest edges. When migrating or wintering, frequents gardens with hummingbird feeding stations.
California thrasher	*Toxostoma redivivum*	Species of Concern	None	Inhabits chaparral and dense shrubs around foothills.
MAMMALS				
Pacific western big-eared bat	*Corynorhinus (=Plecotus) townsendii townsendii*	Species of Concern	None	Found primarily in rural areas in a variety of habitats, including oak woodlands in California's inner Coast Range and Sierra Nevada foothills; associated with caves and abandoned mines.
Merced kangaroo rat	*Dipodomys heermanni dixoni*	Species of Concern	None	Occurs in grassland and shrub habitats in eastern Merced County.
Spotted bat	*Euderma maculatum*	Species of Concern	None	Closely associated with rocky cliffs in a variety of habitats.
Greater western mastiff bat	*Eumops perotis californicus*	Species of Concern	None	Found in a variety of habitats up to 8,000-foot elevation; distribution linked to presence of significant rock features for roosting.
Small-footed myotis bat	*Myotis ciliolabrum*	Species of Concern	None	Roosts in mines and trees in a variety of habitats below 6,000-foot elevation.
Long-legged myotis bat	*Myotis volans*	Species of Concern	None	Found in pinyon-juniper, Joshua tree woodland, and montane coniferous forests; day-roosts in hollow trees, also uses rock crevasses, mines and buildings.
Yuma myotis bat	*Myotis yumanensis*	Species of Concern	None	Found throughout California at lower to mid-elevations in a variety of habitats.

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
Long-eared myotis bat	*Myotis evotis*	Species of Concern	None	Associated with mixed hardwood/coniferous forest and montane coniferous forest.
Fringed myotis bat	*Myotis thysanodes*	Species of Concern	None	Found from coast range to at least 6,400-foot elevation in the Sierra. Year-round resident. Roost sites include mines, caves, old buildings, and trees. Widely distributed, but rare.
San Joaquin pocket mouse	*Perognathus inornatus*	Species of Concern	None	Needs friable soils.
PLANTS				
Henderson's bent grass	*Agrostis hendersonii*	Species of Concern	None	Occurs around the margins of vernal pools and in thin soils in mesic grassland. Known from the northern Sacramento Valley and from two disjunct locations in the San Joaquin Valley.
Hoover's calycadenia	*Calycadenia hooveri*	Species of Local Concern	None	Plant grows in rocky, exposed places below 300 meters in northern and central Sierra Nevada Foothills.
Tuolumne coyote thistle (=button celery)	*Eryngium pinnatisectum*	Species of Concern	None	Occurs in riparian scrub and vernally mesic clay depressions.
Delta coyote thistle	*Eryngium racemosum*	None	Proposed	Plant grows in seasonally flooded clay depressions in riparian scrub in northern San Joaquin Valley and in nearby areas of Sierra Nevada foothills.
Parry's horkelia	*Horkelia parryi*	Species of Local Concern	None	Plant grows in open chaparral between 240 and 2700-foot elevation in north and central Sierra Nevada foothills. It is mostly found on the Ione Formation.

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
Ahart's (dwarf) rush	*Juncus leiospermus var. ahartii*	Species of Concern	None	Endemic to Northern California in Butte, Calaveras, Placer, Sacramento, and Yuba Counties. Occurs on vernal pool margins and mesic valley and foothill grassland areas at elevations between 90 and 300 feet.
Pincushion navarretia	*Navarretia myersii ssp. Myersii*	Species of Concern	None	Occurs in vernal pools.
Sanford's arrowhead	*Sagittaria sanfordii*	Species of Concern	None	Occurs in shallow, standing, fresh water and sluggish waterways within marshes, swamps, ponds, vernal pools and lakes, reservoirs, sloughs, ditches, canals, streams and rivers at elevations between 10 to 2,000 feet.

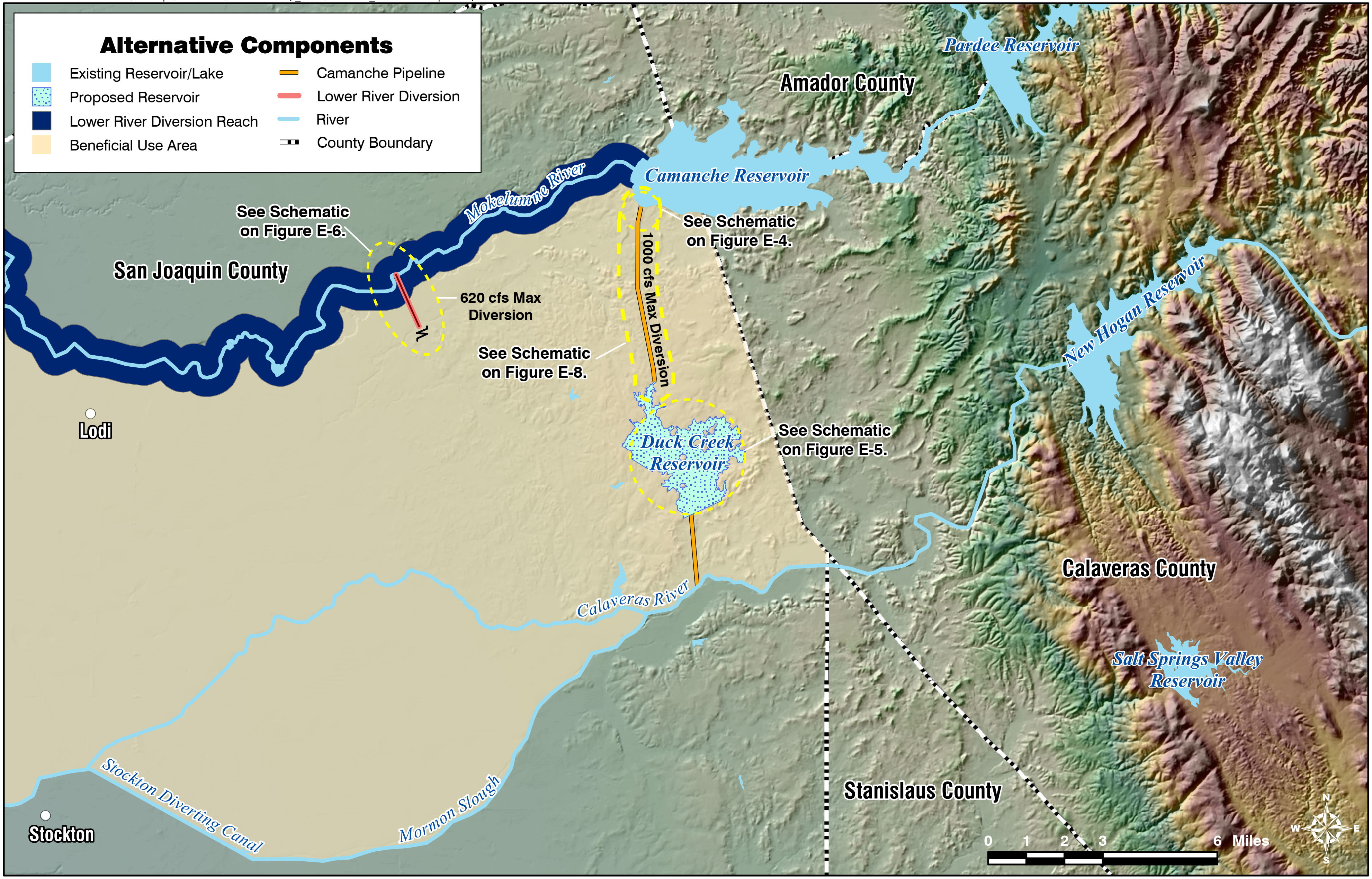
Table D-2. Potentially Occurring Species with Critical Habitat Proposed or Designated

Common Name	Scientific Name	Federal Status	State Status	General Habitat Description
INVERTEBRATES				
Vernal pool invertebrates		Proposed Critical Habitat	None	Occur in vernal pool habitats
FISH				
Delta smelt	Hypomesus transpacificus	Threatened	Threatened	Found in the lower reaches of the Sacramento River below Isleton, the San Joaquin River below Mossdale, through the Delta and into Suisun Bay; occur in open surface waters and shoal areas; ideal spawning areas are those with moderate to fast flows (including tidal action) and thriving aquatic vegetation.
PLANTS				
Vernal pool plants		Proposed Critical Habitat	None	Occur in vernal pool habitats

APPENDIX E

Preliminary Engineering Layouts for Alternatives Carried Forward for Further Consideration in the MORE Water Feasibility Analysis.

Source: Base from USGS NED, 1999 | \\hdr-m3647\3322Mokel\Map_Docs\camanche_diversion.mxd | Last Updated : 6-1-04

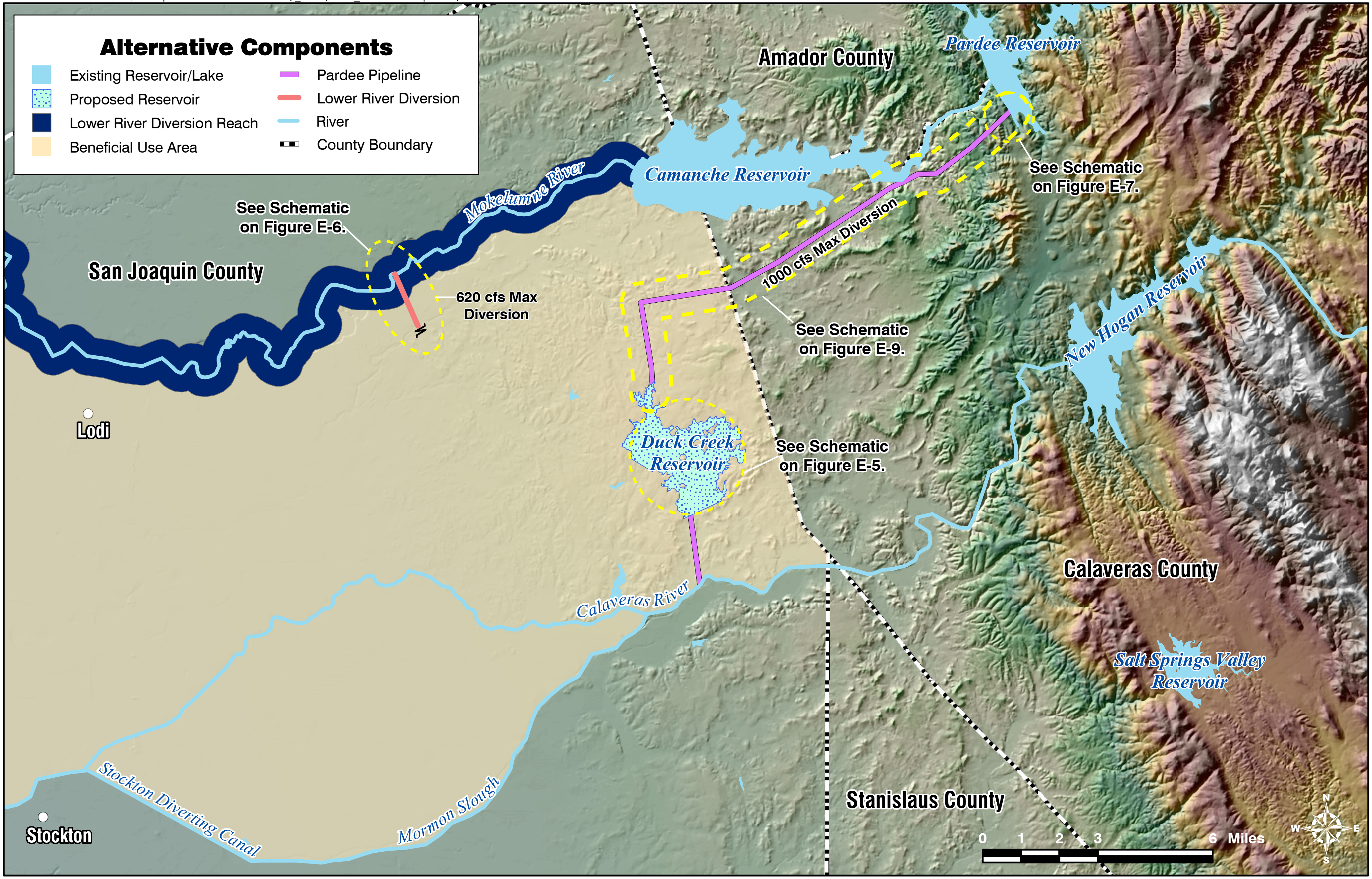


Duck Creek Dam & Reservoir Construction - Camanche Reservoir Diversion

FIGURE E-1.

HDR ONE COMPANY | Many Solutions℠

Source: Base from USGS NED, 1999 | \\hdr-m3647\3322Mokel\Map_Docs\pardee_diversion.mxd | Last Updated : 6-1-04



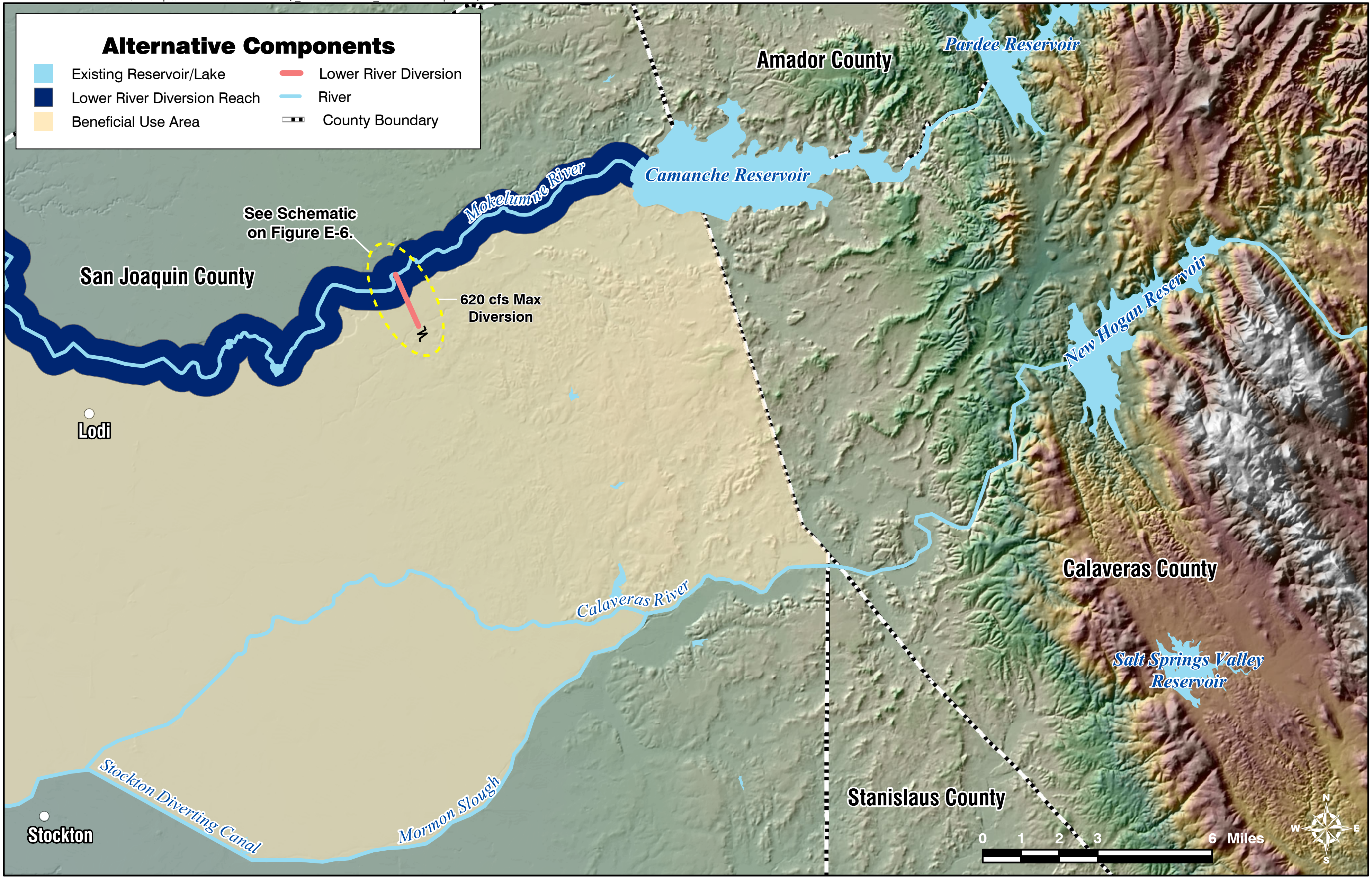
Duck Creek Dam & Reservoir Construction - Pardee Reservoir Diversion

FIGURE E-2.

HDR ONE COMPANY | Many Solutions℠

MORE WATER Project | Phase 1 Reconnaissance Study

Source: Base from USGS NED, 1999 | \\hdr-m3647\3322Mokel\Map_Docs\LowerRiver_Diversion.mxd | Last Updated : 6-1-04

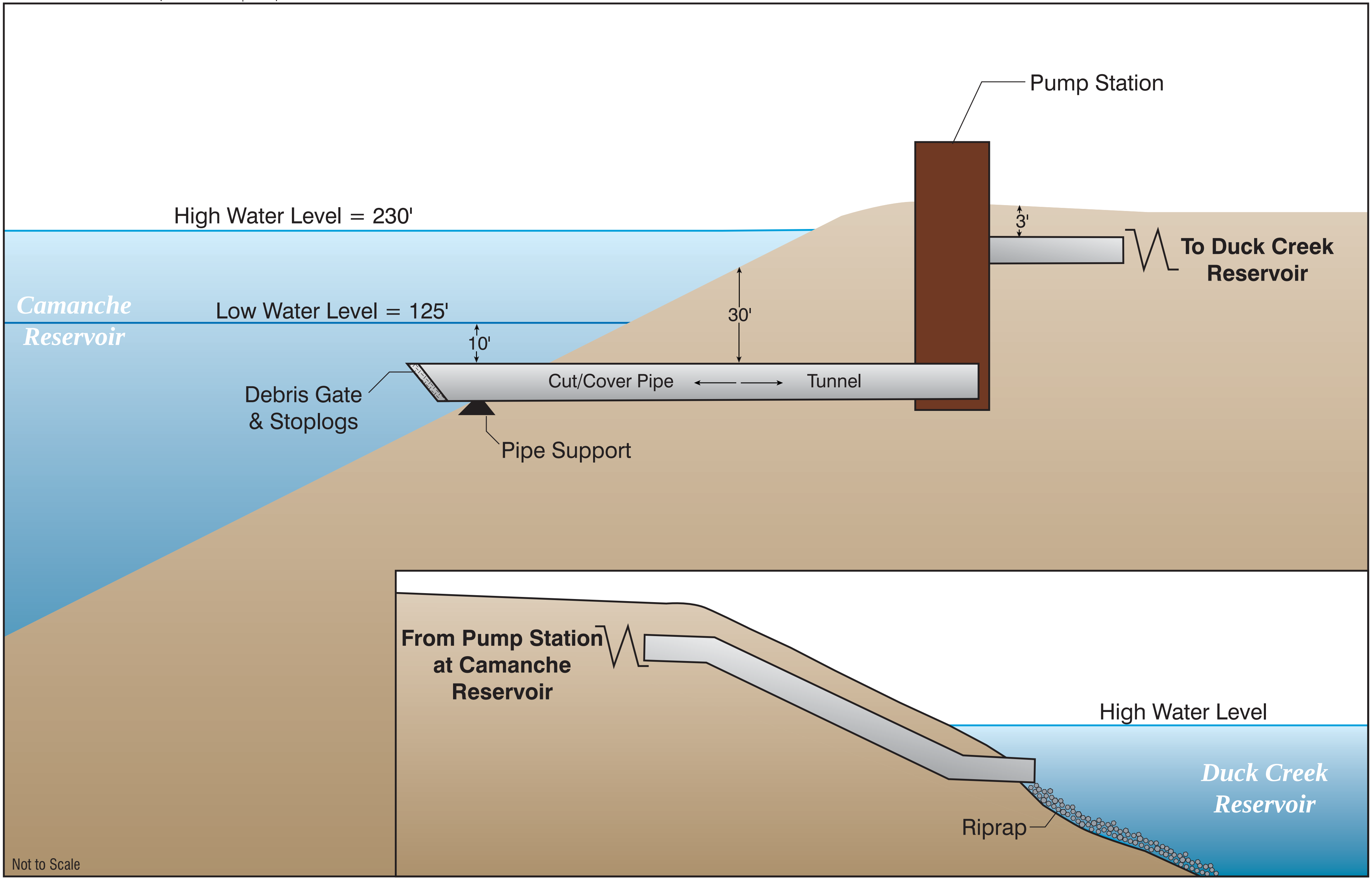


Lower Mokelumne River Diversion

FIGURE E-3.

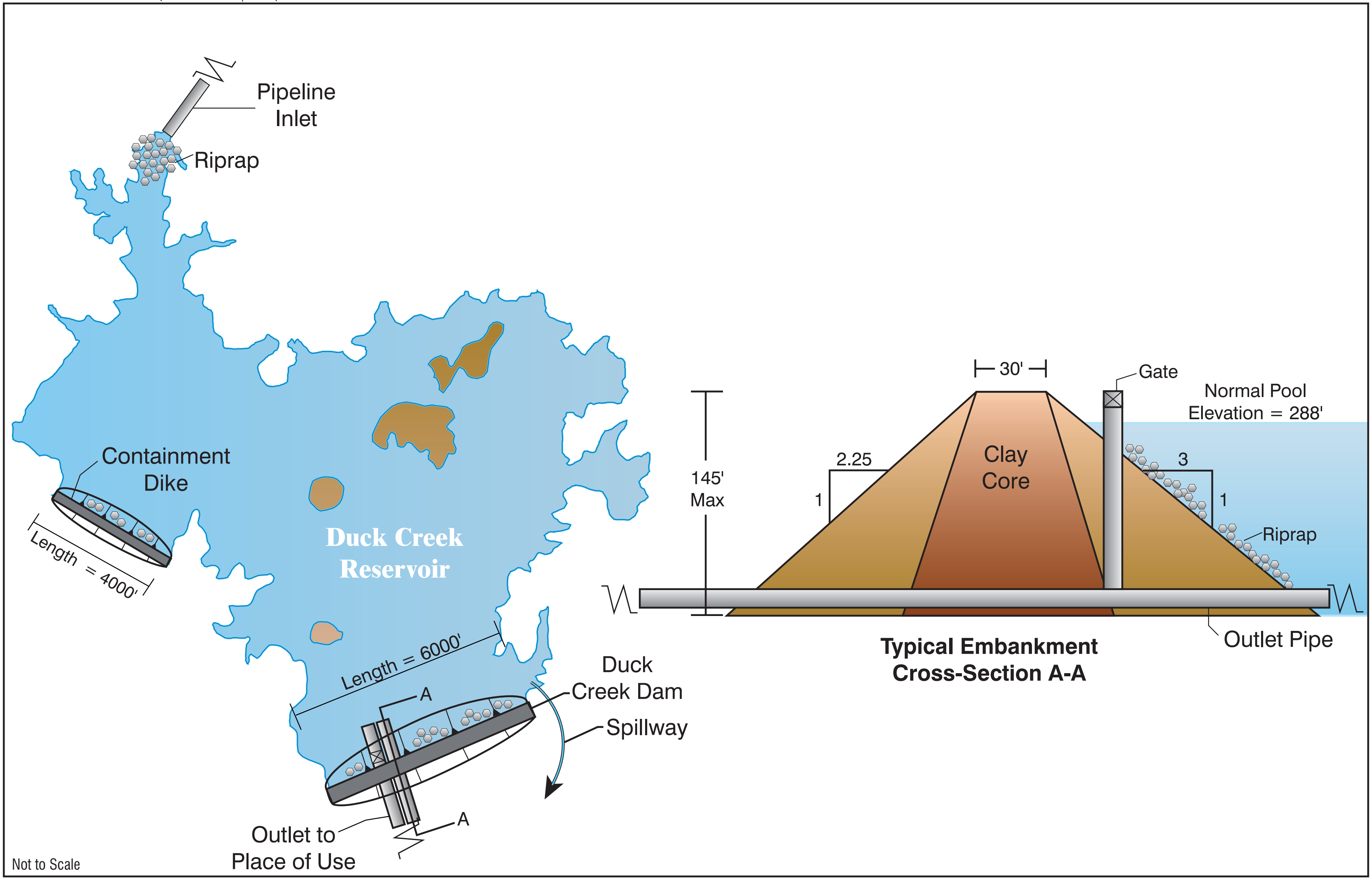
MORE WATER Project | Phase 1 Reconnaissance Study

HDR ONE COMPANY | Many Solutions℠



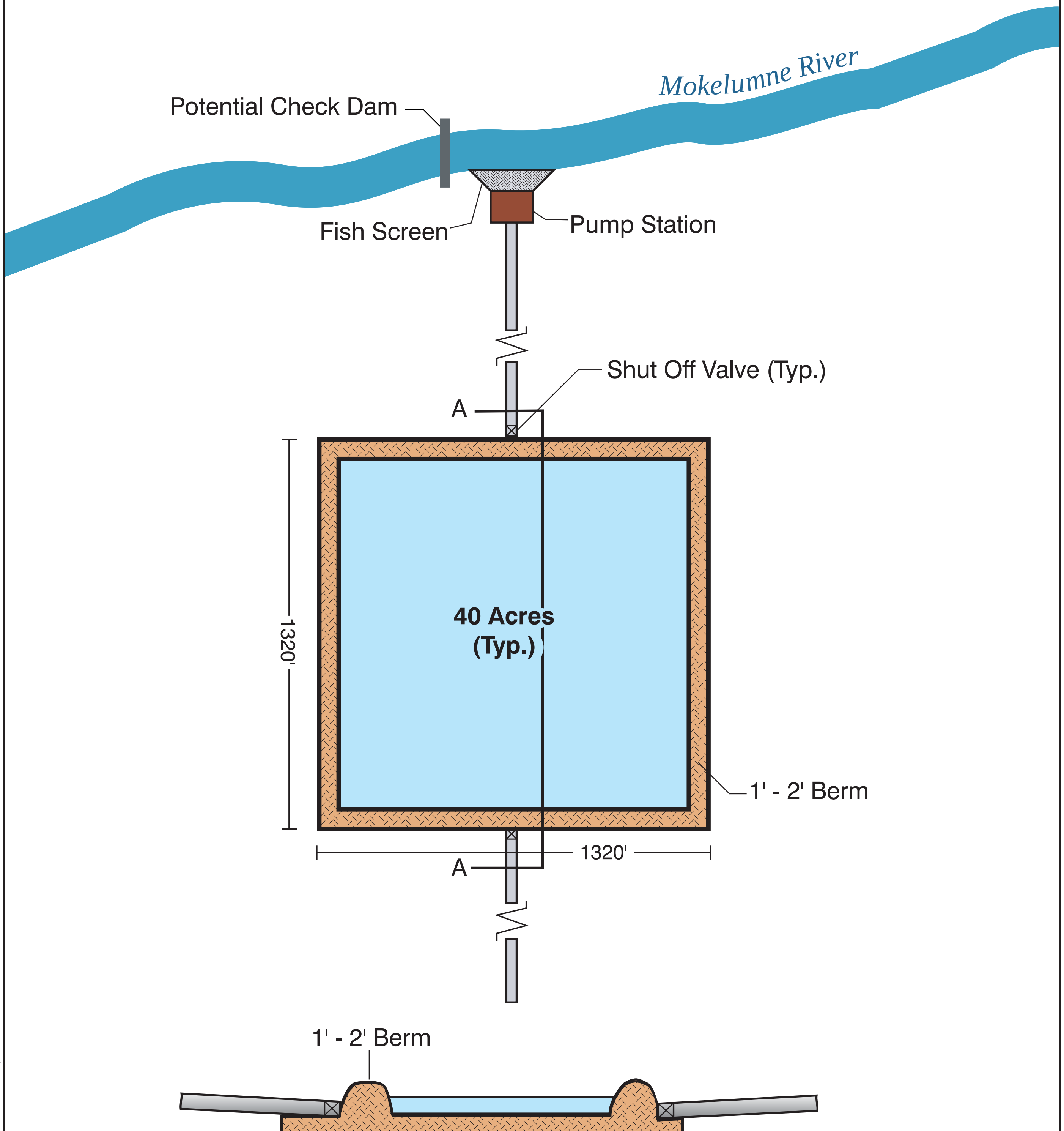
Diversion at Camanche Reservoir

FIGURE E-4.



Duck Creek Dam & Reservoir

FIGURE E-5.



Cross-Section A-A

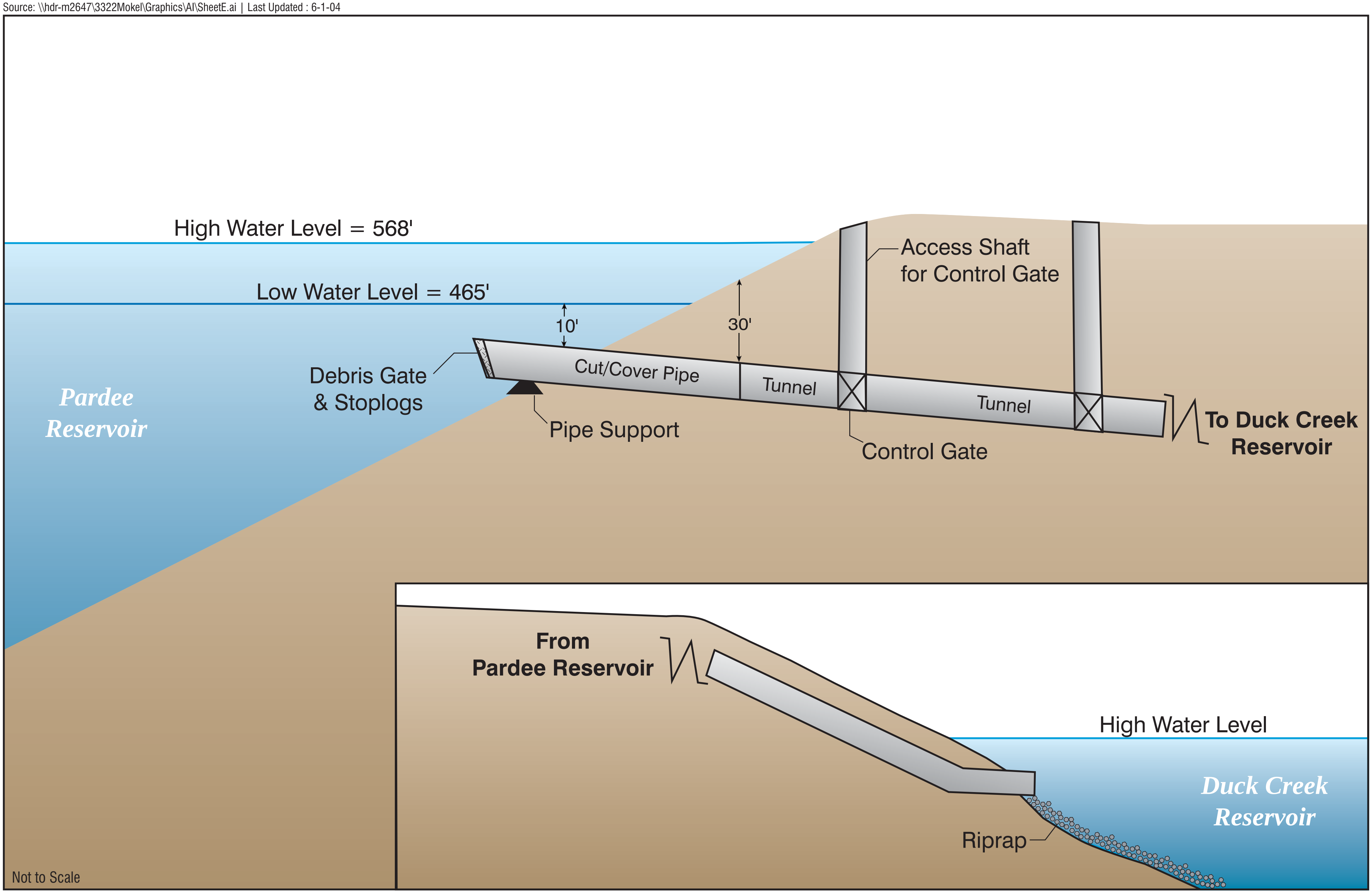
Note: Diversion facility shown used for cost estimating purposes only, other facilities could be investigated in further future analyses.

Source: \\hdr-m2647\3322Mokel\Graphics\AI\SheetC.ai | Last Updated : 6-1-04

Lower Mokelumne River Diversion Facility Schematic

FIGURE E-6.

Source: \\hdr-m2647\3322Mokel\Graphics\AI\SheetE.ai | Last Updated : 6-1-04



Diversion at Pardee Reservoir

FIGURE E-7.

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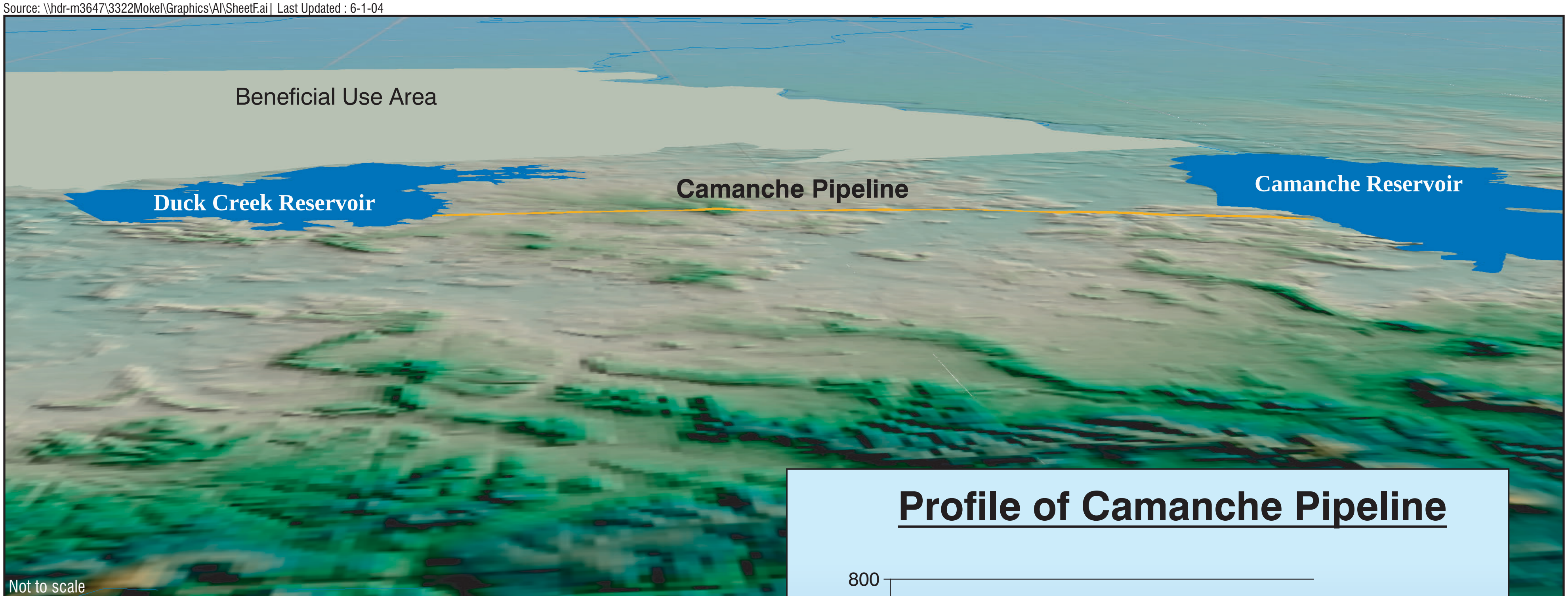

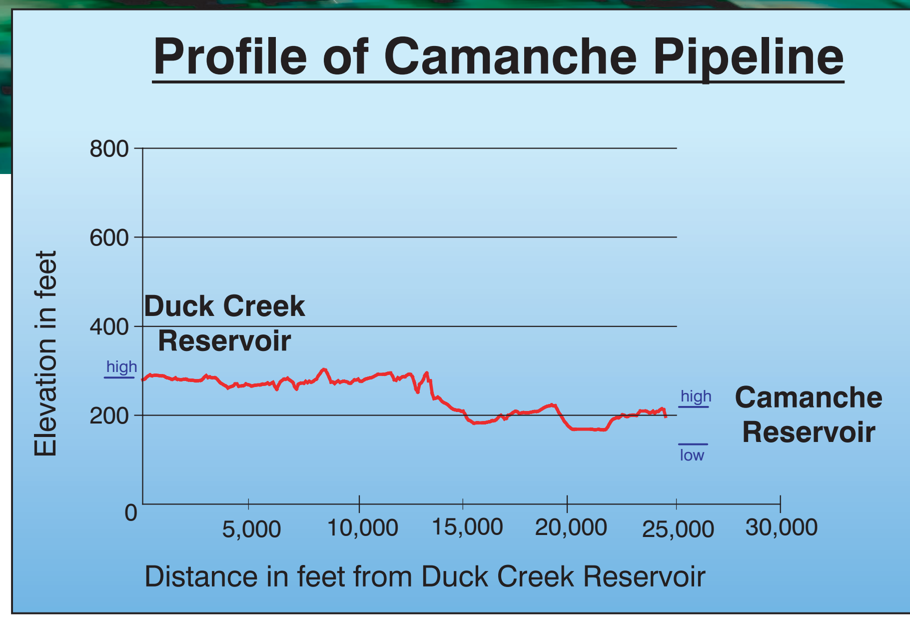

3D Perspective of Camanche Pipeline

FIGURE E-8.

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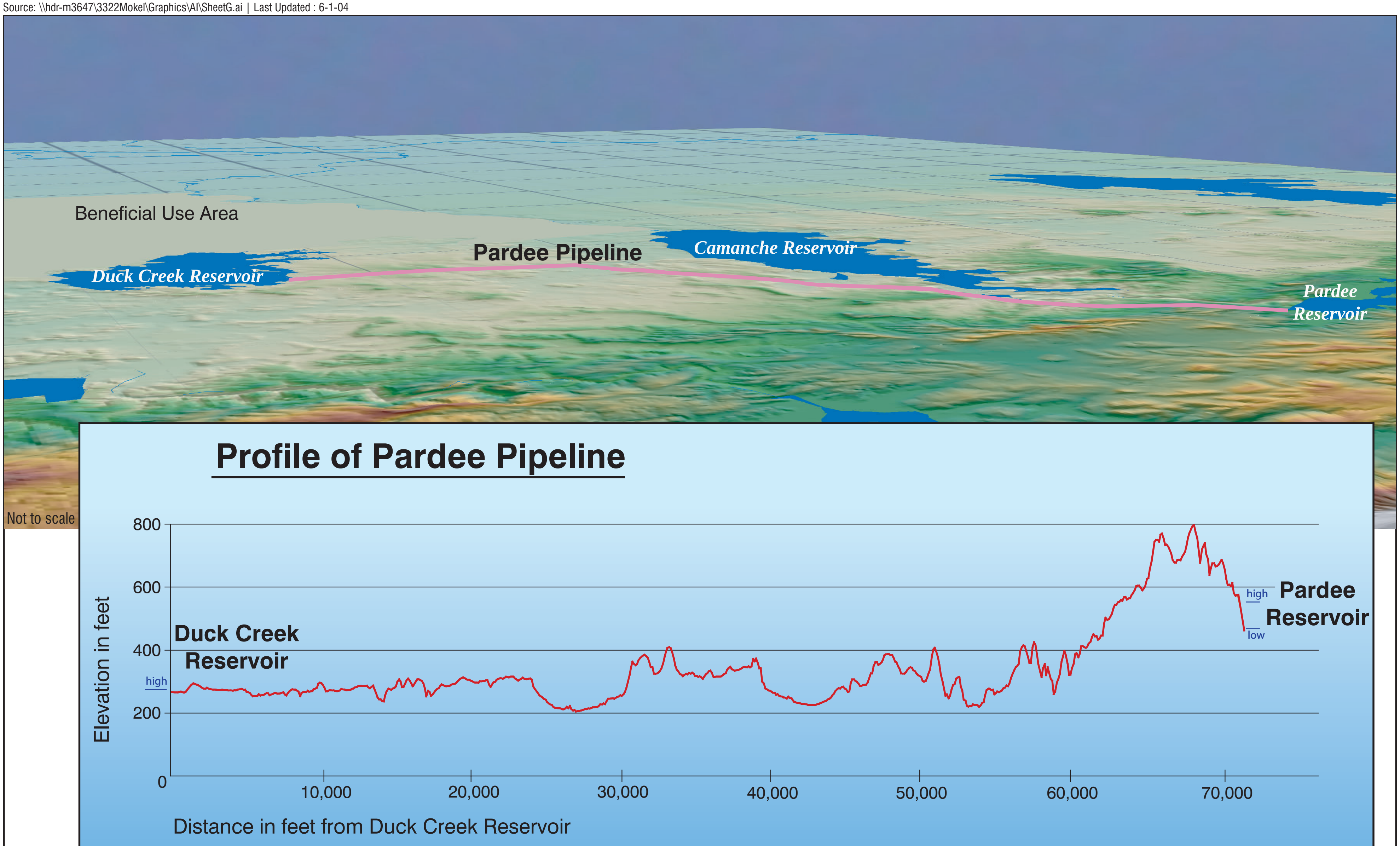


3D Perspective of Pardee Pipeline

FIGURE E-9.

APPENDIX F

PRELIMINARY OPERATION STUDY OF ALTERNATIVES CARRIED FORWARD

Figure F-1. Flow Duration Curve - Mokelumne Hill Gage

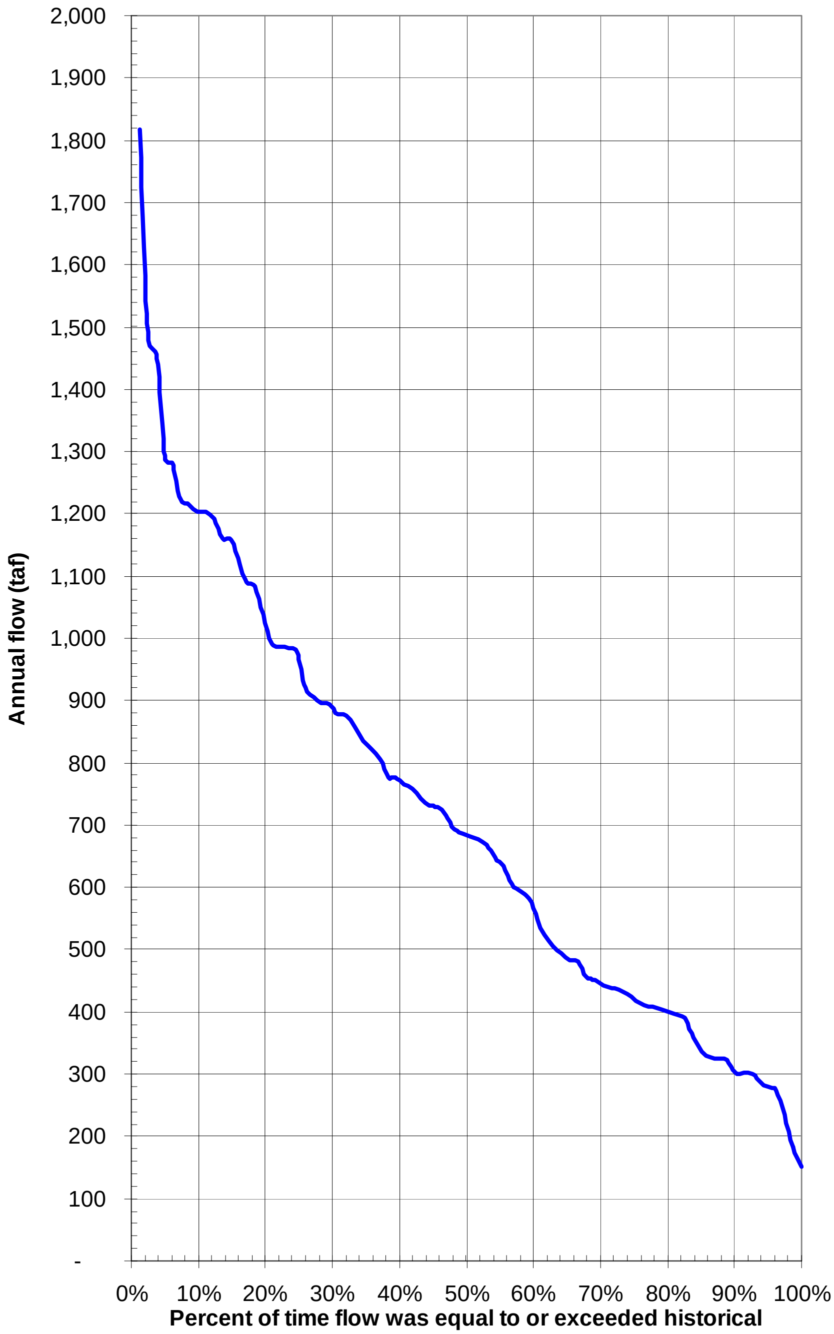


Figure F-2. Channel Losses on the Lower Mokelumne River as function of Camanche Reservoir Release

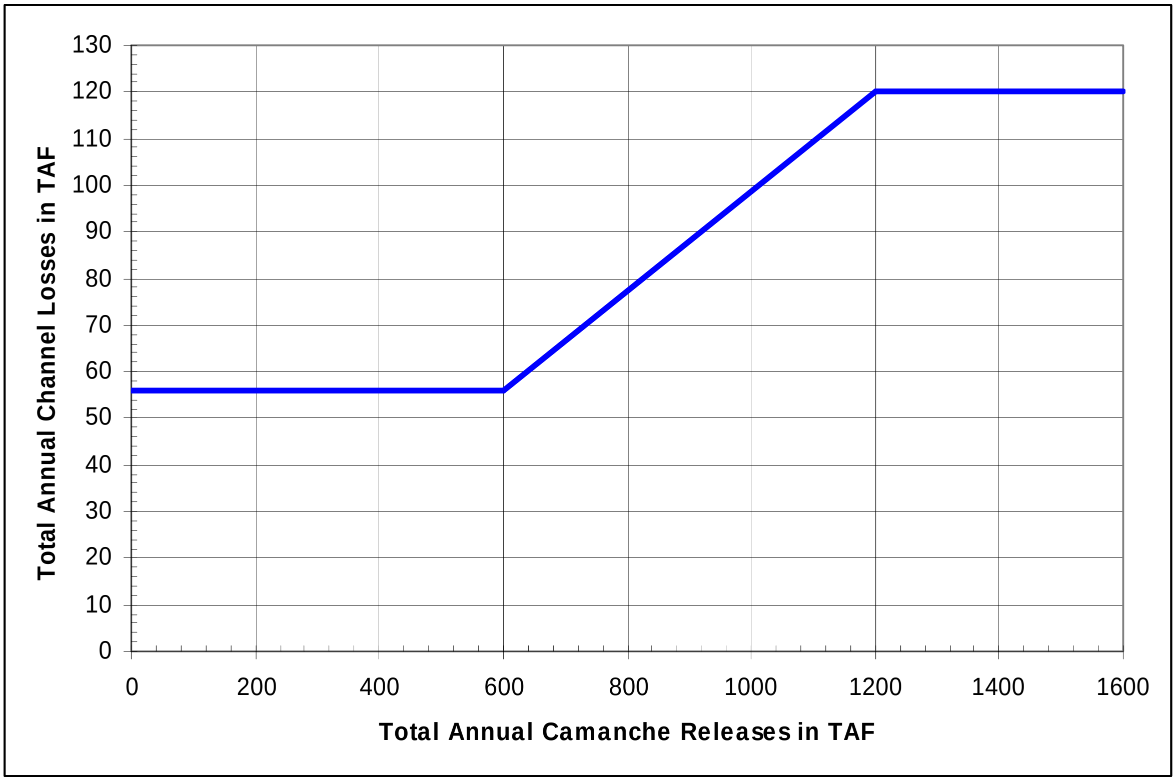


Table F-1. Fish Release Requirements in CFS

Year Type	Requirements (cfs)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual (taf)
Normal	Minimum Camanche Reservoir Release	325	325	325	325	325	325	325	325	325	100	100	100	194
Below Normal		250	250	250	250	250	250	250	250	250	100	100	100	154
Dry		220	220	220	220	220	220	220	220	100	100	100	100	130
Critical		115	130	130	130	130	130	130	100	100	100	100	100	80
Normal	Expected Flow below Woodbridge Diversion Dam	100	100	100	100	100	100	150	300	300	25	25	25	86
Below Normal		100	100	100	100	100	100	150	200	200	20	20	20	73
Dry		80	80	80	80	80	80	150	150	20	20	20	20	52

Methodology

The MORE Model performs mass balance calculations for the Mokelumne River and East Bay systems on a monthly time step basis, given the following information: the available unappropriated flow, the window period for direct diversion and diversion to storage per the Authority's water right applications, the storage capacity of the reservoir (i.e., Duck Creek Reservoir), the estimated evaporation from the reservoir, and the capacity of the discharge facilities to the area of beneficial use.

The model can be run in three modes:

1. Regular Mode: In this mode the model is diverting the water to Duck Creek Reservoir given the diversion window period and not-to-exceed diversion rates, and is discharging the water to the area of beneficial use at a specified rate. This type of operation may cause the reservoir to spill whenever the reservoir is full and the diversion rate exceeds the demand. In this case, the diversion rate is reduced by the spill amount and the remaining flood flow in the Mokelumne River is adjusted accordingly (the remaining flood flow can be diverted downstream of Camanche if this option is activated - see Mode 3).
2. No-spill Mode: In this mode, the model iterates on the demand rate and converges on the solution of what is the maximum demand rate needed in order to prevent the reservoir from spilling (during the entire simulation period). As in Mode 1, this type of operation can be combined with Mode 3.
3. Direct Diversion Mode: In this mode the available unappropriated water is diverted directly to the area of beneficial use during a specified period and rates. The diversion points could vary anywhere in the system. In this study, it was assumed that the diversion point is on the lower Mokelumne River. When this mode of operation is activated with Mode 1 or 2 above, the model assumes that diversion to storage takes precedence over direct diversion.

As discussed earlier, the diversion to Duck Creek could take place from either Pardee or Camanche Reservoirs. From a mass balance point of view, there is no difference between these alternatives as far as the availability of unappropriated flows water is concerned. However, one aspect that needs to be taken into consideration is the potential impact of the diversions on the power generation at Pardee and Camanche powerplants. In order to assess this impact, the model simulates two types of input datasets provided by EBMUD:

1. Available Flow **With Hydropower Impact**, and,
2. Available Flow **Without Hydropower Impact**.

The dataset associated with the With Hydropower Impact is essentially the total flood control released from Camanche Reservoir, as calculated by EBMUDSIM. When using this dataset, the model will divert water to the project or alternative assuming there are no hydro constraints.

The dataset associated with the Without Hydropower Impact reflects the portion of the flood control released from Camanche Reservoir in excess of the powerplants maximum capacities. In other words, when using this dataset the model will divert to the project only the water that has no impact on EBMUD hydro generation.

The difference in the results between these two simulations is the potential impact on EBMUD's hydro generation. This impact may differ depending if the diversion to Duck Creek Reservoir is from Pardee or Camanche Reservoirs. If the water is diverted from Pardee Reservoir it will cause hydro losses at both powerplants, if the water is diverted from Camanche Reservoir it will cause hydro losses at the Camanche powerplant only.

Hydro losses are quantified in the model in terms of the reduced yield in acre-feet and loss of power generation to EBMUD in kilowatt-hours.

Finally, it should be noted that floods, especially due to rainstorm events, usually occur over a short duration – hours or days. Therefore, a model with resolution higher than monthly time steps may be needed to better assess the actual quantity of water that could be diverted for beneficial use by the County.

Assumptions

The following are the assumptions used in the operations study:

- The available unappropriated water is based on EBMUDSIM modeling for the period water year 1921-1995.
- The diversions window and rates are shown in Table 8-4, Section 8.
- Level of development is current conditions
- EBMUD demand is 220 mgd.
- Water can be diverted to Duck Creek Reservoir from either Pardee or Camanche Reservoirs.
- Pardee powerplant flow at full capacity is 1,100 cfs.
- Camanche powerplant flow at full capacity is 1,200 cfs.
- Pardee powerplant production rate is approximately 0.28 megawatt-hours per acre-foot of water.
- Camanche powerplant production rate is approximately 0.10 megawatt-hours per acre-foot of water.
- Duck Creek Reservoir active storage is 150 taf.
- Duck Creek's storage at the beginning of the simulation period is 10,000 acre-feet.

Available Flood Water

EBMUD provided HDR with three datasets for the available flood water as simulated with EBMUDSIM:

1. **Full Build-Out Without Hydropower Impact**: This case represents flood release from Camanche Reservoir in excess of EBMUD's hydro capacity assuming full allocation to EBMUD per its water rights (325 mgd) and maximum allocation to all other water users in the basin (no specific planning year). The dataset is given in Table F-2.
2. **Full Build-Out With Hydropower Impact**: This dataset is similar to dataset 1 above except it includes all flood release from Camanche Reservoir (regardless if it is being used for power generation or not). The dataset is given in Table F-3.
3. **Current Conditions Without Hydropower Impact**: This case represents flood release from Camanche Reservoir in excess of EBMUD's hydro capacity assuming EBMUD's demand is 220 mgd and the allocations to all other water users in the basin are based on current conditions. The dataset is given in Table F-4.

Current Conditions with Hydropower Impact

As mentioned above, the operations study was performed assuming current conditions and EBMUD demand of 220 mgd. In order to perform the analysis for this case, a forth dataset- Current Conditions With Hydropower Impact had to be developed. This case was synthesized from the monthly data in the above datasets, as follows:

220 WITH = 220 WITHOUT + (325 WITH-325 WITHOUT) + 105 mgd

The 105 mgd is the difference between EBMUD demand of 325 mgd and 220 mgd (converted to the proper units) and is applied only when the 325 WITH is greater than zero. In other words, flood flow was increased by the reduced EBMUD demand only when the 325 case indicated that the system spills.

It should be noted that the results for case 4 are somewhat conservative since more flood flow is anticipated as a result of larger carryover in normal and wet years due to the lower EBMUD's demand and minimum instream flow requirements in the 220 mgd case versus the 325 case.

The dataset for the Current Conditions With Hydropower Impact is given in Table F-5.

Table F-2. Available Water Under Full Build-Out Without Hydropower Impact

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1922	0	0	0	0	0	0	0	11,929	64,502	0	0	0	76,431
1923	0	0	0	0	0	0	0	0	0	0	0	0	0
1924	0	0	0	0	0	0	0	0	0	0	0	0	0
1925	0	0	0	0	0	0	0	0	0	0	0	0	0
1926	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	0	0	0	0	0	0	0	0	0	0	0	0	0
1928	0	0	0	0	0	0	0	0	0	0	0	0	0
1929	0	0	0	0	0	0	0	0	0	0	0	0	0
1930	0	0	0	0	0	0	0	0	0	0	0	0	0
1931	0	0	0	0	0	0	0	0	0	0	0	0	0
1932	0	0	0	0	0	0	0	0	0	0	0	0	0
1933	0	0	0	0	0	0	0	0	0	0	0	0	0
1934	0	0	0	0	0	0	0	0	0	0	0	0	0
1935	0	0	0	0	0	0	0	0	0	0	0	0	0
1936	0	0	0	0	0	0	0	0	0	0	0	0	0
1937	0	0	0	0	0	0	0	0	0	0	0	0	0
1938	0	0	0	0	0	19,000	56,112	95,121	48,912	0	0	0	219,146
1939	0	0	0	0	0	0	0	0	0	0	0	0	0
1940	0	0	0	0	0	0	0	0	0	0	0	0	0
1941	0	0	0	0	0	0	0	0	1,071	0	0	0	1,071
1942	0	0	0	0	0	0	0	19,246	36,119	0	0	0	55,365
1943	0	0	0	0	0	25,025	0	16,417	0	0	0	0	41,443
1944	0	0	0	0	0	0	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0	0	0	0	0	0	0
1947	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	58,969	166,447	0	0	0	0	0	0	0	0	0	225,416
1952	0	0	0	0	0	0	96,159	107,111	28,919	0	0	0	232,189
1953	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	33,326	0	0	0	31,789	26,658	0	0	0	91,773
1957	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	25,884	73,908	30,109	0	0	0	129,901
1959	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	53,740	0	0	0	0	3,273	0	0	0	57,013
1966	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	82,762	19,101	0	0	0	101,863
1968	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	57,421	125,681	24,337	0	0	0	207,439
1970	0	0	0	108,895	0	0	0	0	0	0	0	0	108,895
1971	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	3,273	0	0	0	3,273
1981	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	34,180	22,197	131,564	99,425	23,802	0	0	0	311,168
1983	0	0	17,954	0	53,848	125,312	24,575	187,599	129,302	38,614	0	0	577,204
1984	0	52,364	78,397	5,103	0	0	0	0	0	0	0	0	135,864
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	61,636	78,704	0	9,715	0	0	0	0	150,056
1987	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	191,780	48,912	15,679	0	0	256,372
Min	0	0	0	0	0	0	0	0	0	0	0	0	0
Max	0	58,969	166,447	108,895	61,636	125,312	131,564	191,780	129,302	38,614	0	0	577,204
Avg	0	1,504	3,551	2,717	2,022	3,652	5,293	14,223	6,599	734	0	0	40,296

Number of diversion years in 74-yr period: ***19***
26%

Table F-3. Available Water Under Full Build-Out With Hydropower Impact

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1922	3	0	0	0	0	0	0	54,305	87,415	17,707	17,707	17,136	194,274
1923	6	0	0	0	0	0	0	1,601	1,550	1,601	1,601	1,550	7,909
1924	0	0	0	0	0	0	0	0	0	0	0	0	0
1925	0	0	0	0	0	0	0	0	0	0	0	0	0
1926	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	0	0	0	0	0	0	0	0	0	0	0	0	0
1928	0	0	0	0	0	0	0	0	0	0	0	0	0
1929	0	0	0	0	0	0	0	0	0	0	0	0	0
1930	0	0	0	0	0	0	0	0	0	0	0	0	0
1931	0	0	0	0	0	0	0	0	0	0	0	0	0
1932	0	0	0	0	0	0	0	0	0	0	0	0	0
1933	0	0	0	0	0	0	0	0	0	0	0	0	0
1934	0	0	0	0	0	0	0	0	0	0	0	0	0
1935	0	0	0	0	0	0	0	0	0	0	0	0	0
1936	0	0	0	0	0	0	0	0	0	0	0	0	0
1937	0	0	0	0	0	0	0	3,869	3,744	3,869	3,869	3,744	19,096
1938	5	0	40,453	0	33,394	78,934	101,414	122,987	69,489	24,427	24,427	23,639	519,170
1939	0	0	0	0	0	0	0	0	0	0	0	0	0
1940	0	0	0	0	0	0	0	0	0	0	0	0	0
1941	0	0	0	0	0	14,632	0	21,262	29,940	18,107	18,107	17,523	119,569
1942	0	0	0	49,697	36,361	0	0	58,508	59,029	23,900	23,900	23,129	274,525
1943	0	5,684	0	66,256	34,871	84,990	2,396	46,439	11,385	11,764	11,764	11,385	286,933
1944	0	0	0	0	0	0	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0	0	0	0	0	0	0
1946	0	0	18,767	14,988	0	0	0	0	0	0	0	0	33,755
1947	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	121,448	231,024	57,262	43,068	903	0	0	0	0	0	0	453,705
1952	0	0	3,281	63,539	56,248	44,506	140,364	133,750	48,313	38,388	38,388	37,150	603,929
1953	0	0	0	0	14,074	0	0	881	852	881	881	852	18,421
1954	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	105,247	46,090	1,159	0	64,597	49,203	25,185	25,185	24,372	341,038
1957	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	2,806	71,985	103,660	52,652	30,792	30,792	29,798	322,485
1959	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	20,703	125,708	36,886	0	0	27,045	26,173	27,045	27,045	26,173	316,779
1966	0	6,967	0	0	0	0	0	0	0	0	0	0	6,968
1967	0	0	0	0	0	0	0	119,009	41,991	43,391	43,391	41,991	289,774
1968	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	20,174	34,474	103,218	154,092	45,529	35,880	35,880	34,723	463,970
1970	0	0	0	168,874	37,782	2,718	0	0	0	0	0	0	209,374
1971	0	6,135	24,857	19,895	17,381	9,105	0	3,286	3,180	3,286	3,286	3,180	93,591
1972	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	52,219	26,820	56,696	0	20,728	259	23,541	22,782	23,541	23,541	22,782	272,910
1975	0	0	0	0	0	0	0	19,853	19,212	19,853	19,853	19,212	97,983
1976	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	7,008	15,781	0	27,028	26,157	27,028	27,028	26,157	156,188
1981	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	98,871	91,589	174,074	124,218	41,289	42,665	42,665	41,289	656,659
1983	0	54,512	77,925	58,421	107,531	185,251	66,229	211,485	145,841	80,557	80,557	77,959	1,146,269
1984	0	110,352	138,376	65,032	34,400	0	0	6,643	6,428	6,643	6,643	6,428	380,946
1985	0	4,503	0	0	0	0	0	0	0	0	0	0	4,503
1986	0	0	0	0	121,098	145,141	0	41,983	17,294	17,871	17,871	17,294	378,552
1987	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	26,680	219,880	69,813	62,139	62,139	60,135	500,787
Min	0	0	0	0	0	0	0	0	0	0	0	0	0
Max	6	121,448	231,024	168,874	121,098	185,251	174,074	219,880	145,841	80,557	80,557	77,959	1,146,269
Avg	0	4,889	7,868	11,508	10,071	9,902	9,279	21,485	11,882	7,926	7,926	7,670	110,406

Number of diversion years in 74-yr period: 26

35%

Table F-4. Available Water Under Current Conditions Without Hydropower Impact

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1922	0	0	0	0	0	0	0	76,675	76,463	0	0	0	153,138
1923	0	0	0	0	0	0	0	0	0	0	0	0	0
1924	0	0	0	0	0	0	0	0	0	0	0	0	0
1925	0	0	0	0	0	0	0	0	0	0	0	0	0
1926	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	0	0	0	0	0	0	0	0	18,208	0	0	0	18,208
1928	0	0	0	0	0	0	0	0	0	0	0	0	0
1929	0	0	0	0	0	0	0	0	0	0	0	0	0
1930	0	0	0	0	0	0	0	0	0	0	0	0	0
1931	0	0	0	0	0	0	0	0	0	0	0	0	0
1932	0	0	0	0	0	0	0	0	0	0	0	0	0
1933	0	0	0	0	0	0	0	0	0	0	0	0	0
1934	0	0	0	0	0	0	0	0	0	0	0	0	0
1935	0	0	0	0	0	0	0	0	0	0	0	0	0
1936	0	0	0	0	33,452	0	0	26,440	15,888	0	0	0	75,779
1937	0	0	0	0	0	0	0	0	0	0	0	0	0
1938	0	0	0	0	0	30,559	69,501	107,419	60,813	0	0	0	268,292
1939	0	0	0	0	0	0	0	0	0	0	0	0	0
1940	0	0	0	0	0	0	0	15,556	0	0	0	0	15,556
1941	0	0	0	0	0	0	0	0	18,863	0	0	0	18,863
1942	0	0	0	7,317	0	0	0	52,449	48,020	0	0	0	107,786
1943	0	0	0	17,278	0	36,585	0	28,715	3,332	0	0	0	85,910
1944	0	0	0	0	0	0	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0	0	0	0	0	0	0
1947	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	126,030	177,638	3,874	0	0	0	0	0	0	0	0	307,541
1952	0	0	0	9,408	2,521	0	109,428	119,347	40,879	9,777	0	0	291,360
1953	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	62,287	110,616	0	0	0	54,171	38,618	0	0	0	265,692
1957	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	39,094	86,206	42,010	0	0	0	167,310
1959	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	17,278	10,294	0	0	0	27,572
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	70,895	63,271	0	0	0	14,081	19,934	0	0	0	168,180
1966	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	122,483	33,917	10,207	0	0	166,608
1968	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	799	22,133	0	67,775	137,978	36,298	0	0	0	264,983
1970	0	0	0	134,596	0	0	0	0	0	0	0	0	134,596
1971	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	672	0	0	0	0	0	0	0	672
1974	0	0	0	7,133	0	0	0	8,055	13,983	0	0	0	29,171
1975	0	0	0	0	0	0	0	0	2,142	0	0	0	2,142
1976	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	12,495	0	0	10,514	19,398	0	0	0	42,408
1981	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	13,404	97,946	34,003	145,012	111,723	38,559	0	0	0	440,646
1983	0	6,962	28,838	9,592	60,740	137,117	37,964	199,896	141,203	54,847	0	38,261	715,420
1984	0	0	89,464	16,233	0	0	0	0	0	0	0	0	105,697
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	214,551	90,510	0	33,941	10,116	0	0	0	349,117
1987	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	40,459	82,889	204,016	60,873	32,097	0	0	420,333
Min	0	0	0	0	0	0	0	0	0	0	0	0	0
Max	0	126,030	177,638	134,596	214,551	137,117	145,012	204,016	141,203	54,847	0	38,261	715,420
Avg	0	1,797	5,799	5,318	6,007	4,990	7,455	19,283	10,133	1,445	0	517	62,743

Number of diversion years in 74-yr period: ***26***
35%

Table F-5. Available Water Under Current Conditions With Hydropower Impact

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1922	9,995	0	0	0	0	0	0	129,043	109,045	27,699	27,699	26,805	330,286
1923	9,998	0	0	0	0	0	0	11,593	11,219	11,593	11,593	11,219	67,215
1924	0	0	0	0	0	0	0	0	0	0	0	0	0
1925	0	0	0	0	0	0	0	0	0	0	0	0	0
1926	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	0	0	0	0	0	0	0	0	18,208	0	0	0	18,208
1928	0	0	0	0	0	0	0	0	0	0	0	0	0
1929	0	0	0	0	0	0	0	0	0	0	0	0	0
1930	0	0	0	0	0	0	0	0	0	0	0	0	0
1931	0	0	0	0	0	0	0	0	0	0	0	0	0
1932	0	0	0	0	0	0	0	0	0	0	0	0	0
1933	0	0	0	0	0	0	0	0	0	0	0	0	0
1934	0	0	0	0	0	0	0	0	0	0	0	0	0
1935	0	0	0	0	0	0	0	0	0	0	0	0	0
1936	0	0	0	0	33,452	0	0	26,440	15,888	0	0	0	75,780
1937	0	0	0	0	0	0	0	13,861	13,413	13,861	13,861	13,413	68,409
1938	9,997	0	50,445	0	42,419	100,485	124,472	145,277	91,059	34,419	34,419	33,308	666,299
1939	0	0	0	0	0	0	0	0	0	0	0	0	0
1940	0	0	0	0	0	0	0	15,556	0	0	0	0	15,556
1941	0	0	0	0	0	24,624	0	31,254	57,401	28,099	28,099	27,192	196,669
1942	0	0	0	67,006	45,386	0	0	101,703	80,599	33,892	33,892	32,798	395,276
1943	0	15,353	0	93,526	43,896	106,542	12,065	68,729	24,386	21,756	21,756	21,054	429,063
1944	0	0	0	0	0	0	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0	0	0	0	0	0	0
1946	0	0	28,759	24,980	0	0	0	0	0	0	0	0	53,738
1947	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	198,178	252,207	71,128	52,093	10,895	0	0	0	0	0	0	584,500
1952	0	0	13,273	82,939	68,116	54,498	163,302	155,978	69,942	58,157	48,380	46,819	761,404
1953	0	0	0	0	23,099	0	0	10,873	10,521	10,873	10,873	10,521	76,760
1954	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	62,287	192,529	55,437	11,151	0	96,971	70,832	35,177	35,177	34,041	593,602
1957	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	12,798	94,864	125,950	74,222	40,784	40,784	39,467	428,869
1959	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	17,278	10,294	0	0	0	27,572
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	101,590	145,231	45,911	0	0	51,118	52,503	37,037	37,037	35,842	506,268
1966	0	16,636	0	0	0	0	0	0	0	0	0	0	16,636
1967	0	0	0	0	0	0	0	168,722	66,476	63,590	53,383	51,660	403,831
1968	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	799	51,332	44,466	123,241	176,381	67,159	45,872	45,872	44,392	599,514
1970	0	0	0	204,567	46,807	12,710	0	0	0	0	0	0	264,083
1971	0	15,804	34,849	29,887	26,406	19,097	0	13,278	12,849	13,278	13,278	12,849	191,574
1972	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	672	0	0	0	0	0	0	0	672
1974	0	61,888	36,812	73,821	0	30,720	9,928	41,588	46,434	33,533	33,533	32,451	400,708
1975	0	0	0	0	0	0	0	29,845	31,023	29,845	29,845	28,881	149,439
1976	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	28,850	25,773	0	47,534	51,951	37,020	37,020	35,826	263,974
1981	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	13,404	171,662	113,387	197,191	146,508	65,715	52,657	52,657	50,958	864,139
1983	0	71,143	98,801	78,005	123,448	207,048	89,287	233,774	167,411	106,782	90,549	125,889	1,392,137
1984	0	67,657	159,435	86,154	43,747	0	0	16,635	16,097	16,635	16,635	16,097	439,092
1985	0	14,172	0	0	0	0	0	0	0	0	0	0	14,172
1986	0	0	0	0	283,038	166,939	0	76,201	37,079	27,863	27,863	26,963	645,946
1987	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	40,459	119,238	242,108	91,443	88,549	72,131	69,804	723,732
Min	0	0	0	0	0	0	0	0	0	0	0	0	0
Max	9,998	198,178	252,207	204,567	283,038	207,048	197,191	242,108	167,411	106,782	90,549	125,889	1,392,137
Avg	405	6,227	11,330	15,729	16,024	13,265	12,616	29,651	18,421	11,743	11,031	11,193	157,637

Number of diversion years in 74-yr period: ***31***

42%

Duck Creek Dam and Reservoir Construction - Pardee and Camanche Reservoir Diversions

For modeling purposes, Duck Creek Reservoir was assumed to have a storage capacity of 150 taf requiring an estimated right-of-way 4,500 acres (including freeboard). The elevation-area-capacity used in the model is shown in Figure F-3 (Hanson 1993).

Reservoir evaporation is based on evaporation rates typical to this region as shown on Figure F-4.

Figure F-3. Duck Creek Reservoir: Elevation-Area-Capacity Curves

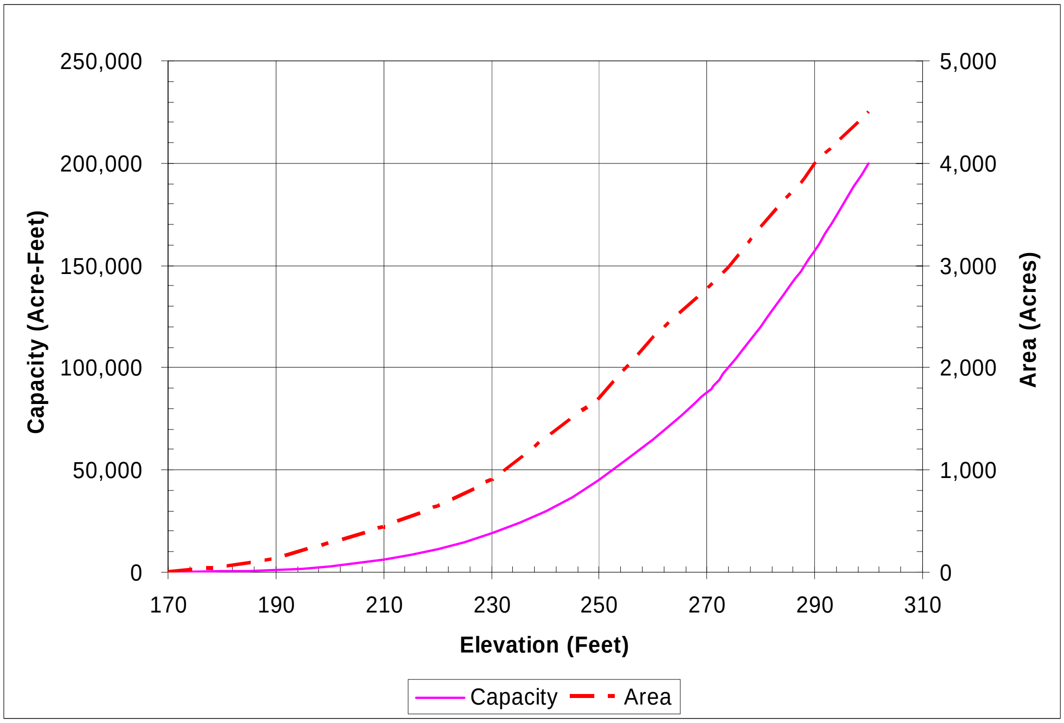
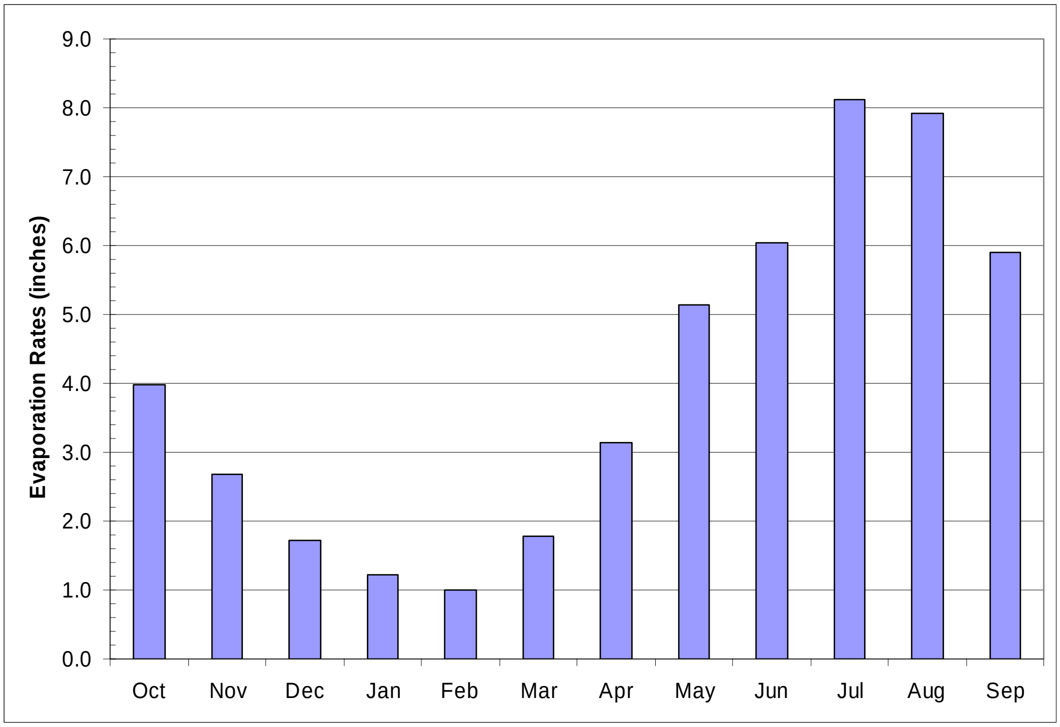


Figure F-4. Duck Creek Reservoir: Evaporation Rates



APPENDIX G

Cost Estimates of the MORE WATER Alternatives

Table G-1 20-May-2004

LOWER MOKELUMNE ALTERNATIVE
Direct Diversion from Mokelumne River DS of Camanche Reservior
Cost Estimating Worksheet

ENR CCI Values		ENR CCI Ratio (adjust to Mar-04)	Estimated Costs for Facilities
1993	4985	1.4	
1999	6018	1.16	
Mar-04	6957		

Item	Facility	Notes	Unit Cost	Quantity	Units	Outdated Cost	ENR CCI Ratio	2003 Updated Cost
	Pumping Station							
1a	Pump Station[2]	2 x 4,000 HP pumps	$4,080,000	2	LS	$8,160,000	1.16	$9,465,600
1b	Intake Structure[2]	% of pump station	45%	1	LS	$3,672,000	1.4	$5,140,800
1c	Fish Screen		$1,200,000	1	LS			$1,200,000
1d	Power Connection[2]		$125	8,000	HP	$1,000,000	1.16	$1,160,000
	Pumping Station Total							**$16,966,400**
	Pipeline							
2a	Mokelumne River to Outlet[2]	approx. 5 miles, 2 x 7.5' pipe	$375	52,800	LF	$19,800,000	1.16	$22,968,000
2b	Valves and Appurtenances[1] (prorated)		$1,071,000	1	LS	$1,071,000	1.4	$1,499,400
2c	Highway 12 Crossing[2]	Directional Drilling, dual pipes	$1,530	150	LF	$229,500	1.16	$266,220
	Pipeline Total							**$24,733,620**
4a	**Construction Cost Subtotal**							**$41,700,020**
4b	Contingency		30%		$			$12,510,006
4c	**Total Construction Cost**							**$54,210,026**
	Engineering, Legal Costs and Contingencies							
5a	Engineering		10%		$			$5,421,003
5b	Admin/Legal		5%		$			$2,710,501
5c	Finance		3%		$			$1,626,301
5d	Construction Management		10%		$			$5,421,003
5e	Environmental		10%		$			$5,421,003
	Engineering, Legal Costs and Contingencies Total							**$20,599,810**
	Land Acquisition							
6a	Reservior	N/A						
6b	50' Right of Way[1]		$3,000	30	AC			$90,000
6c	Intake and Pump Station		$3,000	2	AC			$6,000
6d	Reservior Surveying[2]	N/A						$0
6e	Surveying[2]		10%		$			$9,600
	Land Acquisition Total							**$105,600**
7a	**Total Project Cost**							**$74,915,436**
7b	Annualized Project Cost (100 yrs at 3%)	excludes replacement costs						$2,370,824
	Annual Costs							
8a	Pipeline & Distribution O&M[2]		1.50%		$			$339,330
8b	Dam and Reservoir O&M[2]	N/A	1.50%		$			$0
8c	Intake,Fish Screen and Pump Station O&M[2]		5.00%		$			$317,040
8d	Pumping Energy Costs[3] - Lower Mokelumne Diversion	for avg. annual yield of 49,200 ACFT/Year	$0.11	5,756,400	KW-HR			$604,422
8e	Standby Costs[3] - Lower Mokelumne Diversion	for 8000 HP = 6000 KW assuming Transmision voltage class	$23.50	6,000	KW/MO			$1,692,000
	O&M Costs Subtotal							**$2,952,792**

[1] Unit Cost from "Proposed Duck Creek Project, Reconnaissance-Level Design Study and Cost Estimate", February 1993.

[2] Unit Cost/Percentage from "Studies Level Engineering and Costing Methodology for Pipelines, Pump Stations and Other Facilities", 1999.

[3] From PG&E Schedule S - Standby Service

Computed by: M. Ridgway

Checked by: M. Seits

Table G-2a 20-May-2004

CAMANCHE RESERVIOR ALTERNATIVE

Diversion from Camanche Reservoir to Proposed Duck Creek Reservoir and Direct Diversion from Lower Mokelumne River

Cost Estimating Worksheet (No Hydro Impacts)

ENR CCI Values		**ENR CCI Ratio (adjust to Mar-04)**
1993	4985	1.4
1999	6018	1.16
Mar-04	6957	

Estimated Costs for Facilities

Item	Facility	Notes	Unit Cost	Quantity	Units	Outdated Cost	ENR CCI Ratio	1999 Updated Cost
	Pumping Stations							
	Camanche Diversion							
1a	Pump Station[2]	2 x 17,000 HP pumps	$7,540,000	2	LS	$15,080,000	1.16	$17,492,800
1b	Intake Structure[2]	% of pump station	45%		$	$6,786,000	1.16	$7,871,760
1c	Power Connection[2]		$125	34,000	HP	$4,250,000	1.16	$4,930,000
	Lower Mokelumne Diversion							
1d	Pump Station[2]	2 x 4,000 HP pumps	$4,080,000	2	LS	$8,160,000	1.16	$9,465,600
1e	Intake Structure[2]	% of pump station	45%		LS	$3,672,000	1.4	$5,140,800
1f	Fish Screen		$1,200,000	1	LS			$1,200,000
1g	Power Connection[2]		$125	8,000	HP	$1,000,000	1.16	$1,160,000
	Pumping Stations Subtotal							**$47,260,960**
	Pipelines							
	Camanche Diversion							
2a	Camanche Reservoir to Duck Creek Res[2]	approx. 4.5 miles, 2 x 9' pipe	$570	48,000	LF	$27,360,000	1.16	$31,737,600
2b	Valves and Appurtenances[1] (prorated)		$954,000	1	LS	$954,000	1.4	$1,335,600
2c	Outlet Structure at Duck Creek[1]		$830,000	1	LS	$830,000	1.4	$1,162,000
2d	Rock Slope Protection		$55	890	TON			$48,950
2e	Duck Creek Reservoir To Outlet[2]	approx. 3 miles, 2 x 7.5' pipe	$375	31,680	LF	$11,880,000	1.16	$13,780,800
2f	Highway 12 Crossing[2]	Directional Drilling, dual pipes	$1,836	150	LF	$275,400	1.16	$319,464
	Lower Mokelumne Diversion							
2g	Mokelumne River to Outlet[2]	approx. 5 miles, 2 x 7.5' pipe	$375	52,800	LF	$19,800,000	1.16	$22,968,000
2h	Valves and Appurtenances[1] (prorated)		$1,071,000	1	LS	$1,071,000	1.4	$1,499,400
2i	Highway 12 Crossing[2]	Directional Drilling, dual pipes	$1,530	150	LF	$229,500	1.16	$266,220
	Pipelines Subtotal							**$73,118,034**
3a	**Off-Channel Reservoir - Duck Creek[1]**		$55,000,000	1	LS	$55,000,000	1.4	**$77,000,000**
4a	**Construction Cost Subtotal**							**$197,378,994**
4b	Contingency		30%		$			$59,213,698
4c	**Total Construction Cost**							**$256,592,692**
	Engineering, Legal Costs and Contingencies							
5a	Engineering		10%		$			$25,659,269
5b	Admin/Legal		5%		$			$12,829,635
5c	Finance		3%		$			$7,697,781
5d	Construction Management		10%		$			$25,659,269
5e	Environmental		10%		$			$25,659,269
	Engineering, Legal Costs and Contingencies Subtotal							**$97,505,223**
	Land Acquisition							
	Camanche Diversion							
6a	Reservoir[1]		$3,000	4500	AC			$13,500,000
6b	Reservoir Surveying[2]		$50	4500	AC	$225,000	1.16	$261,000
6c	50' Right of Way[1]	Reservoir to Duck Creek & Duck Creek to outlet	$3,000	92	AC			$274,500
6d	Intake and Pump Station		$3,000	2	AC			$6,000
	Lower Mokelumne Diversion							
6e	50' Right of Way[1]		$3,000	30	AC			$90,000
6f	Intake and Pump Station		$3,000	2	AC			$6,000
6g	Surveying[2]	% of esmt costs	10%		$			$37,650
	Land Acquisition Subtotal							**$14,175,150**
7a	**Total Project Cost**							**$368,273,065**

CAMANCHE RESERVIOR ALTERNATIVE
Diversion from Camanche Reservoir to Proposed Duck Creek Reservior and Direct Diversion from Lower Mokelumne River
Cost Estimating Worksheet (No Hydro Impacts)

ENR CCI Values		**ENR CCI Ratio (adjust to Mar-04)**
1993	4985	1.4
1999	6018	1.16
Mar-04	6957	

Estimated Costs for Facilities

Item	Facility	Notes	Unit Cost	Quantity	Units	Outdated Cost	ENR CCI Ratio	1999 Updated Cost
7b	Annualized Project Cost (100 yrs at 3%)	excludes replacement costs						$11,654,615
	Annual O&M Costs							
8a	Pipeline & Distribution O&M[2]		1.50%		$			$725,324
8b	Reservoir O&M[2]		1.50%		$			$1,155,000
8c	Intake and Pump Stations O&M[2]		5.00%		$			$2,058,548
8d	Pumping Energy Costs[3] - Camanche Diversion	for avg. yield of 37,600 ACFT/Year (no hydro impacts)	$0.11	11,550,720	KW-HR			$1,212,826
8e	Pumping Energy Costs[3] - Lower Mokelumne Diversion	for avg. yield of 44,700 ACFT/Year	$0.11	5,229,900	KW-HR			$549,140
8f	Standby Costs[3] - Camanche Diversion	for 34000 HP = 25000 KW assuming Transmision voltage class	$23.50	25,000	KW/MO			$7,050,000
8g	Standby Costs[3] - Lower Mokelumne Diversion	for 8000 HP = 6000 KW assuming Transmision voltage class	$23.50	6,000	KW/MO			$1,692,000
	O&M Cost Subtotal							**$14,442,837**

[1] Unit Cost from "Proposed Duck Creek Project, Reconnaissance-Level Design Study and Cost Estimate", February 1993.

[2] Unit Cost/Percentage from "Studies Level Engineering and Costing Methodology for Pipelines, Pump Stations and Other Facilities", 1999.

[3] From PG&E Schedule S - Standby Service

Computed by: M. Ridgway

Checked by: M. Seits

Table G-2b 20-May-2004

CAMANCHE RESERVIOR ALTERNATIVE

Diversion from Camanche Reservoir to Proposed Duck Creek Reservoir and Direct Diversion from Lower Mokelumne River

Cost Estimating Worksheet (With Hydro Impacts)

ENR CCI Values		ENR CCI Ratio (adjust to Mar-04)
1993	4985	1.4
1999	6018	1.16
Mar-04	6957	

Estimated Costs for Facilities

Item	Facility	Notes	Unit Cost	Quantity	Units	Outdated Cost	ENR CCI Ratio	1999 Updated Cost
	Pumping Stations							
	Camanche Diversion							
1a	Pump Station[2]	2 x 17,000 HP pumps	$7,540,000	2	LS	$15,080,000	1.16	$17,492,800
1b	Intake Structure[2]	% of pump station	45%		$	$6,786,000	1.16	$7,871,760
1c	Power Connection[2]		$125	34,000	HP	$4,250,000	1.16	$4,930,000
	Lower Mokelumne Diversion							
1d	Pump Station[2]	2 x 4,000 HP pumps	$4,080,000	2	LS	$8,160,000	1.16	$9,465,600
1e	Intake Structure[2]	% of pump station	45%		LS	$3,672,000	1.4	$5,140,800
1f	Fish Screen		$1,200,000	1	LS			$1,200,000
1g	Power Connection[2]		$125	8,000	HP	$1,000,000	1.16	$1,160,000
	Pumping Stations Subtotal							**$47,260,960**
	Pipelines							
	Camanche Diversion							
2a	Camanche Reservoir to Duck Creek Res[2]	approx. 4.5 miles, 2 x 9' pipe	$570	48,000	LF	$27,360,000	1.16	$31,737,600
2b	Valves and Appurtenances[1] (prorated)		$954,000	1	LS	$954,000	1.4	$1,335,600
2c	Outlet Structure at Duck Creek[1]		$830,000	1	LS	$830,000	1.4	$1,162,000
2d	Rock Slope Protection		$55	890	TON			$48,950
2e	Duck Creek Reservoir To Outlet[2]	approx. 3 miles, 2 x 7.5' pipe	$375	31,680	LF	$11,880,000	1.16	$13,780,800
2f	Highway 12 Crossing[2]	Directional Drilling, dual pipes	$1,836	150	LF	$275,400	1.16	$319,464
	Lower Mokelumne Diversion							
2g	Mokelumne River to Outlet[2]	approx. 5 miles, 2 x 7.5' pipe	$375	52,800	LF	$19,800,000	1.16	$22,968,000
2h	Valves and Appurtenances[1] (prorated)		$1,071,000	1	LS	$1,071,000	1.4	$1,499,400
2i	Highway 12 Crossing[2]	Directional Drilling, dual pipes	$1,530	150	LF	$229,500	1.16	$266,220
	Pipelines Subtotal							**$73,118,034**
3a	**Off-Channel Reservoir - Duck Creek[1]**		$55,000,000	1	LS	$55,000,000	1.4	**$77,000,000**
4a	**Construction Cost Subtotal**							**$197,378,994**
4b	Contingency		30%		$			$59,213,698
4c	**Total Construction Cost**							**$256,592,692**
	Engineering, Legal Costs and Contingencies							
5a	Engineering		10%		$			$25,659,269
5b	Admin/Legal		5%		$			$12,829,635
5c	Finance		3%		$			$7,697,781
5d	Construction Management		10%		$			$25,659,269
5e	Environmental		10%		$			$25,659,269
	Engineering, Legal Costs and Contingencies Subtotal							**$97,505,223**
	Land Acquisition							
	Camanche Diversion							
6a	Reservoir[1]		$3,000	4500	AC			$13,500,000
6b	Reservoir Surveying[2]		$50	4500	AC	$225,000	1.16	$261,000
6c	50' Right of Way[1]	Reservoir to Duck Creek & Duck Creek to outlet	$3,000	92	AC			$274,500
6d	Intake and Pump Station		$3,000	2	AC			$6,000
	Lower Mokelumne Diversion							
6e	50' Right of Way[1]		$3,000	30	AC			$90,000
6f	Intake and Pump Station		$3,000	2	AC			$6,000
6g	Surveying[2]	% of esmt costs	10%		$			$37,650
	Land Acquisition Subtotal							**$14,175,150**
7a	**Total Project Cost**							**$368,273,065**

CAMANCHE RESERVIOR ALTERNATIVE
Diversion from Camanche Reservoir to Proposed Duck Creek Reservior and Direct Diversion from Lower Mokelumne River
Cost Estimating Worksheet (With Hydro Impacts)

ENR CCI Values		**ENR CCI Ratio (adjust to Mar-04)**	**Estimated Costs for Facilities**
1993	4985	1.4	
1999	6018	1.16	
Mar-04	6957		

Item	Facility	Notes	Unit Cost	Quantity	Units	Outdated Cost	ENR CCI Ratio	1999 Updated Cost
7b	Annualized Project Cost (100 yrs at 3%)	excludes replacement costs						$11,654,615
	Annual O&M Costs							
8a	Pipeline & Distribution O&M[2]		1.50%		$			$725,324
8b	Reservoir O&M[2]		1.50%		$			$1,155,000
8c	Intake and Pump Stations O&M[2]		5.00%		$			$2,058,548
8d	Pumping Energy Costs[3] - Camanche Diversion	for avg. yield of 45,600 ACFT/Year (with hydro impacts)	$0.11	14,008,320	KW-HR			$1,470,874
8e	Pumping Energy Costs[3] - Lower Mokelumne Diversion	for avg. yield of 44,700 ACFT/Year	$0.11	5,229,900	KW-HR			$549,140
8f	Standby Costs[3] - Camanche Diversion	for 34000 HP = 25000 KW assuming Transmision voltage class	$23.50	25,000	KW/MO			$7,050,000
8g	Standby Costs[3] - Lower Mokelumne Diversion	for 8000 HP = 6000 KW assuming Transmision voltage class	$23.50	6,000	KW/MO			$1,692,000
	O&M Cost Subtotal							**$14,700,885**

[1] Unit Cost from "Proposed Duck Creek Project, Reconnaissance-Level Design Study and Cost Estimate", February 1993.

[2] Unit Cost/Percentage from "Studies Level Engineering and Costing Methodology for Pipelines, Pump Stations and Other Facilities", 1999.

[3] From PG&E Schedule S - Standby Service

Computed by: M. Ridgway

Checked by: M. Seits

Table G-3 20-May-2004

PARDEE RESERVIOR ALTERNATIVE

Diversion from Pardee Reservoir to Proposed Duck Creek Reservior and Direct Diversion from Lower Mokelumne River

Cost Estimating Worksheet

ENR CCI Values		**ENR CCI Ratio (adjust to Mar-04)**	**Estimated Costs for Facilities**
1993	4985	1.4	
1999	6018	1.16	
Mar-04	6957		

Item	Facility	Notes	Unit Cost	Quantity	Units	Outdated Cost	ENR CCI Ratio	Updated Cost
	Intake Structure & Pumping Station							
	Pardee Diversion							
1a	Intake Structure[1]		$493,000	1	LS	$493,000	1.4	$690,200
1b	Diversion Tunnel - 13' ID[1]	10,000 ft	$15,225,000	1	LS	$15,225,000	1.4	$21,315,000
	Lower Mokelumne Diversion							
1c	Pump Station[2]	2 x 4,000 HP pumps	$4,080,000	2	LS	$8,160,000	1.16	$9,465,600
1d	Intake Structure[2]	% of pump station	45%	1	LS	$3,672,000	1.4	$5,140,800
1e	Fish Screen		$1,200,000	1	LS			$1,200,000
1f	Power Connection[2]		$125	8,000	HP	$1,000,000	1.16	$1,160,000
	Intake Structure & Pumping Station Subtotal							**$38,971,600**
	Pipelines							
	Pardee Diversion							
2a	Pardee Reservior to Duck Creek Reservior[1]	11 miles, 10.5' pipe	$795	57,400	LF	$45,633,000	1.4	$63,886,200
2b	Valves and Appurtenances[1]		$1,165,000	1	LS	$1,165,000	1.4	$1,631,000
2c	Outlet Structure[1]		$830,000	1	LS	$830,000	1.4	$1,162,000
2d	Rock Slope Protection		$55	890	TON			$48,950
2e	Duck Creek Reservoir To Outlet[2]	3 miles, 2 x 7.5' pipe	$375	31,680	LF	$11,880,000	1.16	$13,780,800
2f	Highway 12 Crossing[2]	Directional Drilling	$2,142	150	LF	$321,300	1.16	$372,708
	Lower Mokelumne Diversion							
2g	Mokelumne River to Outlet[2]	approx. 5 miles, 2 x 7.5' pipe	$375	52,800	LF	$19,800,000	1.16	$22,968,000
2h	Valves and Appurtenances[1] (prorated)		$1,071,000	1	LS	$1,071,000	1.4	$1,499,400
2i	Highway 12 Crossing[2]	Directional Drilling, dual pipes	$1,530	300	LF	$459,000	1.16	$532,440
	Pipelines Subtotal							**$105,881,498**
3a	**Off-Channel Reservoir[1]**		$55,000,000		LS		1.4	**$77,000,000**
4a	**Construction Cost Subtotal**							**$221,853,098**
4b	Contingency		30%		$			$66,555,929
4c	**Construction Cost Total**							**$288,409,027**
	Engineering, Legal Costs and Contingencies							
5a	Engineering		10%		$			$28,840,903
5b	Admin/Legal		5%		$			$14,420,451
5c	Finance		3%		$			$8,652,271
5d	Construction Management		10%		$			$28,840,903
5e	Environmental		10%		$			$28,840,903
	Engineering, Legal Costs and Contingencies Subtotal							**$109,595,430**
	Land Acquisition							
	Pardee Diversion							
6a	Reservoir[1]		$3,000	4500	AC			$13,500,000
6b	Reservoir Surveying[2]		$50	4500	AC	$225,000	1.16	$261,000
6c	50' Right of Way[1]	Reservoir to Duck Creek & Duck Creek to outlet	$3,000	102	AC			$306,000
	Lower Mokelumne Diversion							
6d	50' Right of Way[1]		$3,000	30	AC			$90,000
6e	Intake and Pump Station		$3,000	2	AC			$6,000
6f	Surveying[2]	% of esmt costs	10%		$			$40,200
	Land Acquisition Subtotal							**$14,203,200**
7a	**Total Project Cost**							**$412,207,658**

PARDEE RESERVIOR ALTERNATIVE

Diversion from Pardee Reservoir to Proposed Duck Creek Reservior and Direct Diversion from Lower Mokelumne River

Cost Estimating Worksheet

ENR CCI Values		**ENR CCI Ratio (adjust to Mar-04)**	**Estimated Costs for Facilities**
1993	4985	1.4	
1999	6018	1.16	
Mar-04	6957		

7b	Annualized Project Cost (100 yrs at 3%)	excludes replacement costs							$13,044,998
	Annual O&M Costs								
8a	Pipeline & Distribution O&M[2]		1.50%		$				$1,262,914
8b	Reservoir O&M[2]		1.50%		$				$1,155,000
8c	Intake and Pump Station O&M[2]		5.00%		$				$824,830
8d	Pumping Energy Costs[3] - Lower Mokelumne Diversion	for avg. yield of 44,700 ACFT/Year	$0.11	5,229,900	KW-HR				$549,140
8e	Standby Costs[3] - Lower Mokelumne Diversion	for 8000 HP = 6000 KW assuming Transmision voltage class	$23.50	6,000	KW/MO				$1,692,000
	O&M Costs Subtotal								**$5,483,883**

[1] Unit Cost from "Proposed Duck Creek Project, Reconnaissance-Level Design Study and Cost Estimate", February 1993.

[2] Unit Cost/percentage from "Studies Level Engineering and Costing Methodology for Pipelines, Pump Stations and Other Facilities", 1999.

[3] From PG&E Schedule S - Standby Service

Computed by: M. Ridgway

Checked by: M. Seits

TABLE G-1: LIFE CYCLE COST ASSUMPTIONS

Item	Facility	Assumptions
Construction		Construction over 3-year period. Costs distributed as follows: Year 1 = 20%, Year 2 = 40%, Year 3 = 40%.
Replacement		Replacement over 2-year period (50% each year). Replacement cost assumed to be 100% of original construction cost.
1	**Pumping Stations**	
	Pump Station	Replace every 25 years
	Intake	Replace every 25 years
	Fish Screen	Replace every 25 years
	Power Connection	Replace every 25 years
	Tunneling	No replacement
2	**Piping**	
	Mokelumne River to Outlet or Duck Creek Res	Replace every 50 years
	Duck Creek Res to Outlet	Replace every 50 years
	Outlet Structure	No cost listed
	Highway and Stream Crossings	
3a	Highway 12 (min.)	Assumed crossing impact and costs at time of 50-year pipe replacement
3b	Directional Drilling	(Zero cost)
4	Off-Channel Reservoir	One-time cost
7a	**Total Capital Cost**	(Subtotal)
7b	Contingency	30% for all capital costs
7c	**Total Construction Cost**	(Total)
	Engineering, Legal Costs and Contingencies	
8a	Engineering	10% for all construction costs
8b	Admin/Legal	5% for all construction costs
8c	Finance	3% for all construction costs
8d	Construction Management	10% for all construction costs
8f	Environmental	10% for all construction costs
9	**Land Acquisition**	
	Reservoir	One-time cost
	50' Right of Way	One-time cost
	Intake and Pump Station	One-time cost
	Reservoir Surveying	One-time cost
	Surveying	One-time cost
	Reservoir Interest During Construction	
		--
		--
11a		
	Remaining Interest During Construction	
		--
		--
12a		
13a	**Total Project Cost**	
13b	Annualized Project Cost	
14	**Annual Costs**	
	~~Non-Reservoir Debt Service (6%, 30 years)~~	Not included
	~~Reservoir Debt Service (6%, 40 years)~~	Not included
	Pipeline & Distribution O&M	100 years
	Dam and Reservoir O&M	100 years, as applicable
	Intake / Fish Screen / Pump Station O&M	100 years, as applicable
	Pumping Energy Costs	100 years
	Purchase of Water	(Zero cost)
15a	**Total Annual Cost**	
16a	**Available Project Yield (acft/yr)**	
17a	**Annual Cost of Water ($/acft)**	
18a	**Annual Cost of Water ($/1000 gal)**	

TABLE G-2: LOWER MOKELUMNE DIVERSION

Project Year	Year	Pumping Stations: 1a Pump Station	1b Intake	1c Fish Screen	1d Power Connection	1e Tunneling	Piping: 2a Mokelumne River to Outlet	2b Valves & Appurtenances	2c Highway 12 (min.)	Construction Subtotal/Total: 4a Total Capital Cost	4b Contingency	4c Total Construction Cost	Engineering, Legal Costs, and Contingencies: 5a Engineering	5b Admin/Legal	5c Finance	5d Construction Management	5e Environmental	Total Engineering, Legal Costs, and Contingencies	Land Acquisition: 6b 50' Right of Way	6c Intake and Pump Station	6d Reservoir Surveying	6e Surveying	Total Land Acquisition	Annual Costs: 8a Pipeline & Distribution O&M	8b Dam and Reservoir O&M	8c Intake, Fish Screen and Pump Station O&M	8d Pumping Energy Costs	8e Standby Costs	Total Annual Costs	TOTALS: Total Construction, Engineering (et al), and Land Acquisition Costs	Total Annual Costs	Interest During Construction	Grand Total Costs		Discounted Dollar Values: Total Construction, Engineering (et al), and Land Acquisition Costs	Total Annual Costs	Discounted Grand Total Costs
											30%		10%	5%	3%	10%	10%																				
Construction		$9,465,600	$5,140,800	$1,200,000	$1,160,000	$0	$22,968,000	$1,499,400	$266,220	$41,700,020	$12,510,006	$54,210,026	$5,421,003	$2,710,501	$1,626,301	$5,421,003	$5,421,003	$20,599,810														Interest					
Year 1		20%	20%	20%	20%	20%	20%	20%	20%																							Rate			Federal Discount Rate		3.000%
Years 2 & 3		40%	40%	40%	40%	40%	40%	40%	40%																							3.000%					
Replacement		$9,465,600	$5,140,800	$1,200,000	$1,160,000	$0	$22,968,000	$1,499,400	$266,220	$41,700,020	$12,510,006	$54,210,026	$5,421,003	$2,710,501	$1,626,301	$5,421,003	$5,421,003	$20,599,810																			
Years 1 & 2		50%	50%	50%	50%	50%	50%	50%	50%																												
1	2003	$1,893,120	$1,028,160	$240,000	$232,000	$0	$4,593,600	$299,880	$53,244	$8,340,004	$2,502,001	$10,842,005	$1,084,201	$542,100	$325,260	$1,084,201	$1,084,201	$4,119,962	$90,000	$6,000	$0	$9,600	$105,600						$0	$15,067,567	$0	$226,014	$15,293,581	1	14,628,706	-	14,848,137
2	2004	$3,786,240	$2,056,320	$480,000	$464,000	$0	$9,187,200	$599,760	$106,488	$16,680,008	$5,004,002	$21,684,010	$2,168,401	$1,084,201	$650,520	$2,168,401	$2,168,401	$8,239,924											$0	$29,923,934	$0	$900,886	$30,824,820	2	28,206,178	-	29,055,350
3	2005	$3,786,240	$2,056,320	$480,000	$464,000	$0	$9,187,200	$599,760	$106,488	$16,680,008	$5,004,002	$21,684,010	$2,168,401	$1,084,201	$650,520	$2,168,401	$2,168,401	$8,239,924											$0	$29,923,934	$0	$1,798,604	$31,722,538	3	27,384,639	-	29,030,616
4	2006									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330	$0	$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	4	-	2,623,517	2,623,517
5	2007									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	5	-	2,547,104	2,547,104
6	2008									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	6	-	2,472,917	2,472,917
7	2009									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	7	-	2,400,890	2,400,890
8	2010									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	8	-	2,330,961	2,330,961
9	2011									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	9	-	2,263,069	2,263,069
10	2012									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	10	-	2,197,155	2,197,155
11	2013									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	11	-	2,133,160	2,133,160
12	2014									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	12	-	2,071,029	2,071,029
13	2015									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	13	-	2,010,708	2,010,708
14	2016									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	14	-	1,952,143	1,952,143
15	2017									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	15	-	1,895,285	1,895,285
16	2018									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	16	-	1,840,082	1,840,082
17	2019									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	17	-	1,786,488	1,786,488
18	2020									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	18	-	1,734,454	1,734,454
19	2021									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	19	-	1,683,936	1,683,936
20	2022									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	20	-	1,634,889	1,634,889
21	2023									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	21	-	1,587,271	1,587,271
22	2024									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	22	-	1,541,040	1,541,040
23	2025									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	23	-	1,496,155	1,496,155
24	2026									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	24	-	1,452,578	1,452,578
25	2027									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	25	-	1,410,270	1,410,270
26	2028	$4,732,800	$2,570,400	$600,000	$580,000					$8,483,200	$2,544,960	$11,028,160	$1,102,816	$551,408	$330,845	$1,102,816	$1,102,816	$4,190,701						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$15,218,861	$2,952,792		$18,171,653	26	7,056,906	1,369,194	8,426,100
27	2029	$4,732,800	$2,570,400	$600,000	$580,000					$8,483,200	$2,544,960	$11,028,160	$1,102,816	$551,408	$330,845	$1,102,816	$1,102,816	$4,190,701						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$15,218,861	$2,952,792		$18,171,653	27	6,851,365	1,329,315	8,180,679
28	2030									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	28	-	1,290,597	1,290,597
29	2031									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	29	-	1,253,007	1,253,007
30	2032									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	30	-	1,216,511	1,216,511
31	2033									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	31	-	1,181,079	1,181,079
32	2034									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	32	-	1,146,678	1,146,678
33	2035									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	33	-	1,113,280	1,113,280
34	2036									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	34	-	1,080,854	1,080,854
35	2037									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	35	-	1,049,373	1,049,373
36	2038									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	36	-	1,018,809	1,018,809
37	2039									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	37	-	989,135	989,135
38	2040									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	38	-	960,325	960,325
39	2041									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	39	-	932,355	932,355
40	2042									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	40	-	905,199	905,199
41	2043									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	41	-	878,834	878,834
42	2044									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	42	-	853,236	853,236
43	2045									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	43	-	828,385	828,385
44	2046									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	44	-	804,257	804,257
45	2047									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	45	-	780,832	780,832
46	2048									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	46	-	758,090	758,090
47	2049									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	47	-	736,009	736,009
48	2050									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	48	-	714,572	714,572
49	2051									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	49	-	693,759	693,759
50	2052									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	50	-	673,553	673,553
51	2053	$4,732,800	$2,570,400	$600,000	$580,000		$11,484,000	$749,700	$133,110	$20,850,010	$6,255,003	$27,105,013	$2,710,501	$1,355,251	$813,150	$2,710,501	$2,710,501	$10,299,905						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$37,404,918	$2,952,792		$40,357,710	51	8,283,812	653,935	8,937,747
52	2054	$4,732,800	$2,570,400	$600,000	$580,000		$11,484,000	$749,700	$133,110	$20,850,010	$6,255,003	$27,105,013	$2,710,501	$1,355,251	$813,150	$2,710,501	$2,710,501	$10,299,905						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$37,404,918	$2,952,792		$40,357,710	52	8,042,536	634,888	8,677,424
53	2055									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	53	-	616,396	616,396
54	2056									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	54	-	598,443	598,443
55	2057									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	55	-	581,013	581,013
56	2058									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	56	-	564,090	564,090
57	2059									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	57	-	547,660	547,660
58	2060									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	58	-	531,709	531,709
59	2061									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	59	-	516,222	516,222
60	2062									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	60	-	501,187	501,187
61	2063									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	61	-	486,589	486,589
62	2064									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	62	-	472,416	472,416
63	2065									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	63	-	458,657	458,657
64	2066									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	64	-	445,298	445,298
65	2067									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	65	-	432,328	432,328
66	2068									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	66	-	419,736	419,736
67	2069									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	67	-	407,510	407,510
68	2070									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	68	-	395,641	395,641
69	2071									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	69	-	384,118	384,118
70	2072									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	70	-	372,930	372,930
71	2073									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	71	-	362,068	362,068
72	2074									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	72	-	351,522	351,522
73	2075									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	73	-	341,284	341,284
74	2076									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	74	-	331,343	331,343
75	2077									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	75	-	321,693	321,693
76	2078	$4,732,800	$2,570,400	$600,000	$580,000					$8,483,200	$2,544,960	$11,028,160	$1,102,816	$551,408	$330,845	$1,102,816	$1,102,816	$4,190,701						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$15,218,861	$2,952,792		$18,171,653	76	1,609,730	312,323	1,922,053
77	2079	$4,732,800	$2,570,400	$600,000	$580,000					$8,483,200	$2,544,960	$11,028,160	$1,102,816	$551,408	$330,845	$1,102,816	$1,102,816	$4,190,701						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$15,218,861	$2,952,792		$18,171,653	77	1,562,845	303,226	1,866,071
78	2080									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	78	-	294,394	294,394
79	2081									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	79	-	285,820	285,820
80	2082									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	80	-	277,495	277,495
81	2083									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	81	-	269,412	269,412
82	2084									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	82	-	261,565	261,565
83	2085									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	83	-	253,947	253,947
84	2086									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	84	-	246,551	246,551
85	2087									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	85	-	239,369	239,369
86	2088									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	86	-	232,398	232,398
87	2089									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	87	-	225,629	225,629
88	2090									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	88	-	219,057	219,057
89	2091									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	89	-	212,677	212,677
90	2092									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	90	-	206,482	206,482
91	2093									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	91	-	200,468	200,468
92	2094									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	92	-	194,629	194,629
93	2095									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	93	-	188,960	188,960
94	2096									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	94	-	183,457	183,457
95	2097									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	95	-	178,113	178,113
96	2098									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	96	-	172,926	172,926
97	2099									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	97	-	167,889	167,889
98	2100									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	98	-	162,999	162,999
99	2101									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	99	-	158,251	158,251
100	2102									$0	$0	$0	$0	$0	$0	$0	$0	$0						$339,330		$317,040	$604,422	$1,692,000	$2,952,792	$0	$2,952,792		$2,952,792	100	-	153,642	153,642
																																		TOTAL			$191,293,990

Total Discounted Cost	$ 191,293,990
Annualized Cost	$6,053,817
Yield (ac-ft)	49,200
Total Cost/ac-ft.	**$123.05**

TABLE G-3a: COMANCHE DIVERSION (No Hydro Impacts)

Project Year	Year	Pumping Stations 1a,d Pump Station	1b,e Intake	1c,g Power Connection	1f Fish Screen	Piping 2a Mokelumne River to Duck Creek Res	2b,h Valves & Appurtenances	2c,d Outlet Structure	2e,g Duck Creek Res/River to Outlet	2f,i Highway 12 (min.)	Off-Channel Res. 3a Off-Channel Reservoir
Construction		$26,958,400	$13,012,560	$6,090,000	$1,200,000	$31,737,600	$2,835,000	$1,210,950	$36,748,800	$585,684	$77,000,000
Year 1		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Years 2 & 3		40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Replacement		$26,958,400	$13,012,560	$6,090,000	$1,200,000	$31,737,600	$2,835,000	$1,210,950	$36,748,800	$585,684	$77,000,000
Years 1 & 2		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
1	2003	$5,391,680	$2,602,512	$1,218,000	$240,000	$6,347,520	$567,000	$242,190	$7,349,760	$117,137	$15,400,000
2	2004	$10,783,360	$5,205,024	$2,436,000	$480,000	$12,695,040	$1,134,000	$484,380	$14,699,520	$234,274	$30,800,000
3	2005	$10,783,360	$5,205,024	$2,436,000	$480,000	$12,695,040	$1,134,000	$484,380	$14,699,520	$234,274	$30,800,000
4	2006										
5	2007										
6	2008										
7	2009										
8	2010										
9	2011										
10	2012										
11	2013										
12	2014										
13	2015										
14	2016										
15	2017										
16	2018										
17	2019										
18	2020										
19	2021										
20	2022										
21	2023										
22	2024										
23	2025										
24	2026										
25	2027										
26	2028	$13,479,200	$6,506,280	$3,045,000							
27	2029	$13,479,200	$6,506,280	$3,045,000							
28	2030										
29	2031										
30	2032										
31	2033										
32	2034										
33	2035										
34	2036										
35	2037										
36	2038										
37	2039										
38	2040										
39	2041										
40	2042										
41	2043										
42	2044										
43	2045										
44	2046										
45	2047										
46	2048										
47	2049										
48	2050										
49	2051										
50	2052										
51	2053	$13,479,200	$6,506,280	$3,045,000		$15,868,800	$1,417,500	$605,475	$18,374,400	$292,842	
52	2054	$13,479,200	$6,506,280	$3,045,000		$15,868,800	$1,417,500	$605,475	$18,374,400	$292,842	
53	2055										
54	2056										
55	2057										
56	2058										
57	2059										
58	2060										
59	2061										
60	2062										
61	2063										
62	2064										
63	2065										
64	2066										
65	2067										
66	2068										
67	2069										
68	2070										
69	2071										
70	2072										
71	2073										
72	2074										
73	2075										
74	2076										
75	2077										
76	2078	$13,479,200	$6,506,280	$3,045,000							
77	2079	$13,479,200	$6,506,280	$3,045,000							
78	2080										
79	2081										
80	2082										
81	2083										
82	2084										
83	2085										
84	2086										
85	2087										
86	2088										
87	2089										
88	2090										
89	2091										
90	2092										
91	2093										
92	2094										
93	2095										
94	2096										
95	2097										
96	2098										
97	2099										
98	2100										
99	2101										
100	2102										

Project Year	Year	Construction Subtotal/Total 4a Total Capital Cost	4b Contingency (30%)	4c **Total Construction Cost**	Engineering, Legal Costs, and Contingencies 5a Engineering (10%)	5b Admin/Legal (5%)	5c Finance (3%)	5d Construction Management (10%)	5e Environmental (10%)	**Total Engineering, Legal Costs, and Contingencies**
Construction		$197,378,994	$59,213,698	$256,592,692	$25,659,269	$12,829,635	$7,697,781	$25,659,269	$25,659,269	$97,505,223
Year 1										
Years 2 & 3										
Replacement		$197,378,994	$59,213,698	$256,592,692	$25,659,269	$12,829,635	$7,697,781	$25,659,269	$25,659,269	$97,505,223
Years 1 & 2										
1	2003	$39,475,799	$11,842,740	$51,318,538	$5,131,854	$2,565,927	$1,539,556	$5,131,854	$5,131,854	$19,501,045
2	2004	$78,951,598	$23,685,479	$102,637,077	$10,263,708	$5,131,854	$3,079,112	$10,263,708	$10,263,708	$39,002,089
3	2005	$78,951,598	$23,685,479	$102,637,077	$10,263,708	$5,131,854	$3,079,112	$10,263,708	$10,263,708	$39,002,089
4	2006	$0	$0	$0	$0	$0	$0	$0	$0	$0
5	2007	$0	$0	$0	$0	$0	$0	$0	$0	$0
6	2008	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	2009	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	2010	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	2011	$0	$0	$0	$0	$0	$0	$0	$0	$0
10	2012	$0	$0	$0	$0	$0	$0	$0	$0	$0
11	2013	$0	$0	$0	$0	$0	$0	$0	$0	$0
12	2014	$0	$0	$0	$0	$0	$0	$0	$0	$0
13	2015	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	2016	$0	$0	$0	$0	$0	$0	$0	$0	$0
15	2017	$0	$0	$0	$0	$0	$0	$0	$0	$0
16	2018	$0	$0	$0	$0	$0	$0	$0	$0	$0
17	2019	$0	$0	$0	$0	$0	$0	$0	$0	$0
18	2020	$0	$0	$0	$0	$0	$0	$0	$0	$0
19	2021	$0	$0	$0	$0	$0	$0	$0	$0	$0
20	2022	$0	$0	$0	$0	$0	$0	$0	$0	$0
21	2023	$0	$0	$0	$0	$0	$0	$0	$0	$0
22	2024	$0	$0	$0	$0	$0	$0	$0	$0	$0
23	2025	$0	$0	$0	$0	$0	$0	$0	$0	$0
24	2026	$0	$0	$0	$0	$0	$0	$0	$0	$0
25	2027	$0	$0	$0	$0	$0	$0	$0	$0	$0
26	2028	$23,030,480	$6,909,144	$29,939,624	$2,993,962	$1,496,981	$898,189	$2,993,962	$2,993,962	$11,377,057
27	2029	$23,030,480	$6,909,144	$29,939,624	$2,993,962	$1,496,981	$898,189	$2,993,962	$2,993,962	$11,377,057
28	2030	$0	$0	$0	$0	$0	$0	$0	$0	$0
29	2031	$0	$0	$0	$0	$0	$0	$0	$0	$0
30	2032	$0	$0	$0	$0	$0	$0	$0	$0	$0
31	2033	$0	$0	$0	$0	$0	$0	$0	$0	$0
32	2034	$0	$0	$0	$0	$0	$0	$0	$0	$0
33	2035	$0	$0	$0	$0	$0	$0	$0	$0	$0
34	2036	$0	$0	$0	$0	$0	$0	$0	$0	$0
35	2037	$0	$0	$0	$0	$0	$0	$0	$0	$0
36	2038	$0	$0	$0	$0	$0	$0	$0	$0	$0
37	2039	$0	$0	$0	$0	$0	$0	$0	$0	$0
38	2040	$0	$0	$0	$0	$0	$0	$0	$0	$0
39	2041	$0	$0	$0	$0	$0	$0	$0	$0	$0
40	2042	$0	$0	$0	$0	$0	$0	$0	$0	$0
41	2043	$0	$0	$0	$0	$0	$0	$0	$0	$0
42	2044	$0	$0	$0	$0	$0	$0	$0	$0	$0
43	2045	$0	$0	$0	$0	$0	$0	$0	$0	$0
44	2046	$0	$0	$0	$0	$0	$0	$0	$0	$0
45	2047	$0	$0	$0	$0	$0	$0	$0	$0	$0
46	2048	$0	$0	$0	$0	$0	$0	$0	$0	$0
47	2049	$0	$0	$0	$0	$0	$0	$0	$0	$0
48	2050	$0	$0	$0	$0	$0	$0	$0	$0	$0
49	2051	$0	$0	$0	$0	$0	$0	$0	$0	$0
50	2052	$0	$0	$0	$0	$0	$0	$0	$0	$0
51	2053	$59,589,497	$17,876,849	$77,466,346	$7,746,635	$3,873,317	$2,323,990	$7,746,635	$7,746,635	$29,437,212
52	2054	$59,589,497	$17,876,849	$77,466,346	$7,746,635	$3,873,317	$2,323,990	$7,746,635	$7,746,635	$29,437,212
53	2055	$0	$0	$0	$0	$0	$0	$0	$0	$0
54	2056	$0	$0	$0	$0	$0	$0	$0	$0	$0
55	2057	$0	$0	$0	$0	$0	$0	$0	$0	$0
56	2058	$0	$0	$0	$0	$0	$0	$0	$0	$0
57	2059	$0	$0	$0	$0	$0	$0	$0	$0	$0
58	2060	$0	$0	$0	$0	$0	$0	$0	$0	$0
59	2061	$0	$0	$0	$0	$0	$0	$0	$0	$0
60	2062	$0	$0	$0	$0	$0	$0	$0	$0	$0
61	2063	$0	$0	$0	$0	$0	$0	$0	$0	$0
62	2064	$0	$0	$0	$0	$0	$0	$0	$0	$0
63	2065	$0	$0	$0	$0	$0	$0	$0	$0	$0
64	2066	$0	$0	$0	$0	$0	$0	$0	$0	$0
65	2067	$0	$0	$0	$0	$0	$0	$0	$0	$0
66	2068	$0	$0	$0	$0	$0	$0	$0	$0	$0
67	2069	$0	$0	$0	$0	$0	$0	$0	$0	$0
68	2070	$0	$0	$0	$0	$0	$0	$0	$0	$0
69	2071	$0	$0	$0	$0	$0	$0	$0	$0	$0
70	2072	$0	$0	$0	$0	$0	$0	$0	$0	$0
71	2073	$0	$0	$0	$0	$0	$0	$0	$0	$0
72	2074	$0	$0	$0	$0	$0	$0	$0	$0	$0
73	2075	$0	$0	$0	$0	$0	$0	$0	$0	$0
74	2076	$0	$0	$0	$0	$0	$0	$0	$0	$0
75	2077	$0	$0	$0	$0	$0	$0	$0	$0	$0
76	2078	$23,030,480	$6,909,144	$29,939,624	$2,993,962	$1,496,981	$898,189	$2,993,962	$2,993,962	$11,377,057
77	2079	$23,030,480	$6,909,144	$29,939,624	$2,993,962	$1,496,981	$898,189	$2,993,962	$2,993,962	$11,377,057
78	2080	$0	$0	$0	$0	$0	$0	$0	$0	$0
79	2081	$0	$0	$0	$0	$0	$0	$0	$0	$0
80	2082	$0	$0	$0	$0	$0	$0	$0	$0	$0
81	2083	$0	$0	$0	$0	$0	$0	$0	$0	$0
82	2084	$0	$0	$0	$0	$0	$0	$0	$0	$0
83	2085	$0	$0	$0	$0	$0	$0	$0	$0	$0
84	2086	$0	$0	$0	$0	$0	$0	$0	$0	$0
85	2087	$0	$0	$0	$0	$0	$0	$0	$0	$0
86	2088	$0	$0	$0	$0	$0	$0	$0	$0	$0
87	2089	$0	$0	$0	$0	$0	$0	$0	$0	$0
88	2090	$0	$0	$0	$0	$0	$0	$0	$0	$0
89	2091	$0	$0	$0	$0	$0	$0	$0	$0	$0
90	2092	$0	$0	$0	$0	$0	$0	$0	$0	$0
91	2093	$0	$0	$0	$0	$0	$0	$0	$0	$0
92	2094	$0	$0	$0	$0	$0	$0	$0	$0	$0
93	2095	$0	$0	$0	$0	$0	$0	$0	$0	$0
94	2096	$0	$0	$0	$0	$0	$0	$0	$0	$0
95	2097	$0	$0	$0	$0	$0	$0	$0	$0	$0
96	2098	$0	$0	$0	$0	$0	$0	$0	$0	$0
97	2099	$0	$0	$0	$0	$0	$0	$0	$0	$0
98	2100	$0	$0	$0	$0	$0	$0	$0	$0	$0
99	2101	$0	$0	$0	$0	$0	$0	$0	$0	$0
100	2102	$0	$0	$0	$0	$0	$0	$0	$0	$0

Project Year	Year	Land Acquisition 6a Reservoir	6c,e 50' Right of Way	6d,f Intake and Pump Station	6b Reservoir Surveying	6g Surveying	**Total Land Acquisition**	Annual Costs 8a Pipeline & Distribution O&M	8b Dam and Reservoir O&M	8c Intake and Pump Stations O&M	8d,e Pumping Energy Costs	8f,g Standby Cost	**Total Annual Costs**
Construction													
Year 1													
Years 2 & 3													
Replacement													
Years 1 & 2													
1	2003	$13,500,000	$364,500	$12,000	$261,000	$37,650	$14,175,150						$0
2	2004												$0
3	2005												$0
4	2006							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
5	2007							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
6	2008							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
7	2009							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
8	2010							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
9	2011							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
10	2012							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
11	2013							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
12	2014							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
13	2015							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
14	2016							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
15	2017							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
16	2018							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
17	2019							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
18	2020							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
19	2021							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
20	2022							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
21	2023							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
22	2024							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
23	2025							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
24	2026							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
25	2027							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
26	2028							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
27	2029							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
28	2030							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
29	2031							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
30	2032							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
31	2033							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
32	2034							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
33	2035							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
34	2036							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
35	2037							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
36	2038							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
37	2039							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
38	2040							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
39	2041							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
40	2042							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
41	2043							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
42	2044							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
43	2045							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
44	2046							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
45	2047							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
46	2048							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
47	2049							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
48	2050							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
49	2051							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
50	2052							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
51	2053							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
52	2054							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
53	2055							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
54	2056							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
55	2057							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
56	2058							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
57	2059							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
58	2060							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
59	2061							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
60	2062							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
61	2063							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
62	2064							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
63	2065							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
64	2066							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
65	2067							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
66	2068							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
67	2069							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
68	2070							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
69	2071							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
70	2072							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
71	2073							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
72	2074							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
73	2075							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
74	2076							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
75	2077							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
76	2078							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
77	2079							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
78	2080							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
79	2081							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
80	2082							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
81	2083							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
82	2084							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
83	2085							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
84	2086							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
85	2087							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
86	2088							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
87	2089							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
88	2090							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
89	2091							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
90	2092							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
91	2093							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
92	2094							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
93	2095							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
94	2096							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
95	2097							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
96	2098							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
97	2099							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
98	2100							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
99	2101							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838
100	2102							$725,324	$1,155,000	$2,058,548	$1,761,966	$8,742,000	$14,442,838

Project Year	Year	TOTALS: Total Construction, Engineering (et al), and Land Acquisition Costs	Total Annual Costs	Interest During Construction	**Grand Total Costs**		Discounted Dollar Values: **Total Construction, Engineering (et al), and Land Acquisition Costs**	**Total Annual Costs**	**Discounted Grand Total Costs**
Construction				Interest					
Year 1				Rate			Federal Discount Rate		3.000%
Years 2 & 3				3.000%					
Replacement									
Years 1 & 2									
1	2003	$84,994,733	$0	$1,274,921	$86,269,654	1	$82,519,158	$0	$83,756,946
2	2004	$141,639,166	$0	$4,674,429	$146,313,596	2	$133,508,499	$0	$137,914,597
3	2005	$141,639,166	$0	$8,923,604	$150,562,771	3	$129,619,901	$0	$137,786,264
4	2006	$0	$14,442,838		$14,442,838	4	$0	$12,832,274	$12,832,274
5	2007	$0	$14,442,838		$14,442,838	5	$0	$12,458,519	$12,458,519
6	2008	$0	$14,442,838		$14,442,838	6	$0	$12,095,649	$12,095,649
7	2009	$0	$14,442,838		$14,442,838	7	$0	$11,743,349	$11,743,349
8	2010	$0	$14,442,838		$14,442,838	8	$0	$11,401,310	$11,401,310
9	2011	$0	$14,442,838		$14,442,838	9	$0	$11,069,233	$11,069,233
10	2012	$0	$14,442,838		$14,442,838	10	$0	$10,746,828	$10,746,828
11	2013	$0	$14,442,838		$14,442,838	11	$0	$10,433,813	$10,433,813
12	2014	$0	$14,442,838		$14,442,838	12	$0	$10,129,916	$10,129,916
13	2015	$0	$14,442,838		$14,442,838	13	$0	$9,834,870	$9,834,870
14	2016	$0	$14,442,838		$14,442,838	14	$0	$9,548,417	$9,548,417
15	2017	$0	$14,442,838		$14,442,838	15	$0	$9,270,308	$9,270,308
16	2018	$0	$14,442,838		$14,442,838	16	$0	$9,000,299	$9,000,299
17	2019	$0	$14,442,838		$14,442,838	17	$0	$8,738,155	$8,738,155
18	2020	$0	$14,442,838		$14,442,838	18	$0	$8,483,645	$8,483,645
19	2021	$0	$14,442,838		$14,442,838	19	$0	$8,236,549	$8,236,549
20	2022	$0	$14,442,838		$14,442,838	20	$0	$7,996,649	$7,996,649
21	2023	$0	$14,442,838		$14,442,838	21	$0	$7,763,737	$7,763,737
22	2024	$0	$14,442,838		$14,442,838	22	$0	$7,537,609	$7,537,609
23	2025	$0	$14,442,838		$14,442,838	23	$0	$7,318,067	$7,318,067
24	2026	$0	$14,442,838		$14,442,838	24	$0	$7,104,919	$7,104,919
25	2027	$0	$14,442,838		$14,442,838	25	$0	$6,897,980	$6,897,980
26	2028	$41,316,681	$14,442,838		$55,759,519	26	$19,158,327	$6,697,068	$25,855,395
27	2029	$41,316,681	$14,442,838		$55,759,519	27	$18,600,318	$6,502,008	$25,102,325
28	2030	$0	$14,442,838		$14,442,838	28	$0	$6,312,629	$6,312,629
29	2031	$0	$14,442,838		$14,442,838	29	$0	$6,128,766	$6,128,766
30	2032	$0	$14,442,838		$14,442,838	30	$0	$5,950,258	$5,950,258
31	2033	$0	$14,442,838		$14,442,838	31	$0	$5,776,950	$5,776,950
32	2034	$0	$14,442,838		$14,442,838	32	$0	$5,608,689	$5,608,689
33	2035	$0	$14,442,838		$14,442,838	33	$0	$5,445,329	$5,445,329
34	2036	$0	$14,442,838		$14,442,838	34	$0	$5,286,727	$5,286,727
35	2037	$0	$14,442,838		$14,442,838	35	$0	$5,132,745	$5,132,745
36	2038	$0	$14,442,838		$14,442,838	36	$0	$4,983,247	$4,983,247
37	2039	$0	$14,442,838		$14,442,838	37	$0	$4,838,104	$4,838,104
38	2040	$0	$14,442,838		$14,442,838	38	$0	$4,697,189	$4,697,189
39	2041	$0	$14,442,838		$14,442,838	39	$0	$4,560,377	$4,560,377
40	2042	$0	$14,442,838		$14,442,838	40	$0	$4,427,551	$4,427,551
41	2043	$0	$14,442,838		$14,442,838	41	$0	$4,298,593	$4,298,593
42	2044	$0	$14,442,838		$14,442,838	42	$0	$4,173,391	$4,173,391
43	2045	$0	$14,442,838		$14,442,838	43	$0	$4,051,836	$4,051,836
44	2046	$0	$14,442,838		$14,442,838	44	$0	$3,933,822	$3,933,822
45	2047	$0	$14,442,838		$14,442,838	45	$0	$3,819,244	$3,819,244
46	2048	$0	$14,442,838		$14,442,838	46	$0	$3,708,004	$3,708,004
47	2049	$0	$14,442,838		$14,442,838	47	$0	$3,600,004	$3,600,004
48	2050	$0	$14,442,838		$14,442,838	48	$0	$3,495,149	$3,495,149
49	2051	$0	$14,442,838		$14,442,838	49	$0	$3,393,349	$3,393,349
50	2052	$0	$14,442,838		$14,442,838	50	$0	$3,294,514	$3,294,514
51	2053	$106,903,558	$14,442,838		$121,346,396	51	$23,675,202	$3,198,557	$26,873,759
52	2054	$106,903,558	$14,442,838		$121,346,396	52	$22,985,633	$3,105,395	$26,091,028
53	2055	$0	$14,442,838		$14,442,838	53	$0	$3,014,947	$3,014,947
54	2056	$0	$14,442,838		$14,442,838	54	$0	$2,927,133	$2,927,133
55	2057	$0	$14,442,838		$14,442,838	55	$0	$2,841,876	$2,841,876
56	2058	$0	$14,442,838		$14,442,838	56	$0	$2,759,103	$2,759,103
57	2059	$0	$14,442,838		$14,442,838	57	$0	$2,678,741	$2,678,741
58	2060	$0	$14,442,838		$14,442,838	58	$0	$2,600,719	$2,600,719
59	2061	$0	$14,442,838		$14,442,838	59	$0	$2,524,970	$2,524,970
60	2062	$0	$14,442,838		$14,442,838	60	$0	$2,451,428	$2,451,428
61	2063	$0	$14,442,838		$14,442,838	61	$0	$2,380,027	$2,380,027
62	2064	$0	$14,442,838		$14,442,838	62	$0	$2,310,706	$2,310,706
63	2065	$0	$14,442,838		$14,442,838	63	$0	$2,243,403	$2,243,403
64	2066	$0	$14,442,838		$14,442,838	64	$0	$2,178,062	$2,178,062
65	2067	$0	$14,442,838		$14,442,838	65	$0	$2,114,623	$2,114,623
66	2068	$0	$14,442,838		$14,442,838	66	$0	$2,053,032	$2,053,032
67	2069	$0	$14,442,838		$14,442,838	67	$0	$1,993,235	$1,993,235
68	2070	$0	$14,442,838		$14,442,838	68	$0	$1,935,180	$1,935,180
69	2071	$0	$14,442,838		$14,442,838	69	$0	$1,878,815	$1,878,815
70	2072	$0	$14,442,838		$14,442,838	70	$0	$1,824,092	$1,824,092
71	2073	$0	$14,442,838		$14,442,838	71	$0	$1,770,963	$1,770,963
72	2074	$0	$14,442,838		$14,442,838	72	$0	$1,719,382	$1,719,382
73	2075	$0	$14,442,838		$14,442,838	73	$0	$1,669,303	$1,669,303
74	2076	$0	$14,442,838		$14,442,838	74	$0	$1,620,682	$1,620,682
75	2077	$0	$14,442,838		$14,442,838	75	$0	$1,573,478	$1,573,478
76	2078	$41,316,681	$14,442,838		$55,759,519	76	$4,370,150	$1,527,649	$5,897,799
77	2079	$41,316,681	$14,442,838		$55,759,519	77	$4,242,864	$1,483,154	$5,726,018
78	2080	$0	$14,442,838		$14,442,838	78	$0	$1,439,955	$1,439,955
79	2081	$0	$14,442,838		$14,442,838	79	$0	$1,398,015	$1,398,015
80	2082	$0	$14,442,838		$14,442,838	80	$0	$1,357,296	$1,357,296
81	2083	$0	$14,442,838		$14,442,838	81	$0	$1,317,763	$1,317,763
82	2084	$0	$14,442,838		$14,442,838	82	$0	$1,279,382	$1,279,382
83	2085	$0	$14,442,838		$14,442,838	83	$0	$1,242,118	$1,242,118
84	2086	$0	$14,442,838		$14,442,838	84	$0	$1,205,940	$1,205,940
85	2087	$0	$14,442,838		$14,442,838	85	$0	$1,170,815	$1,170,815
86	2088	$0	$14,442,838		$14,442,838	86	$0	$1,136,714	$1,136,714
87	2089	$0	$14,442,838		$14,442,838	87	$0	$1,103,606	$1,103,606
88	2090	$0	$14,442,838		$14,442,838	88	$0	$1,071,462	$1,071,462
89	2091	$0	$14,442,838		$14,442,838	89	$0	$1,040,254	$1,040,254
90	2092	$0	$14,442,838		$14,442,838	90	$0	$1,009,956	$1,009,956
91	2093	$0	$14,442,838		$14,442,838	91	$0	$980,539	$980,539
92	2094	$0	$14,442,838		$14,442,838	92	$0	$951,980	$951,980
93	2095	$0	$14,442,838		$14,442,838	93	$0	$924,253	$924,253
94	2096	$0	$14,442,838		$14,442,838	94	$0	$897,333	$897,333
95	2097	$0	$14,442,838		$14,442,838	95	$0	$871,197	$871,197
96	2098	$0	$14,442,838		$14,442,838	96	$0	$845,822	$845,822
97	2099	$0	$14,442,838		$14,442,838	97	$0	$821,186	$821,186
98	2100	$0	$14,442,838		$14,442,838	98	$0	$797,268	$797,268
99	2101	$0	$14,442,838		$14,442,838	99	$0	$774,047	$774,047
100	2102	$0	$14,442,838		$14,442,838	100	$0	$751,502	$751,502
							$ 438,680,053	$ 415,524,695	$ 868,014,996

Total Discounted Cost	$ 868,014,996
Annualized Cost	$27,469,781
Yield (ac-ft)	82,300
Total Cost/ac-ft.	**$333.78**

TABLE G-3b: COMANCHE DIVERSION (With Hydro Impacts)

		Pumping Stations				Piping					Off-Channel Res.	Construction Subtotal/Total		
		1a,d	1b,e	1c,g	1f	2a	2b,h	2c,d	2e,g	2f,i	3a	4a	4b	4c
Project Year	Year	Pump Station	Intake	Power Connection	Fish Screen	Mokelumne River to Duck Creek Res	Valves & Appurtances	Outlet Structure	Duck Creek Res/River to Outlet	Highway 12 (min.)	Off-Channel Reservoir	Total Capital Cost	Contingency	**Total Construction Cost**
													30%	
Construction		$26,958,400	$13,012,560	$6,090,000	$1,200,000	$31,737,600	$2,835,000	$1,210,950	$36,748,800	$585,684	$77,000,000	$197,378,994	$59,213,698	**$256,592,692**
Year 1		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%			
Years 2 & 3		40%	40%	40%	40%	40%	40%	40%	40%	40%	40%			
Replacement		$26,958,400	$13,012,560	$6,090,000	$1,200,000	$31,737,600	$2,835,000	$1,210,950	$36,748,800	$585,684	$77,000,000	$197,378,994	$59,213,698	**$256,592,692**
Years 1 & 2		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%			
1	2003	$5,391,680	$2,602,512	$1,218,000	$240,000	$6,347,520	$567,000	$242,190	$7,349,760	$117,137	$15,400,000	$39,475,799	$11,842,740	**$51,318,538**
2	2004	$10,783,360	$5,205,024	$2,436,000	$480,000	$12,695,040	$1,134,000	$484,380	$14,699,520	$234,274	$30,800,000	$78,951,598	$23,685,479	**$102,637,077**
3	2005	$10,783,360	$5,205,024	$2,436,000	$480,000	$12,695,040	$1,134,000	$484,380	$14,699,520	$234,274	$30,800,000	$78,951,598	$23,685,479	**$102,637,077**
4	2006											$0	$0	**$0**
5	2007											$0	$0	**$0**
6	2008											$0	$0	**$0**
7	2009											$0	$0	**$0**
8	2010											$0	$0	**$0**
9	2011											$0	$0	**$0**
10	2012											$0	$0	**$0**
11	2013											$0	$0	**$0**
12	2014											$0	$0	**$0**
13	2015											$0	$0	**$0**
14	2016											$0	$0	**$0**
15	2017											$0	$0	**$0**
16	2018											$0	$0	**$0**
17	2019											$0	$0	**$0**
18	2020											$0	$0	**$0**
19	2021											$0	$0	**$0**
20	2022											$0	$0	**$0**
21	2023											$0	$0	**$0**
22	2024											$0	$0	**$0**
23	2025											$0	$0	**$0**
24	2026											$0	$0	**$0**
25	2027											$0	$0	**$0**
26	2028	$13,479,200	$6,506,280	$3,045,000								$23,030,480	$6,909,144	**$29,939,624**
27	2029	$13,479,200	$6,506,280	$3,045,000								$23,030,480	$6,909,144	**$29,939,624**
28	2030											$0	$0	**$0**
29	2031											$0	$0	**$0**
30	2032											$0	$0	**$0**
31	2033											$0	$0	**$0**
32	2034											$0	$0	**$0**
33	2035											$0	$0	**$0**
34	2036											$0	$0	**$0**
35	2037											$0	$0	**$0**
36	2038											$0	$0	**$0**
37	2039											$0	$0	**$0**
38	2040											$0	$0	**$0**
39	2041											$0	$0	**$0**
40	2042											$0	$0	**$0**
41	2043											$0	$0	**$0**
42	2044											$0	$0	**$0**
43	2045											$0	$0	**$0**
44	2046											$0	$0	**$0**
45	2047											$0	$0	**$0**
46	2048											$0	$0	**$0**
47	2049											$0	$0	**$0**
48	2050											$0	$0	**$0**
49	2051											$0	$0	**$0**
50	2052											$0	$0	**$0**
51	2053	$13,479,200	$6,506,280	$3,045,000		$15,868,800	$1,417,500	$605,475	$18,374,400	$292,842		$59,589,497	$17,876,849	**$77,466,346**
52	2054	$13,479,200	$6,506,280	$3,045,000		$15,868,800	$1,417,500	$605,475	$18,374,400	$292,842		$59,589,497	$17,876,849	**$77,466,346**
53	2055											$0	$0	**$0**
54	2056											$0	$0	**$0**
55	2057											$0	$0	**$0**
56	2058											$0	$0	**$0**
57	2059											$0	$0	**$0**
58	2060											$0	$0	**$0**
59	2061											$0	$0	**$0**
60	2062											$0	$0	**$0**
61	2063											$0	$0	**$0**
62	2064											$0	$0	**$0**
63	2065											$0	$0	**$0**
64	2066											$0	$0	**$0**
65	2067											$0	$0	**$0**
66	2068											$0	$0	**$0**
67	2069											$0	$0	**$0**
68	2070											$0	$0	**$0**
69	2071											$0	$0	**$0**
70	2072											$0	$0	**$0**
71	2073											$0	$0	**$0**
72	2074											$0	$0	**$0**
73	2075											$0	$0	**$0**
74	2076											$0	$0	**$0**
75	2077											$0	$0	**$0**
76	2078	$13,479,200	$6,506,280	$3,045,000								$23,030,480	$6,909,144	**$29,939,624**
77	2079	$13,479,200	$6,506,280	$3,045,000								$23,030,480	$6,909,144	**$29,939,624**
78	2080											$0	$0	**$0**
79	2081											$0	$0	**$0**
80	2082											$0	$0	**$0**
81	2083											$0	$0	**$0**
82	2084											$0	$0	**$0**
83	2085											$0	$0	**$0**
84	2086											$0	$0	**$0**
85	2087											$0	$0	**$0**
86	2088											$0	$0	**$0**
87	2089											$0	$0	**$0**
88	2090											$0	$0	**$0**
89	2091											$0	$0	**$0**
90	2092											$0	$0	**$0**
91	2093											$0	$0	**$0**
92	2094											$0	$0	**$0**
93	2095											$0	$0	**$0**
94	2096											$0	$0	**$0**
95	2097											$0	$0	**$0**
96	2098											$0	$0	**$0**
97	2099											$0	$0	**$0**
98	2100											$0	$0	**$0**
99	2101											$0	$0	**$0**
100	2102											$0	$0	**$0**

		Engineering, Legal Costs, and Contingencies						Land Acquisition						Annual Costs					
		5a	5b	5c	5d	5e		6a	6c,e	6d,f	6b	6g		8a	8b	8c	8d,e	8f,g	
Project Year	Year	Engineering	Admin/Legal	Finance	Construction Management	Environmental	**Total Engineering, Legal Costs, and Contingencies**	Reservoir	50' Right of Way	Intake and Pump Station	Reservoir Surveying	Surveying	**Total Land Acquisition**	Pipeline & Distribution O&M	Dam and Reservoir O&M	Intake and Pump Stations O&M	Pumping Energy Costs	Standby Costs	**Total Annual Costs**
		10%	5%	3%	10%	10%													
Construction		$25,659,269	$12,829,635	$7,697,781	$25,659,269	$25,659,269	**$97,505,223**												
Year 1																			
Years 2 & 3																			
Replacement		$25,659,269	$12,829,635	$7,697,781	$25,659,269	$25,659,269	**$97,505,223**												
Years 1 & 2																			
1	2003	$5,131,854	$2,565,927	$1,539,556	$5,131,854	$5,131,854	**$19,501,045**	$13,500,000	$364,500	$12,000	$261,000	$37,650	**$14,175,150**						**$0**
2	2004	$10,263,708	$5,131,854	$3,079,112	$10,263,708	$10,263,708	**$39,002,089**												**$0**
3	2005	$10,263,708	$5,131,854	$3,079,112	$10,263,708	$10,263,708	**$39,002,089**												**$0**
4	2006	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
5	2007	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
6	2008	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
7	2009	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
8	2010	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
9	2011	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
10	2012	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
11	2013	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
12	2014	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
13	2015	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
14	2016	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
15	2017	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
16	2018	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
17	2019	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
18	2020	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
19	2021	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
20	2022	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
21	2023	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
22	2024	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
23	2025	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
24	2026	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
25	2027	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
26	2028	$2,993,962	$1,496,981	$898,189	$2,993,962	$2,993,962	**$11,377,057**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
27	2029	$2,993,962	$1,496,981	$898,189	$2,993,962	$2,993,962	**$11,377,057**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
28	2030	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
29	2031	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
30	2032	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
31	2033	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
32	2034	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
33	2035	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
34	2036	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
35	2037	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
36	2038	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
37	2039	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
38	2040	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
39	2041	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
40	2042	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
41	2043	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
42	2044	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
43	2045	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
44	2046	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
45	2047	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
46	2048	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
47	2049	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
48	2050	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
49	2051	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
50	2052	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
51	2053	$7,746,635	$3,873,317	$2,323,990	$7,746,635	$7,746,635	**$29,437,212**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
52	2054	$7,746,635	$3,873,317	$2,323,990	$7,746,635	$7,746,635	**$29,437,212**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
53	2055	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
54	2056	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
55	2057	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
56	2058	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
57	2059	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
58	2060	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
59	2061	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
60	2062	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
61	2063	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
62	2064	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
63	2065	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
64	2066	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
65	2067	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
66	2068	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
67	2069	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
68	2070	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
69	2071	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
70	2072	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
71	2073	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
72	2074	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
73	2075	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
74	2076	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
75	2077	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
76	2078	$2,993,962	$1,496,981	$898,189	$2,993,962	$2,993,962	**$11,377,057**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
77	2079	$2,993,962	$1,496,981	$898,189	$2,993,962	$2,993,962	**$11,377,057**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
78	2080	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
79	2081	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
80	2082	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
81	2083	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
82	2084	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
83	2085	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
84	2086	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
85	2087	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
86	2088	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
87	2089	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
88	2090	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
89	2091	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
90	2092	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
91	2093	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
92	2094	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
93	2095	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
94	2096	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
95	2097	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
96	2098	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
97	2099	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
98	2100	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
99	2101	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**
100	2102	$0	$0	$0	$0	$0	**$0**							$725,324	$1,155,000	$2,058,548	$2,020,014	$8,742,000	**$14,700,886**

		TOTALS					Discounted Dollar Values		
Project Year	Year	Total Construction, Engineering (et al), and Land Acquisition Costs	Total Annual Costs	Interest During Construction	**Grand Total Costs**		**Total Construction, Engineering (et al), and Land Acquisition Costs**	**Total Annual Costs**	**Discounted Grand Total Costs**
Construction				Interest					
Year 1				Rate			**Federal Discount Rate**		**3.000%**
Years 2 & 3				3.000%					
Replacement									
Years 1 & 2									
1	2003	$84,994,733	$0	$1,274,921	**$86,269,654**	1	$82,519,158	$0	**$83,756,946**
2	2004	$141,639,166	$0	$4,674,429	**$146,313,596**	2	$133,508,499	$0	**$137,914,597**
3	2005	$141,639,166	$0	$8,923,604	**$150,562,771**	3	$129,619,901	$0	**$137,786,264**
4	2006	$0	$14,700,886		**$14,700,886**	4	$0	$13,061,547	**$13,061,547**
5	2007	$0	$14,700,886		**$14,700,886**	5	$0	$12,681,113	**$12,681,113**
6	2008	$0	$14,700,886		**$14,700,886**	6	$0	$12,311,761	**$12,311,761**
7	2009	$0	$14,700,886		**$14,700,886**	7	$0	$11,953,166	**$11,953,166**
8	2010	$0	$14,700,886		**$14,700,886**	8	$0	$11,605,015	**$11,605,015**
9	2011	$0	$14,700,886		**$14,700,886**	9	$0	$11,267,005	**$11,267,005**
10	2012	$0	$14,700,886		**$14,700,886**	10	$0	$10,938,840	**$10,938,840**
11	2013	$0	$14,700,886		**$14,700,886**	11	$0	$10,620,233	**$10,620,233**
12	2014	$0	$14,700,886		**$14,700,886**	12	$0	$10,310,906	**$10,310,906**
13	2015	$0	$14,700,886		**$14,700,886**	13	$0	$10,010,588	**$10,010,588**
14	2016	$0	$14,700,886		**$14,700,886**	14	$0	$9,719,017	**$9,719,017**
15	2017	$0	$14,700,886		**$14,700,886**	15	$0	$9,435,939	**$9,435,939**
16	2018	$0	$14,700,886		**$14,700,886**	16	$0	$9,161,106	**$9,161,106**
17	2019	$0	$14,700,886		**$14,700,886**	17	$0	$8,894,278	**$8,894,278**
18	2020	$0	$14,700,886		**$14,700,886**	18	$0	$8,635,221	**$8,635,221**
19	2021	$0	$14,700,886		**$14,700,886**	19	$0	$8,383,710	**$8,383,710**
20	2022	$0	$14,700,886		**$14,700,886**	20	$0	$8,139,524	**$8,139,524**
21	2023	$0	$14,700,886		**$14,700,886**	21	$0	$7,902,451	**$7,902,451**
22	2024	$0	$14,700,886		**$14,700,886**	22	$0	$7,672,282	**$7,672,282**
23	2025	$0	$14,700,886		**$14,700,886**	23	$0	$7,448,818	**$7,448,818**
24	2026	$0	$14,700,886		**$14,700,886**	24	$0	$7,231,862	**$7,231,862**
25	2027	$0	$14,700,886		**$14,700,886**	25	$0	$7,021,225	**$7,021,225**
26	2028	$41,316,681	$14,700,886		**$56,017,567**	26	$19,158,327	$6,816,723	**$25,975,051**
27	2029	$41,316,681	$14,700,886		**$56,017,567**	27	$18,600,318	$6,618,178	**$25,218,496**
28	2030	$0	$14,700,886		**$14,700,886**	28	$0	$6,425,416	**$6,425,416**
29	2031	$0	$14,700,886		**$14,700,886**	29	$0	$6,238,267	**$6,238,267**
30	2032	$0	$14,700,886		**$14,700,886**	30	$0	$6,056,570	**$6,056,570**
31	2033	$0	$14,700,886		**$14,700,886**	31	$0	$5,880,165	**$5,880,165**
32	2034	$0	$14,700,886		**$14,700,886**	32	$0	$5,708,898	**$5,708,898**
33	2035	$0	$14,700,886		**$14,700,886**	33	$0	$5,542,620	**$5,542,620**
34	2036	$0	$14,700,886		**$14,700,886**	34	$0	$5,381,184	**$5,381,184**
35	2037	$0	$14,700,886		**$14,700,886**	35	$0	$5,224,451	**$5,224,451**
36	2038	$0	$14,700,886		**$14,700,886**	36	$0	$5,072,282	**$5,072,282**
37	2039	$0	$14,700,886		**$14,700,886**	37	$0	$4,924,546	**$4,924,546**
38	2040	$0	$14,700,886		**$14,700,886**	38	$0	$4,781,113	**$4,781,113**
39	2041	$0	$14,700,886		**$14,700,886**	39	$0	$4,641,857	**$4,641,857**
40	2042	$0	$14,700,886		**$14,700,886**	40	$0	$4,506,657	**$4,506,657**
41	2043	$0	$14,700,886		**$14,700,886**	41	$0	$4,375,395	**$4,375,395**
42	2044	$0	$14,700,886		**$14,700,886**	42	$0	$4,247,957	**$4,247,957**
43	2045	$0	$14,700,886		**$14,700,886**	43	$0	$4,124,230	**$4,124,230**
44	2046	$0	$14,700,886		**$14,700,886**	44	$0	$4,004,107	**$4,004,107**
45	2047	$0	$14,700,886		**$14,700,886**	45	$0	$3,887,482	**$3,887,482**
46	2048	$0	$14,700,886		**$14,700,886**	46	$0	$3,774,254	**$3,774,254**
47	2049	$0	$14,700,886		**$14,700,886**	47	$0	$3,664,325	**$3,664,325**
48	2050	$0	$14,700,886		**$14,700,886**	48	$0	$3,557,597	**$3,557,597**
49	2051	$0	$14,700,886		**$14,700,886**	49	$0	$3,453,977	**$3,453,977**
50	2052	$0	$14,700,886		**$14,700,886**	50	$0	$3,353,376	**$3,353,376**
51	2053	$106,903,558	$14,700,886		**$121,604,444**	51	$23,675,202	$3,255,705	**$26,930,907**
52	2054	$106,903,558	$14,700,886		**$121,604,444**	52	$22,985,633	$3,160,879	**$26,146,512**
53	2055	$0	$14,700,886		**$14,700,886**	53	$0	$3,068,814	**$3,068,814**
54	2056	$0	$14,700,886		**$14,700,886**	54	$0	$2,979,431	**$2,979,431**
55	2057	$0	$14,700,886		**$14,700,886**	55	$0	$2,892,652	**$2,892,652**
56	2058	$0	$14,700,886		**$14,700,886**	56	$0	$2,808,400	**$2,808,400**
57	2059	$0	$14,700,886		**$14,700,886**	57	$0	$2,726,602	**$2,726,602**
58	2060	$0	$14,700,886		**$14,700,886**	58	$0	$2,647,186	**$2,647,186**
59	2061	$0	$14,700,886		**$14,700,886**	59	$0	$2,570,084	**$2,570,084**
60	2062	$0	$14,700,886		**$14,700,886**	60	$0	$2,495,227	**$2,495,227**
61	2063	$0	$14,700,886		**$14,700,886**	61	$0	$2,422,550	**$2,422,550**
62	2064	$0	$14,700,886		**$14,700,886**	62	$0	$2,351,991	**$2,351,991**
63	2065	$0	$14,700,886		**$14,700,886**	63	$0	$2,283,486	**$2,283,486**
64	2066	$0	$14,700,886		**$14,700,886**	64	$0	$2,216,977	**$2,216,977**
65	2067	$0	$14,700,886		**$14,700,886**	65	$0	$2,152,405	**$2,152,405**
66	2068	$0	$14,700,886		**$14,700,886**	66	$0	$2,089,713	**$2,089,713**
67	2069	$0	$14,700,886		**$14,700,886**	67	$0	$2,028,848	**$2,028,848**
68	2070	$0	$14,700,886		**$14,700,886**	68	$0	$1,969,755	**$1,969,755**
69	2071	$0	$14,700,886		**$14,700,886**	69	$0	$1,912,384	**$1,912,384**
70	2072	$0	$14,700,886		**$14,700,886**	70	$0	$1,856,683	**$1,856,683**
71	2073	$0	$14,700,886		**$14,700,886**	71	$0	$1,802,605	**$1,802,605**
72	2074	$0	$14,700,886		**$14,700,886**	72	$0	$1,750,102	**$1,750,102**
73	2075	$0	$14,700,886		**$14,700,886**	73	$0	$1,699,128	**$1,699,128**
74	2076	$0	$14,700,886		**$14,700,886**	74	$0	$1,649,639	**$1,649,639**
75	2077	$0	$14,700,886		**$14,700,886**	75	$0	$1,601,591	**$1,601,591**
76	2078	$41,316,681	$14,700,886		**$56,017,567**	76	$4,370,150	$1,554,943	**$5,925,093**
77	2079	$41,316,681	$14,700,886		**$56,017,567**	77	$4,242,864	$1,509,653	**$5,752,517**
78	2080	$0	$14,700,886		**$14,700,886**	78	$0	$1,465,683	**$1,465,683**
79	2081	$0	$14,700,886		**$14,700,886**	79	$0	$1,422,993	**$1,422,993**
80	2082	$0	$14,700,886		**$14,700,886**	80	$0	$1,381,547	**$1,381,547**
81	2083	$0	$14,700,886		**$14,700,886**	81	$0	$1,341,307	**$1,341,307**
82	2084	$0	$14,700,886		**$14,700,886**	82	$0	$1,302,240	**$1,302,240**
83	2085	$0	$14,700,886		**$14,700,886**	83	$0	$1,264,311	**$1,264,311**
84	2086	$0	$14,700,886		**$14,700,886**	84	$0	$1,227,486	**$1,227,486**
85	2087	$0	$14,700,886		**$14,700,886**	85	$0	$1,191,734	**$1,191,734**
86	2088	$0	$14,700,886		**$14,700,886**	86	$0	$1,157,024	**$1,157,024**
87	2089	$0	$14,700,886		**$14,700,886**	87	$0	$1,123,324	**$1,123,324**
88	2090	$0	$14,700,886		**$14,700,886**	88	$0	$1,090,606	**$1,090,606**
89	2091	$0	$14,700,886		**$14,700,886**	89	$0	$1,058,840	**$1,058,840**
90	2092	$0	$14,700,886		**$14,700,886**	90	$0	$1,028,000	**$1,028,000**
91	2093	$0	$14,700,886		**$14,700,886**	91	$0	$998,059	**$998,059**
92	2094	$0	$14,700,886		**$14,700,886**	92	$0	$968,989	**$968,989**
93	2095	$0	$14,700,886		**$14,700,886**	93	$0	$940,766	**$940,766**
94	2096	$0	$14,700,886		**$14,700,886**	94	$0	$913,365	**$913,365**
95	2097	$0	$14,700,886		**$14,700,886**	95	$0	$886,762	**$886,762**
96	2098	$0	$14,700,886		**$14,700,886**	96	$0	$860,934	**$860,934**
97	2099	$0	$14,700,886		**$14,700,886**	97	$0	$835,858	**$835,858**
98	2100	$0	$14,700,886		**$14,700,886**	98	$0	$811,513	**$811,513**
99	2101	$0	$14,700,886		**$14,700,886**	99	$0	$787,877	**$787,877**
100	2102	$0	$14,700,886		**$14,700,886**	100	$0	$764,929	**$764,929**
							$ 438,680,053	$ 422,948,812	$ 875,439,113

Total Discounted Cost	**$ 875,439,113**
Annualized Cost	**$27,704,729**
Yield (ac-ft)	**90,300**
Total Cost/ac-ft.	**$306.81**

TABLE G-4: PARDEE DIVERSION

		Pumping Stations					Piping					Off-Channel Res.
		1c	1a,d	1e	1f	1b	2a	2b,h	2c,d	2e,g	2f,i	3a
Project Year	Year	Pump Station	Intake	Fish Screen	Power Connection	Tunneling	Mokelumne River to Duck Creek Res	Valves & Appurtances	Outlet Structure	Duck Creek Res/River to Outlet	Highway 12 (min.)	Off-Channel Reservoir
Construction		$9,465,600	$5,831,000	$1,200,000	$1,160,000	$21,315,000	$63,886,200	$3,130,400	$1,210,950	$36,748,800	$905,148	$77,000,000
Year 1		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Years 2 & 3		40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Replacement		$9,465,600	$5,831,000	$1,200,000	$1,160,000	$21,315,000	$63,886,200	$3,130,400	$1,210,950	$36,748,800	$905,148	$77,000,000
Years 1 & 2		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
1	2003	$1,893,120	$1,166,200	$240,000	$232,000	$4,263,000	$12,777,240	$626,080	$242,190	$7,349,760	$181,030	$15,400,000
2	2004	$3,786,240	$2,332,400	$480,000	$464,000	$8,526,000	$25,554,480	$1,252,160	$484,380	$14,699,520	$362,059	$30,800,000
3	2005	$3,786,240	$2,332,400	$480,000	$464,000	$8,526,000	$25,554,480	$1,252,160	$484,380	$14,699,520	$362,059	$30,800,000
26	2028	$4,732,800	$2,915,500	$600,000	$580,000							
27	2029	$4,732,800	$2,915,500	$600,000	$580,000							
51	2053	$4,732,800	$2,915,500	$600,000	$580,000		$31,943,100	$1,565,200	$605,475	$18,374,400	$452,574	
52	2054	$4,732,800	$2,915,500	$600,000	$580,000		$31,943,100	$1,565,200	$605,475	$18,374,400	$452,574	
76	2078	$4,732,800	$2,915,500	$600,000	$580,000							
77	2079	$4,732,800	$2,915,500	$600,000	$580,000							

		Subtotal/Total			Engineering, Legal Costs, and Contingencies					
		4a	4b	4c	5a	5b	5c	5d	5e	
Project Year	Year	Total Capital Cost	Contingency	**Total Construction Cost**	Engineering	Admin/Legal	Finance	Construction Management	Environmental	**Total Engineering, Legal Costs, and Contingencies**
			30%		10%	5%	3%	10%	10%	
Construction		$221,853,098	$66,555,929	$288,409,027	$28,840,903	$14,420,451	$8,652,271	$28,840,903	$28,840,903	$109,595,430
Replacement		$221,853,098	$66,555,929	$288,409,027	$28,840,903	$14,420,451	$8,652,271	$28,840,903	$28,840,903	$109,595,430
1	2003	$44,370,620	$13,311,186	$57,681,805	$5,768,181	$2,884,090	$1,730,454	$5,768,181	$5,768,181	$21,919,086
2	2004	$88,741,239	$26,622,372	$115,363,611	$11,536,361	$5,768,181	$3,460,908	$11,536,361	$11,536,361	$43,838,172
3	2005	$88,741,239	$26,622,372	$115,363,611	$11,536,361	$5,768,181	$3,460,908	$11,536,361	$11,536,361	$43,838,172
4	2006	$0	$0	$0	$0	$0	$0	$0	$0	$0
5	2007	$0	$0	$0	$0	$0	$0	$0	$0	$0
6	2008	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	2009	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	2010	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	2011	$0	$0	$0	$0	$0	$0	$0	$0	$0
10	2012	$0	$0	$0	$0	$0	$0	$0	$0	$0
11	2013	$0	$0	$0	$0	$0	$0	$0	$0	$0
12	2014	$0	$0	$0	$0	$0	$0	$0	$0	$0
13	2015	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	2016	$0	$0	$0	$0	$0	$0	$0	$0	$0
15	2017	$0	$0	$0	$0	$0	$0	$0	$0	$0
16	2018	$0	$0	$0	$0	$0	$0	$0	$0	$0
17	2019	$0	$0	$0	$0	$0	$0	$0	$0	$0
18	2020	$0	$0	$0	$0	$0	$0	$0	$0	$0
19	2021	$0	$0	$0	$0	$0	$0	$0	$0	$0
20	2022	$0	$0	$0	$0	$0	$0	$0	$0	$0
21	2023	$0	$0	$0	$0	$0	$0	$0	$0	$0
22	2024	$0	$0	$0	$0	$0	$0	$0	$0	$0
23	2025	$0	$0	$0	$0	$0	$0	$0	$0	$0
24	2026	$0	$0	$0	$0	$0	$0	$0	$0	$0
25	2027	$0	$0	$0	$0	$0	$0	$0	$0	$0
26	2028	$8,828,300	$2,648,490	$11,476,790	$1,147,679	$573,840	$344,304	$1,147,679	$1,147,679	$4,361,180
27	2029	$8,828,300	$2,648,490	$11,476,790	$1,147,679	$573,840	$344,304	$1,147,679	$1,147,679	$4,361,180
28	2030	$0	$0	$0	$0	$0	$0	$0	$0	$0
29	2031	$0	$0	$0	$0	$0	$0	$0	$0	$0
30	2032	$0	$0	$0	$0	$0	$0	$0	$0	$0
31	2033	$0	$0	$0	$0	$0	$0	$0	$0	$0
32	2034	$0	$0	$0	$0	$0	$0	$0	$0	$0
33	2035	$0	$0	$0	$0	$0	$0	$0	$0	$0
34	2036	$0	$0	$0	$0	$0	$0	$0	$0	$0
35	2037	$0	$0	$0	$0	$0	$0	$0	$0	$0
36	2038	$0	$0	$0	$0	$0	$0	$0	$0	$0
37	2039	$0	$0	$0	$0	$0	$0	$0	$0	$0
38	2040	$0	$0	$0	$0	$0	$0	$0	$0	$0
39	2041	$0	$0	$0	$0	$0	$0	$0	$0	$0
40	2042	$0	$0	$0	$0	$0	$0	$0	$0	$0
41	2043	$0	$0	$0	$0	$0	$0	$0	$0	$0
42	2044	$0	$0	$0	$0	$0	$0	$0	$0	$0
43	2045	$0	$0	$0	$0	$0	$0	$0	$0	$0
44	2046	$0	$0	$0	$0	$0	$0	$0	$0	$0
45	2047	$0	$0	$0	$0	$0	$0	$0	$0	$0
46	2048	$0	$0	$0	$0	$0	$0	$0	$0	$0
47	2049	$0	$0	$0	$0	$0	$0	$0	$0	$0
48	2050	$0	$0	$0	$0	$0	$0	$0	$0	$0
49	2051	$0	$0	$0	$0	$0	$0	$0	$0	$0
50	2052	$0	$0	$0	$0	$0	$0	$0	$0	$0
51	2053	$61,769,049	$18,530,715	$80,299,764	$8,029,976	$4,014,988	$2,408,993	$8,029,976	$8,029,976	$30,513,910
52	2054	$61,769,049	$18,530,715	$80,299,764	$8,029,976	$4,014,988	$2,408,993	$8,029,976	$8,029,976	$30,513,910
53	2055	$0	$0	$0	$0	$0	$0	$0	$0	$0
54	2056	$0	$0	$0	$0	$0	$0	$0	$0	$0
55	2057	$0	$0	$0	$0	$0	$0	$0	$0	$0
56	2058	$0	$0	$0	$0	$0	$0	$0	$0	$0
57	2059	$0	$0	$0	$0	$0	$0	$0	$0	$0
58	2060	$0	$0	$0	$0	$0	$0	$0	$0	$0
59	2061	$0	$0	$0	$0	$0	$0	$0	$0	$0
60	2062	$0	$0	$0	$0	$0	$0	$0	$0	$0
61	2063	$0	$0	$0	$0	$0	$0	$0	$0	$0
62	2064	$0	$0	$0	$0	$0	$0	$0	$0	$0
63	2065	$0	$0	$0	$0	$0	$0	$0	$0	$0
64	2066	$0	$0	$0	$0	$0	$0	$0	$0	$0
65	2067	$0	$0	$0	$0	$0	$0	$0	$0	$0
66	2068	$0	$0	$0	$0	$0	$0	$0	$0	$0
67	2069	$0	$0	$0	$0	$0	$0	$0	$0	$0
68	2070	$0	$0	$0	$0	$0	$0	$0	$0	$0
69	2071	$0	$0	$0	$0	$0	$0	$0	$0	$0
70	2072	$0	$0	$0	$0	$0	$0	$0	$0	$0
71	2073	$0	$0	$0	$0	$0	$0	$0	$0	$0
72	2074	$0	$0	$0	$0	$0	$0	$0	$0	$0
73	2075	$0	$0	$0	$0	$0	$0	$0	$0	$0
74	2076	$0	$0	$0	$0	$0	$0	$0	$0	$0
75	2077	$0	$0	$0	$0	$0	$0	$0	$0	$0
76	2078	$8,828,300	$2,648,490	$11,476,790	$1,147,679	$573,840	$344,304	$1,147,679	$1,147,679	$4,361,180
77	2079	$8,828,300	$2,648,490	$11,476,790	$1,147,679	$573,840	$344,304	$1,147,679	$1,147,679	$4,361,180
78	2080	$0	$0	$0	$0	$0	$0	$0	$0	$0
79	2081	$0	$0	$0	$0	$0	$0	$0	$0	$0
80	2082	$0	$0	$0	$0	$0	$0	$0	$0	$0
81	2083	$0	$0	$0	$0	$0	$0	$0	$0	$0
82	2084	$0	$0	$0	$0	$0	$0	$0	$0	$0
83	2085	$0	$0	$0	$0	$0	$0	$0	$0	$0
84	2086	$0	$0	$0	$0	$0	$0	$0	$0	$0
85	2087	$0	$0	$0	$0	$0	$0	$0	$0	$0
86	2088	$0	$0	$0	$0	$0	$0	$0	$0	$0
87	2089	$0	$0	$0	$0	$0	$0	$0	$0	$0
88	2090	$0	$0	$0	$0	$0	$0	$0	$0	$0
89	2091	$0	$0	$0	$0	$0	$0	$0	$0	$0
90	2092	$0	$0	$0	$0	$0	$0	$0	$0	$0
91	2093	$0	$0	$0	$0	$0	$0	$0	$0	$0
92	2094	$0	$0	$0	$0	$0	$0	$0	$0	$0
93	2095	$0	$0	$0	$0	$0	$0	$0	$0	$0
94	2096	$0	$0	$0	$0	$0	$0	$0	$0	$0
95	2097	$0	$0	$0	$0	$0	$0	$0	$0	$0
96	2098	$0	$0	$0	$0	$0	$0	$0	$0	$0
97	2099	$0	$0	$0	$0	$0	$0	$0	$0	$0
98	2100	$0	$0	$0	$0	$0	$0	$0	$0	$0
99	2101	$0	$0	$0	$0	$0	$0	$0	$0	$0
100	2102	$0	$0	$0	$0	$0	$0	$0	$0	$0

		Land Acquisition					
		6a	6c,d	6e	6b	6f	
Project Year	Year	Reservoir	50' Right of Way	Intake and Pump Station	Reservoir Surveying	Surveying	**Total Land Acquisition**
1	2003	$13,500,000	$396,000	$6,000	$261,000	$40,200	$14,203,200

		Annual Costs						TOTALS					Discounted Dollar Values		
		8a	8b	8c	8d	8e									
Project Year	Year	Pipeline & Distribution O&M	Dam and Reservoir O&M	Intake O&M	Pumping Energy Costs	Standby Costs	**Total Annual Costs**	Total Construction, Engineering (et al), and Land Acquisition Costs	Total Annual Costs	Interest During Construction	**Grand Total Costs**		**Total Construction, Engineering (et al), and Land Acquisition Costs**	**Total Annual Costs**	**Discounted Grand Total Costs**
Construction										Interest Rate 3.000%					
Year 1													**Federal Discount Rate**		**3.000%**
1	2003						$0	**$93,804,092**	$0	$1,407,061	**$95,211,153**	1	$91,071,934	-	92,438,013
2	2004						$0	**$159,201,783**	$0	$5,202,149	$164,403,933	2	150,062,950	-	154,966,474
3	2005						$0	**$159,201,783**	$0	$9,978,203	$169,179,986	3	145,692,184	-	154,823,653
4	2006	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	4	-	4,872,360	4,872,360
5	2007	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	5	-	4,730,447	4,730,447
6	2008	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	6	-	4,592,667	4,592,667
7	2009	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	7	-	4,458,900	4,458,900
8	2010	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	8	-	4,329,029	4,329,029
9	2011	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	9	-	4,202,940	4,202,940
10	2012	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	10	-	4,080,525	4,080,525
11	2013	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	11	-	3,961,674	3,961,674
12	2014	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	12	-	3,846,286	3,846,286
13	2015	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	13	-	3,734,258	3,734,258
14	2016	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	14	-	3,625,493	3,625,493
15	2017	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	15	-	3,519,896	3,519,896
16	2018	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	16	-	3,417,375	3,417,375
17	2019	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	17	-	3,317,840	3,317,840
18	2020	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	18	-	3,221,204	3,221,204
19	2021	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	19	-	3,127,382	3,127,382
20	2022	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	20	-	3,036,294	3,036,294
21	2023	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	21	-	2,947,858	2,947,858
22	2024	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	22	-	2,861,998	2,861,998
23	2025	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	23	-	2,778,639	2,778,639
24	2026	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	24	-	2,697,708	2,697,708
25	2027	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	25	-	2,619,134	2,619,134
26	2028	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$15,837,970	$5,483,884		$21,321,854	26	7,343,983	2,542,848	9,886,831
27	2029	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$15,837,970	$5,483,884		$21,321,854	27	7,130,081	2,468,785	9,598,865
28	2030	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	28	-	2,396,878	2,396,878
29	2031	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	29	-	2,327,066	2,327,066
30	2032	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	30	-	2,259,288	2,259,288
31	2033	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	31	-	2,193,483	2,193,483
32	2034	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	32	-	2,129,595	2,129,595
33	2035	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	33	-	2,067,568	2,067,568
34	2036	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	34	-	2,007,348	2,007,348
35	2037	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	35	-	1,948,881	1,948,881
36	2038	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	36	-	1,892,118	1,892,118
37	2039	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	37	-	1,837,008	1,837,008
38	2040	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	38	-	1,783,502	1,783,502
39	2041	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	39	-	1,731,556	1,731,556
40	2042	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	40	-	1,681,122	1,681,122
41	2043	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	41	-	1,632,157	1,632,157
42	2044	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	42	-	1,584,619	1,584,619
43	2045	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	43	-	1,538,465	1,538,465
44	2046	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	44	-	1,493,655	1,493,655
45	2047	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	45	-	1,450,151	1,450,151
46	2048	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	46	-	1,407,913	1,407,913
47	2049	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	47	-	1,366,906	1,366,906
48	2050	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	48	-	1,327,093	1,327,093
49	2051	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	49	-	1,288,440	1,288,440
50	2052	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	50	-	1,250,913	1,250,913
51	2053	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$110,813,674	$5,483,884		$116,297,558	51	24,541,149	1,214,478	25,755,627
52	2054	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$110,813,674	$5,483,884		$116,297,558	52	23,826,358	1,179,105	25,005,464
53	2055	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	53	-	1,144,762	1,144,762
54	2056	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	54	-	1,111,420	1,111,420
55	2057	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	55	-	1,079,048	1,079,048
56	2058	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	56	-	1,047,620	1,047,620
57	2059	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	57	-	1,017,107	1,017,107
58	2060	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	58	-	987,482	987,482
59	2061	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	59	-	958,720	958,720
60	2062	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	60	-	930,797	930,797
61	2063	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	61	-	903,686	903,686
62	2064	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	62	-	877,365	877,365
63	2065	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	63	-	851,811	851,811
64	2066	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	64	-	827,001	827,001
65	2067	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	65	-	802,913	802,913
66	2068	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	66	-	779,527	779,527
67	2069	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	67	-	756,823	756,823
68	2070	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	68	-	734,779	734,779
69	2071	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	69	-	713,378	713,378
70	2072	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	70	-	692,600	692,600
71	2073	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	71	-	672,427	672,427
72	2074	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	72	-	652,842	652,842
73	2075	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	73	-	633,827	633,827
74	2076	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	74	-	615,366	615,366
75	2077	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	75	-	597,443	597,443
76	2078	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$15,837,970	$5,483,884		$21,321,854	76	1,675,215	580,042	2,255,256
77	2079	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$15,837,970	$5,483,884		$21,321,854	77	1,626,422	563,147	2,189,569
78	2080	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	78	-	546,745	546,745
79	2081	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	79	-	530,820	530,820
80	2082	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	80	-	515,359	515,359
81	2083	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	81	-	500,349	500,349
82	2084	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	82	-	485,776	485,776
83	2085	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	83	-	471,627	471,627
84	2086	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	84	-	457,890	457,890
85	2087	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	85	-	444,554	444,554
86	2088	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	86	-	431,605	431,605
87	2089	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	87	-	419,034	419,034
88	2090	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	88	-	406,830	406,830
89	2091	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	89	-	394,980	394,980
90	2092	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	90	-	383,476	383,476
91	2093	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	91	-	372,307	372,307
92	2094	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	92	-	361,463	361,463
93	2095	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	93	-	350,935	350,935
94	2096	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	94	-	340,713	340,713
95	2097	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	95	-	330,790	330,790
96	2098	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	96	-	321,155	321,155
97	2099	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	97	-	311,801	311,801
98	2100	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	98	-	302,719	302,719
99	2101	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	99	-	293,902	293,902
100	2102	$1,262,914	$1,155,000	$824,830	$549,140	$1,692,000	$5,483,884	$0	$5,483,884		$5,483,884	100	-	285,342	285,342
													##########	##########	$ 626,144,303

Total Discounted Cost	**$ 626,144,303**
Annualized Cost	**$19,815,380**
Yield (ac-ft)	**82,300**
Total Cost/ac-ft.	**$240.77**