1.0 Purpose and Need

The Western Area Power Administration (Western), created in 1977 under the Department of Energy (DOE) Organization Act (Public Law 95-91), markets and transmits electric power throughout 15 western states. Western's Sierra Nevada Customer Service Region (Sierra Nevada Region) markets approximately 1,480 megawatts (MW) of power from the Central Valley Project (CVP) and other sources and markets nonfirm energy from the Washoe Project. The Sierra Nevada Region's marketing area is shown in Figure 1.1.

Western's mission is to market and transmit electricity that is in excess of CVP Project Use (power required for project operations), which for the Sierra Nevada Region is generated from CVP and Washoe Project powerplants. Western's power marketing responsibility includes managing and maintaining the Federal transmission system to interconnected utility systems. The hydroelectric generation facilities of the CVP are operated by the Bureau of Reclamation (Reclamation). Reclamation manages and releases water in accordance with the various acts authorizing specific projects and with other enabling legislation. Western's capacity and energy sales must be in conformance with the laws that govern its sale of electrical power. Further, hydropower operations at each facility comply with water flows and other constraints set by Reclamation, the U.S. Fish and Wildlife Service (the Service), and other regulatory agencies, acting in accordance with laws, regulations, and policies.

1.1 Proposed Action

Existing contracts for the sale of Sierra Nevada Region power resources expire in the year 2004. The Sierra Nevada Region proposes to develop a marketing plan that defines the prod ucts and services to be offered and the eligibility and allocation criteria that will lead to alloca tions of CVP and Washoe Project electric power resources beyond the year 2004. Because determining levels of long-term firm power resources to be marketed and subsequently enter ing into contracts for the delivery of related products and services could be a major Federal action with potentially significant impacts to the human environment, this 2004 Power Market ing Program Final Environmental Impact Statement (2004 EIS) is being prepared in compli ance with the National Environmental Policy Act of 1969 (NEPA), as amended, and associated implementing regulations, particularly Council on Environmental Quality regulations (40 CFR Parts 1500-1508) and DOE regulations (10 CFR Part 1021). This 2004 EIS describes the environmental consequences of the range of reasonable marketing plan alternatives that meet the following needs (Section 1.2) and satisfy the purposes of the proposed 2004 Power Mar keting Plan (2004 Plan) (Section 1.3).

Figure 1.1. Sierra Nevada Region Marketing Area

The 2004 EIS is intended to support decisions related to the development and adoption of Sierra Nevada Region's 2004 Plan. Resulting power allocations to customers will occur in a separate public process under the Administrative Procedures Act (APA). Because of the com plexity of power marketing, industry changes (restructuring) now underway, and the need to remain economically viable in a highly competitive and rapidly changing marketplace, the 2004 Plan will establish the framework within which Sierra Nevada Region's power marketing decisions will be made. The 2004 Plan will provide the necessary flexibility to allow Western on an ongoing basis to adapt its marketing decisions to changing economic conditions and to the changing demands and needs of its customers.

It is important to understand that the 2004 EIS analyses intentionally encompass the more extreme cases to ensure that any specific marketing plan constructed will be within the range of options studied. Where necessary for consideration of non-linear relationships between the extremes, the 2004 EIS also examines selected interior points. The analyses indicated that any specific marketing plan that fits within the ranges studied will not generate significant environ mental impacts if implemented. Establishing the specific provisions of the final 2004 Plan is more appropriately conducted under the APA public process, which can proceed without any need to reassess environmental impacts every time a provision changes or a final value is determined. Within the 2004 EIS, this approach is referred to as a "tent stakes" approach, which is illustrated in Figure 1.2.

Figure 1.2. The Tent Stakes Approach for Examining the Limits of the Alternatives

The 2004 EIS is not merely intended to support a one-time decision but to support a flexible and adaptive marketing program that will allow decisions to conform to current industry stan dards. Some changes will be made relatively infrequently, such as contract renewals, and some could be made hourly, such as supplemental power purchases. Alternatives are inten tionally not assembled into complete, cohesive power products because such an approach is not necessary to capture the range of anticipated impacts and to provide opportunities for mitiga tion and for avoiding impacts. Some "what if" scenarios, such as removal of allocations to certain customer groups, are included to identify the environmental impact sensitivity of shift ing allocations and to cover the range of available options. However, a preferred alternative has been selected that fits between the extremes.

Certain assumptions guided the impact analyses. For river operations at generating and regu lating facilities, the impact analyses assumed water fluctuations will remain within constraints established by the facility design and by flood control, temperature, and environmental param eters that normally govern Reclamation dam and river operations, including anticipated changes that may result from implementation of the Central Valley Project Improvement Act (CVPIA). It was assumed that although many power customers do not own transmission or generating facilities, new open access opportunities through electric utility market restructur ing will make such resources universally available at market rates, so customers' access will be similar to the Sierra Nevada Region's access. Market costs for power in the year 2005 were projected, as were anticipated costs for

Sierra Nevada Region's power products. Power rates and rate structure (i.e., the amounts to be charged to Western's customers) will be set through separate public processes and designed to recover power costs. The year 2005 was selected for the EIS analyses because it is the first year beyond expiration of the present power contracts. Future years beyond 2005 were not analyzed because of the increasing difficulty of projecting future conditions, especially in light of the major changes occurring in the utility industry, and because preliminary results of the impact analysis showed only minor environ mental impacts.

1.2 Need for the Proposed Action

The Sierra Nevada Region needs to determine the level and character of capacity, energy, and other services that will be marketed beyond 2004. These services would be developed by combining potential hydropower operating approaches with power purchases. The Sierra Nevada Region also needs to establish eligibility and allocation criteria for the allocations of electric power resources to be marketed under contracts that will replace those expiring in 2004.

1.3 Purpose of the Proposed Action

In implementing the proposed action, the Sierra Nevada Region plans to achieve a balanced mix of purposes. The purposes of the 2004 Plan are listed below (in no particular order):

- to be consistent with Sierra Nevada Region's statutory and other legal constraints
- to provide long-term resource and contractual stability for the Sierra Nevada Region and for customers contracting with the Sierra Nevada Region
- to provide the greatest practical value of the power resource to the Sierra Nevada Region and to customers contracting with the Sierra Nevada Region
- to protect the natural environment
- to be responsive to future changes in the CVP, the Washoe Project, and the utility industry.

1.4 Statutory and Other Legal Constraints

As noted in the purposes listed above, Western's statutory framework defines the agency's actions and, therefore, the scope of this 2004 EIS with regard to how the Sierra Nevada Region will develop and implement the 2004 Plan. Statutory and other legal guidelines were described in Sierra Nevada Region's *Components Relationships Study* (CRS) (Western 1995b) and are summarized in Appendix A of this document.

1.5 Public Involvement

The Sierra Nevada Region developed and followed a Public Involvement Plan in the EIS proc ess. The Public Involvement Plan was designed to guide the Sierra Nevada Region through a collaborative and systematic decision-making process and provide opportunities for input from the public and interested parties and agencies. The primary purposes of public involvement, as set out in the Public Involvement Plan, were to

- inform the public
- gather information from the public to identify public concerns and values
- develop and maintain credibility that the Sierra Nevada Region will responsibly address environmental and allocation concerns and consider them in decision making.

The public participation process for the 2004 EIS has been integrated with the public involve ment needs of developing the marketing plan to ensure issues can be addressed in the appropri ate process. The two separate public processes required by NEPA and the APA have similar coordination needs involving the public. In this NEPA process, the focus was on the environ mental impacts of a range of marketing alternatives. The APA process gives the public an opportunity to participate in administrative rulemaking and gives the public a chance to pro vide input into the government rules and regulations that affect them.

The EIS Public Involvement Plan had six steps:

1. Pre-Scoping Meetings and Comment Tracking. A series of approximately 25 pre-scoping stakeholder meetings (involving customers, agencies, interested groups, and individuals) were informally held during the summer of 1993 to discuss issues and concerns related to the proj ect. These informal public meetings introduced the Sierra Nevada Region and its operations and jurisdictions, the 2004 EIS process and schedule, the future 2004 Plan process, and public input opportunities. The public meetings helped identify interested and affected parties and elicited comments for consideration in shaping the 2004 EIS process.

Computer database - A computer database was designed and implemented to serve several project functions. The database maintains a list of groups and individuals that may be inter ested in the progress and outcome of the project. Interest has been solicited throughout the process by asking interested parties to contact us by letter or by telephone and to return project interest cards, comment cards, address list updates, and 2004 EIS feedback cards. This list has been updated throughout the environmental review process and presently contains approximately 430 entries.

The computer database also ensured that all issues brought forth through scoping were identi fied and tracked as individual entries. The database was designed as a comment tracking sys tem to ensure that all comments received were addressed at appropriate times in the process under the correct subject. For example, a person may have made comments on two or three topics. These comments were entered into the comment tracking system separately for each issue discussed. Comments received concerning the 2004 EIS were entered into the tracking system and sorted by topic to assist in providing an efficient framework for responses. Responses were also retained in the database.

2. Development of Information Update. The *2004 EIS Update,* a periodic bulletin, was developed to inform customers, agencies, and interested parties of project progress and to encourage public involvement during the 2004 EIS process and the 2004 Plan development. To date, 12 issues have been distributed to interested individuals and organizations.

3. Consultation and Coordination. The scoping process provided public input on the range of actions, alternatives, and impacts to be considered. The *Federal Register* notice of the scoping period was published on August 10 and 13, 1993 (58 FR 42536 and 58 FR 43105). In con junction with the notice, a news release was sent to local newspapers, and scoping invitation letters were mailed to those on the interested parties mailing list. Scoping meetings were con ducted at key locations and times within Sierra Nevada Region's market area (Fresno on August 30, 1993; Sacramento on September 1, 1993; and Redding on September 2, 1993). The Sierra Nevada Region received a number of written and verbal comments from customers, agencies, interested parties, and the public. These comments were used to determine issues and components to consider for analysis associated with the proposed action and development of alternatives to help identify the scope of the environmental analyses.

Cooperating and Consulting Agencies - The 2004 EIS also reflects comments by cooperating and consulting agencies. Reclamation is a cooperating agency, and the Service and the National Marine Fisheries Service (NMFS) are consulting agencies.

4. 2004 EIS Public Issues and Alternatives Workshops. Based upon the interest generated through scoping, two public workshops were held in Sacramento (May 18, 1994, Issues and Alternatives Public Workshop and January 18, 1995, EIS Alternatives Workshop). The workshops (as well as the CRS) were conducted to further clarify and refine issues. Alterna tives considered in the 2004 EIS were developed with input from the workshops. Comments received were entered into the comment tracking data system. The 2004 EIS Implementation Plan (Western 1995c) identified how these comments would affect the scope of the 2004 EIS.

5. Public Review and Comments on the draft 2004 EIS. The draft 2004 EIS was distributed to interested parties and agencies for public review and comment. The draft summary for the project was distributed to the entire project mailing list. Notice of the availability of the draft 2004 EIS was published in the *Federal Register* (61 FR 26174 and 61 FR 26177). Comments received were entered into the comment tracking database to identify, track, analyze, and facilitate response. A public hearing was held to receive formal comments on the draft 2004 EIS. The comments and responses are included in Appendix O.

6. Publish Notices of Availability of the final 2004 EIS and record of decision (ROD). Notices of the availability of the final 2004 EIS and subsequent ROD will be published in the *Federal Register*. The ROD will identify the decisions reached and the rationale for these decisions.

The Public Involvement Plan offered the following wide range of communication tools to inform and involve the public:

- fact sheets
- briefing packets
- 2004 EIS Update informational bulletins
- comment forms and interest cards
- news releases
- *Federal Register* notices
- mailing list
- computer database
- Implementation Plan
- 2004 EIS public information meetings and hearings
- time periods allowed for public comment.

The Sierra Nevada Region prepared an *EIS Implementation Plan* (Implementation Plan) for the 2004 Power Marketing Program (Western 1995c). The Implementation Plan recorded the results of the scoping process, including a summary of the key issues raised during scoping and how they would be addressed in the 2004 EIS. It also served as a guide to preparing the 2004 EIS by describing the purpose and need for the project, anticipated consultation with other agencies, opportunities for public review in the 2004 EIS process, and coordination with other related EIS projects under concurrent development. The Implementation Plan was pub lished in March 1995. Copies of the Implementation Plan can be obtained by contacting the Project Manager of the Sierra Nevada Regional Office as listed on the cover sheet of this 2004 EIS.

1.6 Relationship of the 2004 EIS to Other Actions and NEPA Processes

This section describes actions and processes that are related to the 2004 EIS. Some of the acti vities are part of processes requiring compliance under NEPA; all influence the affected envi ronment and potential alternatives available to the Sierra Nevada Region for the 2004 EIS. Figure 1.3 shows how these other processes relate to the 2004 EIS.

1.6.1 Relationship to Interior's CVPIA PEIS

Title 34 of Public Law 102-575, the CVPIA, was enacted on October 30, 1992. Section 3409 of the CVPIA directs the Secretary of the Interior to prepare a programmatic EIS (PEIS) "analyzing the direct and indirect impacts and benefits of implementing this title, including all fish, wildlife, and habitat restoration actions and the potential renewal of all existing CVP water contracts. Such statement shall consider impacts and benefits within the Sacramento, San Joaquin, and Trinity River basins, and the San Francisco Bay/Sacramento-San Joaquin River Delta Estuary."

This PEIS, and subsequent NEPA documents that may be tiered from it, will result in changes to river and dam operations within the CVP system. New operational constraints intended to benefit fish, wildlife, and associated habitats may affect the amount of hydropower the Sierra Nevada Region has to sell and will almost certainly affect the timing of operations. Existing operations and potential changes are described in the CRS (Western 1995b). Assumptions about potential river operations made to support the analyses included in the 2004 EIS are described in the modeling report (Western 1997).

The U.S. Department of the Interior's (Interior's) PEIS process and the 2004 EIS process are related because the results of the PEIS will determine the water available for power genera tion. These processes address different proposed actions related to the CVP, have different needs and purposes, and have different lead agencies. The Sierra Nevada Region is a cooper ating agency in Interior's PEIS process; Reclamation is the lead agency for Interior's PEIS. Reclamation is a cooperating agency for the 2004 EIS. The Service is a consulting agency for the 2004 EIS and a cooperating agency for the PEIS. Reclamation and the Service are co- leads for implementation of the CVPIA.

1.6.2 Relationship to EPAMP EIS

Western published a final EIS (Western 1995a) that replaced its Guidelines and Acceptance Criteria for the Conservation and Renewable Energy Program with its new two-part Energy Planning and Management Program (EPAMP). Many alternatives presented in the EPAMP

Figure 1.3. Relationship of Other Internal and External

Environmental Processes to the 2004 EIS

EIS directly tie the extension of commitments for Western's hydroelectric resources to long- term planning and the efficient use of electric energy by Western's customers.

In the EPAMP EIS, Western analyzed the potential effects of implementing integrated resource planning requirements established in the Energy Policy Act of 1992 (EPAct) and power mar keting provisions. EPAct requires Western's long-term firm power customers to develop and implement integrated resource plans (IRPs). The EPAMP EIS analyzed impacts arising from 13 alternatives that incorporated the following features:

- Contract extension periods ranged from 10 to 35 years. Shorter contract periods were found to increase the uncertainty in power supply for Western's customers. Increased uncertainty was found to result in slight increases in generation and powerplant con struction.
- The percentage of available marketable resources was considered that would be included in allocations to existing customers. The EPAMP EIS found that the greater the percentage of marketable resources made available to existing customers the greater the certainty that exists in the market. As the percentage of Western's marketable resources allocated to existing customers shrinks, the customers may react with greater levels of powerplant construction, generation, or power purchases over time.

- Resource pools varied up to 10 percent of available marketable resources. These pools could be used to support existing customers in developing new conservation or renew able energy technologies, for allocations to new customers, or for contingencies. The size of resource pools offsets Western's resources available for commitment, poten tially increasing powerplant construction and generation. The manner in which the resource pool may be used was not assessed.
- Resource adjustment provisions allowed for contract adjustments over the life of sales contracts. Adjustment provisions ranged from none for some sales contracts to two over a 35-year contract. Some alternatives included adjustments on 5 years notice for limited purposes. Adjustment provisions were coupled with contract length and were not independently assessed.
- Penalty provisions were included in the program as specified in EPAct for failure to comply with IRP requirements. Penalty provisions were not independently assessed.
- The IRP requirements as specified in EPAct were analyzed. The IRP was found to increase investments in demand side management programs and tended to result in environmental benefits.
- Planning options other than IRP were included in the program for certain smaller cus tomers as specified in EPAct. These options are very similar to IRP and apply to only a small number of customers; thus, they were not independently assessed.

In the EPAMP EIS, all alternatives are neutral with respect to river and dam operations, even though some may offer Western more flexibility in responding to operational changes stem ming from other actions or projects. In contrast, this 2004 EIS analyzes potential changes in power generation timing and regulating reservoir inflows. Flows downstream of regulating reservoirs would not be affected because Reclamation has control over these releases. The Sierra Nevada Region may not generate power in such a manner that would force a change in regulating reservoir releases.

The EPAMP EIS analyzed program provisions over Western's entire 15-state region. Many EPAMP power marketing and IRP provisions are incorporated into the 2004 EIS alternatives by reference (see Section 2.2.3). Three issues analyzed in the EPAMP EIS that do not require further analysis in the 2004 EIS are provisions to require Western's customers to complete IRPs, sales contract length, and the establishment of resource pools.

Western has implemented in the Sierra Nevada Region the IRP requirements assessed in the EPAMP EIS. Actions related to contract extensions and the percentage of marketable resource available for allocations have not yet been implemented, pending completion of the 2004 EIS and the Power Marketing Plan.

1.6.3 Relationship to Trinity River Studies

A combined EIS/environmental impact report (EIR)(1) has been initiated by Reclamation, the Service, the Hoopa Indian Tribe, and Trinity County to address, among other things, potential changes in the Trinity River flow regime, instream habitat improvements for fishery enhance ment, and potential reductions in the amount of hydroelectric power available for marketing. These changes may reduce water diversions from the Trinity Basin into the Sacramento River Basin, which have been the norm since construction of Trinity Dam in 1963. The diverted water is used to generate power at Carr, Spring Creek, and Keswick powerplants. For every acre-foot of water not diverted, approximately 1,100 kilowatt-hours (kWh) of electric power generation are foregone.

In 1984, the Trinity River Basin Fish and Wildlife Restoration Act was passed. The Act pro vided funding to implement a program to restore fish and wildlife populations to levels that existed just prior to the construction of the Trinity River Division in 1963. A result of the Act will be a set of recommendations related to the management of flows from the Trinity River Division to the Trinity River. During the studies authorized by the Act, flow is set at 340,000 acre-feet (acre-ft) of water per year. Existing operations and potential changes are described in the CRS (Western 1995b). Assumptions made about Trinity River releases to the Sacra mento River are described in the modeling report (Western 1997). The Sierra Nevada Region is a cooperating agency on the Trinity River EIS.

1.6.4 Relationship to CALFED Bay/Delta Program

Joint efforts of the U.S. Environmental Protection Agency (EPA) and State Water Resources Control Board (SWRCB) to establish new water quality standards for the San Francisco Bay- San Joaquin/Sacramento River Delta Estuary (Bay/Delta) expanded in 1995 to encompass broader program objectives addressing water supply, ecosystem restoration, and levee mainte nance as well as water quality. The expanded program operates under the policy guidance of CALFED, a consortium of five state agencies (California Resources, Department of Water Resouces, Department of Fish and Game, California Environmental Protection Agency, and SWRCB) and five federal agencies (Interior, Bureau of Reclamation, Fish and Wildlife Ser vice, NMFS, and EPA, with the U.S. Army Corps of Engineers as a cooperating agency). The Bay/Delta Program may result in decisions affecting river operations including flow levels and timing that have the potential to affect power production from CVP hydroelectric genera tion plants. The Bay/Delta Program is preparing an EIS to address impacts of the decisions that may come from that program.

1.6.5 Relationship to the Westernwide Resource Acquisition Planning Public Process

Section 111 of EPAct specifies that nonregulated utilities with over 500 million kWh of annual sales not for resale must consider the adoption of IRP. Power sales from the CVP to end users exceed this threshold level.

Under a public process separate from the 2004 EIS, Western published resource acquisition principles on June 9, 1995 (60 FR 30533), that will serve as guidelines for project-specific acquisition of power resources (supply side and demand side) and for Western's transmission planning program. These guidelines provide for a separate public process to develop procedures on a project-by-project basis for future power purchases. The 2004 EIS does assess different levels of power purchases, including special emphasis on acquiring or supporting acquisition of renewable resources. Future purchases will be evaluated in the resource acquisition process, analyzed for potential environmental effects, and, as needed, documented under NEPA.

1.6.6 Relationship to FERC's NOPR and EIS on Transmission Services

The Federal Energy Regulatory Commission (FERC) published on April 24, 1996, its notice of Final Rule and EIS on *Promoting Wholesale Competition Through Open Access Non- Discriminatory Transmission Services by Public Utilities (RM95-8-000)* and *Recovery of Stranded Costs by Public Utilities and Transmitting Utilities (RM94-7-001)* and its Notice of Final Rule on *Open Access Same-Time Information Systems* (formerly *Real-Time Information Networks*) and *Standards of Conduct* (RM95-9-000). According to FERC, these three final, interrelated rules are designed to remove impediments to competition in the wholesale bulk power marketplace and to bring more efficient, lower cost power to all sellers and buyers involved in interstate commerce. The legal and policy cornerstone of these rules is to remedy undue discrimination in access to the monoply-owned transmission wires that control whether and to whom electricity can be transported in interstate commerce. A second critical aspect of the rules is to address recovery of the transition costs of moving from a monopoly-regulated regime to one in which all sellers can compete on a fair basis and in which electricity is more competitively priced. FERC's actions to increase access to transmission may affect Sierra Nevada Region's power marketing policies. The impacts of increased access are analyzed in FERC's EIS and are not analyzed in the 2004 EIS.

In light of the changing structure in the power industry, Sierra Nevada Region's transmission services may be marketed separately from power sales. The Sierra Nevada Region's trans mission capacity may be sold as a separate service directly to a customer or integrated with facilities owned by others in the region and operated as a regional transmission grid. Open access may give the Sierra Nevada Region additional access to purchase power from the Desert Southwest region by allowing the agency to move power over existing transmission lines owned by other entities.

1.6.7 Relationship to the California State Law on Electric Utility Industry Restructuring

In 1995, the California Public Utilities Commission (CPUC) ordered the restructuring of the State electric utility industry (Decision 95-12-063 as modified by D.96-01-009). These deci sions have been incorporated into legislation that was signed by the Governor on Septem ber 23, 1996 (Assembly Bill [AB] 1890). The restructuring law is an attempt to lower retail electricity prices by introducing competition and new market mechanisms. A likely outcome of this law is an open retail market for power resources. Sierra Nevada Region's utility custo mers already have access to competitive wholesale markets but may also see retail competition and rights to transmission access extended to their customers. To the extent that the Sierra Nevada Region and its customers have access to the same sources of power and are likely to make similar types of purchases, there may be a reduced need for the Sierra Nevada Region to purchase firming power to support its hydroelectric resources. Access to competitive whole sale markets is scheduled for implementation starting January 1, 1998, for the State's regulated utilities. The CPUC is preparing an EIR to assess the effects of implementing this proposal, which may also affect the Sierra Nevada Region.

Assembly Bill 1890 of 1996 and ongoing planning that will restructure the California electric utility industry are expected to, among other things, result in the development of a Power Exchange and Independent System Operator (ISO). The ISO is mandated with providing open access to the California transmission system. This will result in all Sierra Nevada Region's customers having equal access to the transmission system.

The Power Exchange will provide an hour-to-hour source of power at market price. For the Sierra Nevada Region to competitively supply power to customers, it will need to price its power at or below market price. To the extent a customer is unable to purchase sufficient Sierra Nevada Region power economically, the customer may purchase energy from the Power Exchange or other market sources. The Power Exchange is expected to become the bench mark for the pricing of energy. Exactly how power transactions will contractually take place in 2005 is unknown. However, the Sierra Nevada Region's 2004 Plan is not going to affect the outcome of how these markets develop.

These probable changes in California's energy market have been incorporated into this final 2004 EIS. In comparison with the draft 2004 EIS, the environmental effects identified in the final 2004 EIS tend to be smaller with less variation across the alternatives. This is especially true for socioeconomic effects. The reduction in the magnitude of impacts results from a more efficiently operated market that provides greater flexibility and access.

It is likely that the Sierra Nevada Region and its customers may use the Power Exchange for some of its purchases. Given the small percentage of California load represented by the Sierra Nevada Region's customers and assuming the economic dispatch of resources and the same mix of resources available to the California market, the Sierra Nevada Region may use the Power Exchange, and its use would not result in environmental impacts. If the Power Exchange creates a new mix of resources, this change would be attributable to the Power Exchange itself, not to the Sierra Nevada Region's choice to use the Power Exchange.

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[a]An EIR is an environmental impact report prepared under the California Environmental Quality Act (California Public Resources Code, Section 21000 *et seq*).

2.0 Description of Alternatives Including the No-Action Alternative

This chapter identifies and compares Sierra Nevada Region's power marketing alternatives including the no-action alternative. Section 2.1 describes background information related to Sierra Nevada Region's existing programs and activities. Section 2.2 describes the components considered for the alternatives, how they were identified and developed, and why some issues were not incorporated into the alternatives. Section 2.3 describes the range of alternatives assessed in this 2004 EIS. The last section, 2.4, summarizes the environmental impacts associated with each alternative.

2.1 Background and Current Marketing Activities

The DOE Organization Act transferred power marketing functions from Reclamation to Western in 1977. In accordance with this Act, Western assumed the responsibilities of planning, designing, constructing, operating, and maintaining transmission systems; marketing Federal power; and setting power rates to ensure sufficient revenues necessary to meet repayment obligations. In March 1980, Western and Reclamation entered into an agreement that further defined the transfer of functions and responsibilities. Power dispatch functions were also assumed by Western, with the stipulation that hydropower generation would be carried out within Reclamation's water operating constraints.

Although the Sierra Nevada Region markets the power from the CVP and Washoe Projects, both are operated by Reclamation in accordance with certain physical and environmental constraints. The power function is subordinate to the following higher priority, legislatively defined functions of the CVP: river regulation, flood control, domestic uses, improvement of navigation, and irrigation. The CVPIA of 1992, which added fish and wildlife to the list of CVP purposes, provides for reoperation of the CVP to "achieve a reasonable balance among competing demands for CVP water." In addition to these purposes, other factors that affect operation of the CVP include water rights that are set by the SWRCB, safety of dams, seepage, drainage, water quality, water temperature, and flow management.

The Coordinated Operation Agreement (COA) between Reclamation and the State of California Department of Water Resources became effective in 1986. It delineates the rights and responsibilities of the CVP and the State Water Project (SWP) regarding the Sacramento River Valley and the Delta water needs and provides a mechanism to measure and account for those responsibilities.

2.1.1 Existing Programs and Power Marketing Activities

Western has wide discretion within its statutory guidelines regarding with whom and on what terms it will contract for the sale of Federal power, as long as its customers meet statutorily defined preference requirements (see Appendix A). Current Sierra Nevada Region preference power customers include irrigation and reclamation districts, cooperatives, public utility districts, municipalities, State and Federal agencies, and other public bodies. Power surplus to preference customer needs may be sold, if available, to nonpreference customers on a nonfirm or short-term basis.

After providing the power needed to deliver project water to CVP water customers (Project Use requirements), CVP power is marketed to preference customers pursuant to the Reclamation Project Act of 1939. The sale of excess power cannot impair the efficiency of the project for irrigation purposes. Western markets power in such a way as to encourage its widespread use at the lowest possible rates consistent with sound business principles. The relationship of power generation to other purposes of the project will influence the amount and timing of resources available for marketing. Water flows and facility maintenance schedules also influence timing and availability of power resources.

The annual CVP firm power sales typically exceed 6 billion kWh, at a current contractual maximum simultaneous load of 1,152 MW. Because of the diversity of when Sierra Nevada Region customers require the maximum capacity that they purchase, the Sierra Nevada Region is able to market power under individual contracts totaling approximately 1,480 MW. The sum of Project Use and preference customer contractual obligations currently requires the Sierra Nevada Region to purchase power to firm Federal hydropower. The Sierra Nevada Region purchases energy and capacity from Pacific Gas & Electric Company (PG&E), entities in the Pacific Northwest, and other suppliers.

Western is authorized to purchase power from other sources to firm generation from Reclamation's hydroelectric powerplants. Western may also make power purchases and acquire or provide electric utility services for a Federal customer pursuant to the Economy Act. In 1937, the authorized CVP features included a steamplant designed to support capacity-rich CVP hydropower plants. While no CVP steamplant has ever been constructed, purchases from

non-Federal resources have achieved a similar purpose of firming CVP power, therefore making CVP power more marketable.

2.1.2 Sierra Nevada Region/PG&E Integration

The Sierra Nevada Region currently supports its firm power deliveries through means provided in Contract 14-06-200-2948A (Contract 2948A), which expires in 2004. This contract between the Sierra Nevada Region and PG&E provides for the sale, interchange, and purchase of power; transmission services; and the interconnection of specified Sierra Nevada Region transmission facilities. Under the terms of Contract 2948A, the Sierra Nevada Region delivers to PG&E the generation of CVP hydropower plants, along with its power purchases, and PG&E supports firm power deliveries to Sierra Nevada Region's preference customers up to a maximum simultaneous demand of 1,152 MW. The Sierra Nevada Region purchases power to support the CVP marketing program and primarily imports it through use of Sierra Nevada Region's share of the Pacific Northwest-Pacific Southwest Intertie (Pacific Intertie) and the California-Oregon Transmission Project (COTP).

To the extent that CVP hydropower generation plus Sierra Nevada Region's firm power purchases exceed Sierra Nevada Region contractual obligations to its customers, the excess energy may either be sold into an energy account with PG&E (called EA2) for repurchase at a future time or sold under the terms of several marketing options that the Sierra Nevada Region uses to market surplus energy. Conversely, if CVP hydropower plus Sierra Nevada Region's power purchases are less than preference customer loads, the Sierra Nevada Region may withdraw energy from EA2 and, if necessary, purchase additional power from PG&E.

2.1.3 Sales Contract Expiration

Due to the expiration of the long-term CVP power sales contracts and Contract 2948A on December 31, 2004, the Sierra Nevada Region is developing the 2004 Plan. The development and implementation of the 2004 Plan to market power from the CVP and Washoe Project are the subject of this 2004 EIS. A full listing of customers whose power sales contracts expire in 2004 is included in Appendix B.

2.2 Components of Program Alternatives

There are many possible alternatives that could result from combinations of power resources, marketing options, and hydropower generation within operational constraints. To focus this 2004 EIS on a relevant and manageable set of alternatives, the Sierra Nevada Region evaluated the range of possibilities in the CRS (Western 1995b). In the CRS, the Sierra Nevada Region considered 63 initial components that could be included in the marketing plan alternatives.

The initial components are listed in Table 2.1. The initial components came from internal Sierra Nevada Region discussions and from public input during scoping and other public involvement processes. The full process and its findings are described in the CRS.

Table 2.1. Initial 63 Components

2.2.1 Selection of Components for Consideration

The CRS describes the CVP and Washoe Project, as well as Sierra Nevada Region's programs and operational constraints. In addition, the report describes the process and findings of a series of exercises used to focus on those marketing plan components most important for incorporation into the 2004 EIS alternatives. The process included five exercises. The exercises were conducted in the order listed below, but previous exercises were revisited as the process unfolded. The process and outcomes are described in Figure 2.1. The five steps were as follows:

1. Component Definition - Components were defined to ensure common understanding and to begin grouping the components to reduce duplication.

2. Component Compatibility - Components were divided into three groups. Using matrices to evaluate possible combinations, each component was paired with each component from within its group and then with each component in selected other groups. Compatibility between components was judged to determine possible combinations that could be included in alternatives and to eliminate conflicting combinations.

3. Key Component Grouping - The components were organized and consolidated into groups with similar characteristics. For example, different approaches to allocating Sierra Nevada Region power were grouped under the heading "Allocation to Customer Groups."

4. System Flow Diagrams - Diagrams were developed to anticipate the potential for components to affect the environment. These diagrams helped to structure the discussion of the potential maximum and minimum effects and actions that may occur. The study group discussed the possibility of expanding or curtailing the components to mitigate or fully assess potential sensitivities. This exercise did not result in any component changes.

5. Further Refinement - In later stages of the process, the study team revisited and modified several component groups. These exercises focused on the components of a marketing plan and not a marketing plan alternative. This analysis was necessary to reduce the complexity of component interactions to focus on those important to constructing marketing plan alternatives.

Figure 2.1. Components Relationships Study Process

2.2.2 Issues Not Incorporated into Alternatives

Initially, 63 components were considered in the CRS process. Following the steps described in the preceding section, some components were found to remain constant across the alternatives and therefore are not actively analyzed in this 2004 EIS. These nonvariable components are likely to be included in whatever power marketing plan the Sierra Nevada Region develops. These components are described in the next section along with the key component groups that are varied in the alternatives.

The 2004 EIS indirectly addresses the products and services that the Sierra Nevada Region may provide to its customers. Potential environmental effects of various products and services are captured through 1) an analysis of the power resources needed to develop the products and services, 2) the implicit effect that certain combinations of hydropower operations and power purchases have on product and service availability, and 3) the customer group allocation analysis which assesses changes in allocations that may result from the inability of some customer groups to use certain power combinations.

Some participants in the scoping process raised ideas for possible Sierra Nevada Region marketing activities that did not fit the purpose and need of this 2004 EIS. The disposition of scoping comments was described in the Implementation Plan for this 2004 EIS, which Sierra Nevada Region publicly distributed in March 1995 (Western 1995c).

Some participants in the scoping process suggested that Sierra Nevada Region market its power to fulfill social and environmental objectives. For example, the power could be sold at market rates, which some participants suggested would encourage the efficient use of electricity, and the profits could be used to support education programs or to reduce the national debt. Western's statutory requirements specify that rates are not to exceed amounts necessary to recover costs assigned to power (see Appendix A). Therefore, rates are designed to recover costs.

A participant suggested that the Sierra Nevada Region should allocate its power to public agencies that encourage mass transit and thereby reduce air pollution and encourage energy conservation. This suggestion assumes that Sierra Nevada Region power will be less expensive than market rates and therefore reduce operating expenses, keeping public transportation costs low. This 2004 EIS analyzes the affects of changing the quantity of power that is allocated to different types of customer groups. This 2004 EIS does not assess the secondary benefits that may accrue from the power's end use. One key reason for excluding this analysis is that the Sierra Nevada Region is not making allocations to specific customers in this 2004 EIS. Specific allocations will be made in a separate process under the APA, in which customers will submit applications. This application process will allow potential customers to present potential benefits. At this point, neither the customers nor the size of their Sierra Nevada Region power allocations are known, making the assessment of secondary benefits highly speculative, at best.

Some participants suggested that the 2004 EIS should address the implementation of new technologies for improving generation and transmission efficiency. These technologies are dependent on scientific advances and on the cost-effectiveness of implementation. These decisions will occur independently of the 2004 Plan and, if necessary, will have separate environmental review before they are implemented. Technology improvements are assumed within the renewables alternative.

Other scoping comments were about issues being addressed in other processes. Examples of these include Trinity River diversions, water entitlements, and IRP provisions. The relationship between the 2004 EIS and other EISs and processes is described in Chapter 1.

2.2.3 Components Incorporated into Alternatives

The Sierra Nevada Region first identified all the possible components of a marketing plan. Initially, 63 possible components were identified consisting of resources, potential products and services, and terms and conditions under which products and services could be marketed. The CRS condensed the 63 components down to six key component groups that could affect the environment and could be varied in the 2004 EIS alternatives. Other components were found to have no potential to affect the environment or to have a constant effect regardless of alternative.

The six key component groups that are varied in the analysis of alternatives include the following:

1. Baseload Operations - Within the operational constraints established by Interior, this refers to releasing water from hydroelectric facilities to generate electricity at a relatively constant rate. This approach would emphasize a steady water release rate from dams above regulating reservoirs. The regulating reservoirs would not be required to fluctuate their pool elevations in order to maintain nearly steady releases. While it may be desirable for various operational reasons to maintain some reserve space in the regulating reservoirs, it was assumed the pools in the regulating reservoirs would be held steady at full or allowable pool. Keeping the regulating reservoirs at these levels will maintain the maximum elevation difference between the water in the reservoir and the water downstream of the dam, thereby ensuring maximum baseload power production at the regulating dam.

2. Peaking Operations - Within the operational constraints established by Interior, this refers to storing and releasing water from hydroelectric facilities to generate electricity during the relatively short period of maximum demand. This approach would emphasize periodic water releases from dams above regulating reservoirs timed to produce electricity when it is most needed. Generation from the regulating dam powerplants would remain steady. In the peaking alternative, the pool elevations within the regulating reservoirs could fluctuate to the maximum allowed within the constraints established by Interior. Pool elevations could span the full range between full pool and minimum operating pool on a weekly or daily basis.

3. Power Purchases - These refer to Sierra Nevada Region power purchases used to supplement the Federal hydroelectric resource. Purchases were assumed to be made from various power markets in northern and central California, the Pacific Northwest, and the Desert Southwest. For purposes of modeling and analysis in this 2004 EIS, purchase levels of 0 MW, 450 MW, and 900 MW, each at capacity factors of 15 percent and 85 percent, are assumed. The no-action alternative has an approximate average monthly purchase level of about 640 MW assuming average hydrologic conditions and no contractual interchanges or exchanges.

4. Renewable Resources - These resource types will be emphasized in one alternative and could be acquired through either selective purchases or allocations of Federal resources to Sierra Nevada Region's customers active in developing renewable resources.

5. Power Cost Analysis - This refers to analyzing cost impacts to Sierra Nevada Region's customers from combining the costs for purchases and Sierra Nevada Region's hydropower resources (aggregated) or treating these resources individually, each with its own cost (disaggregated).

6. Allocation to Customer Groups - This refers to assessing the impacts of changing the quantities of power that customer groups currently receive from the Sierra Nevada Region. Customers are divided into the following three groups, with the customers in each group having similar load characteristics: utilities, agriculture, and other (such as State and Federal agencies).

These variable components are the focus of the 2004 EIS analysis. The packaging of these components into alternatives is explained in the next section. These components have been varied across the alternatives or compared with the no-action alternative analysis to determine the maximum potential impacts resulting from implementing the Sierra Nevada Region's 2004 Plan.

To capture the entire range of potential environmental impacts, the Sierra Nevada Region used a tent stakes approach to constructing alternatives. The tent stakes approach used reasonable maximum and minimum values for key component groups to bracket the range of potential impacts. Although the final marketing plan may not be identical with any one of the 2004 EIS alternatives, the values for any alternative selected and its components will be within the range considered and its impacts will fall within the range of impacts assessed. The tent stakes approach captures the greatest possible range of impacts likely to occur, as illustrated in Figure 1.2.

Nonvariable and independent components do not vary across alternatives; therefore, the environmental effects attributable to these components are constant. Nonvariable and independent components include eligibility criteria, first preference, preference, marketing area, delivery conditions, and transmission together with maintenance activities. These components are referred to as nonvariable in Figure 2.2. Such components may be included in the 2004 Plan. Because they are already included in Sierra Nevada Region's present activities, they represent no change from the no-action alternative. Environmental impact analyses in this 2004 EIS focused on those components that vary across the alternatives. Constant effects associated with nonvariable and independent components are included in this 2004 EIS. The effects of the first five of these components result from the fact that they exclude or limit participation in the Sierra Nevada Region's programs. Delivery conditions are primarily compatibility requirements for transmission facilities. Maintenance may include activities necessary to keep the transmission system in good repair and rights-of-way management.

Other components were found to be independent with no probable environmental, social, or economic effect. These components may be included in the 2004 Plan but require no further analysis in this 2004 EIS. Components in this category include minimum load requirements, executed contract requirements, alternative financing arrangements, withdrawal provisions, termination provisions, and standard provisions. As with the nonvariable components discussed in the preceding paragraph, these represent activities that have been underway and do not represent a change from the no-action alternative.

Components that were analyzed in the EPAMP EIS (Western 1995a) were not analyzed in this 2004 EIS. These components, which are likely to be included in the 2004 Plan, include contract length, power planning requirements such as IRP for customers, withdrawal provisions, contract adjustment provisions, and the creation of resource pools. The potential impacts

Figure 2.2. Alternative Formation

resulting from these components were assessed in the EPAMP EIS. Further analysis in this 2004 EIS is, therefore, not necessary. The EPAMP EIS is also described in Section 1.6.2.

EPAMP incorporates two parts, the Power Marketing Initiative (PMI) and IRP. Provisions requiring customers to prepare IRPs, as specified in EPAMP, have been adopted for the Sierra Nevada Region. Power marketing provisions will not be adopted until completion of the 2004 EIS and the 2004 Plan. The PMI provisions included in EPAMP and a summary of the EPAMP EIS findings are described in Table 2.2.

The combination of variable and constant components used to develop alternatives is shown in Figure 2.2.

Table 2.2 Summary of EPAMP PMI Provisions and Environmental Findings

PMI Provisions	**Description**	**Environmental Findings**
Extension Period	10, 15, 25, or 35 years or on a project-specific basis. The EPAMP preferred alternative had an 18- to 20-year extension.	Shorter contract periods were found to increase the uncertainty in power supply for Western's customers. Increased uncertainty was found to result in slight increases in generation and powerplant construction.
Percentage Extension	90%, 95%, 98%, or 100% of marketable resource; adjustment due to operational changes possible; adjustment only after appropriate consultation process. The preferred alternative allowed variation by project.	As the percentage of Western's marketable resources allocated to existing customers shrinks, the customers may react with greater levels of powerplant construction and electricity generation over time.
Resource Pool	10%, 5%, or 2%. No resource pool for some alternatives. The preferred alternative included project-specific resource pools that could be used for various purposes.	The size of resource pools offsets Western's resources available for commitment, potentially increasing powerplant construction and generation. The manner in which the resource pool is used was not assessed.

Resource Adjustment Provisions	Tied to extension period. Longer contract periods included more opportunities for adjustment over time.	Adjustment provisions were coupled with contract length and were not independently assessed.
Penalty	Prescribed in EPAct; allows for a 10% to 30% surcharge with greater levels for longer periods of noncompliance. A 10% power reduction is allowed as an optional penalty.	Penalty provisions were not independently assessed. Impacts would be limited to noncomplying customers.

2.3 Description of Alternatives

This section begins with a summary of the changes that have occurred since publication of the draft 2004 EIS. This summary is followed by a description of the alternatives.

2.3.1 Final EIS Refinements Affecting the Structure of Alternatives

Some of the refinements made in the final EIS are the result of comments received on the draft EIS. These comments are described in Appendix O of Volume 2 of this final 2004 EIS. The technical specifications of each of the refinements, along with assumptions that did not change, can be found in the sections throughout the document addressing specific topic areas. For example, assumptions about utility systems are described in Section 3.10, Utility Systems Description. This section describes changes that affect the manner in which alternatives are structured.

The key change affecting alternative structure is the treatment of the energy market assumed for 2005. In the draft EIS, each of the alternatives incorporated varying levels of firm capacity purchases at different capacity factors. In these types of contracts, Western would be required to purchase the energy and capacity even if it was not needed or if it was not the most economic purchase available at any given time.

In the final 2004 EIS, the power market is assumed to operate with generally open access for both wholesale and retail customers. Further, power could be purchased on an hourly basis, as needed. Because of this flexibility, when Western makes purchases, it is unlikely that customers would make a similar purchase to meet the same need. In addition, because both Western and its customers would have equal access to the market, all purchases would be under similar terms and conditions. Thus, a purchase by Western would be offset by purchases foregone by Western's customers and vice versa. The results of these assumptions about equal access and hourly pricing include the following:

- Purchase levels described in the alternatives would be the maximum purchased in any 1 hour by the Sierra Nevada Region.
- The Sierra Nevada Region could purchase up to the maximum purchase level but need not purchase more than it needs.

- The power cost analysis shown in the draft EIS is not applicable under open access conditions. All purchases in the final 2004 EIS are assumed to be made from power markets. The Sierra Nevada Region's market costs would be passed on to its customers, meaning there would be no difference between a Sierra Nevada Region purchase and a customer's direct market purchase. The no purchase option represents the effects of Sierra Nevada Region disaggregating costs associated with any purchases. Purchase options were also analyzed on an aggregated basis.

Another change is the assumed cost of renewable resources. In the draft EIS, it was assumed that all renewables available to Western would be priced at levels incorporating technological improvements that may be forthcoming by the year 2005. The final 2004 EIS assumes that these optimistic prices will be available in 20 percent of the renewable resources that would be available in 2005. This tends to raise the costs of renewables in comparison with the draft 2004 EIS but on average keeps the costs below 1996 levels. This change, along with updates to energy market rates, better reflects expected market conditions after 2004. The effect of these changed assumptions on the analysis is a reduction in the level of renewables that could be purchased or supported in the renewables alternative.

2.3.2 Overview of the Five Alternatives

Five alternatives were developed for analysis in this 2004 EIS. These alternatives are structured around operations of the CVP hydroelectric system. Each alternative also includes power purchases and power cost analysis options. The five alternatives are summarized in Table 2.3. A separate analysis of allocation to customer groups is described in Section 2.3.8.

All of the alternatives are based on the same assumed set of hydrological conditions. These conditions were developed to estimate hydroelectric generation after implementation of the Bay/Delta Standards, CVP Improvement Act provisions, and adjustments to Trinity River flows. These conditions are summarized in Chapter 3 and detailed in a modeling report (Western 1997). Each alternative was analyzed using average and adverse years. Power production for these years was developed from a 70-year historic water and power operations study. The adverse year represents the seventh driest January combined with the seventh driest February and so on through the adverse year. This combination is used because it represents the 90-percent exceedance level of the 70-year historic monthly record. The average year represents a composite year made up of the average generation in each month. The average year was used to establish the energy available from the CVP. The adverse year was used to establish capacity levels available for marketing. This approach is commonly used within the electric utility industry as a measure of hydrologic performance. For all established alternatives, it was assumed, when necessary, the Sierra Nevada Region may purchase energy to meet its commitments to serve Project Use.

Table 2.3. Summary of 2004 EIS Alternatives

	ALTERNATIVES												
	No-Action	Maximize Hydropower Peaking [a]					Baseload					Renewables	Preferred
Power Resources (MW)													
CVP Load-Carrying Capacity [b]	1,089	1,377					508					1,377[c]	1,326
Minimum and Maximum Monthly CVP Capacity [d]	1,255 and 1,665												
Power Purchases	478[e]	0	450[f]	450[g]	900[f]	900[g]	0	450[f]	450[g]	900[f]	900[g]	50	[h]
Allocation to Customer Groups	Historic	100% increase (or to the extent possible) and 100% decrease in existing allocations to each of three customer groups: utilities, agriculture, and other.											
Constant Components													
Nonvariable	These components include eligibility criteria, first preference, preference, marketing area, delivery conditions, and transmission requirements.												
Independent	Components in this category include minimum load requirements, executed contract requirement, alternative financing arrangements, termination provisions, withdrawal provisions, and standard provisions.												
EPAMP EIS	These components include contract length, power planning requirements such as IRP for customers and contract adjustment provisions.												

[a] Maximized peaking with no purchases has been identified as the environmentally preferred alternative.
[b] Determined assuming a 90% exceedance - shown for the peak month.
[c] Assumes hydropower peaking operations are maximized.
[d] Based on projected hydroplant capabilities assuming 90% exceedance.
[e] Approximate average monthly purchase assuming average hydrologic conditions and no contractual interchanges or exchanges.
[f] Up to a 15% capacity factor.
[g] Up to an 85% capacity factor.

[h] Purchases may be made to support customers but market costs would be passed through to customers making them equivalent to customer purchases.

For all of the alternatives, the Sierra Nevada Region has discretion in hourly power scheduling at the following hydroelectric powerplants: Trinity, Carr, Shasta, Spring Creek, New Melones, Folsom, and San Luis. Other facilities with CVP hydroelectric generation and Washoe are operated for river regulation, and Western does not have any discretion at these facilities.

2.3.3 No-Action Alternative

The no-action alternative represents marketing activities currently under way at the Sierra Nevada Region, which meet 2005 loads that are comparable to current load patterns.

Under this alternative, the Sierra Nevada Region would continue its present approach to marketing power as discussed in Section 2.1, including sale of available transmission capacity.

Hydropower Operations - Within the operating constraints established by Interior, hydroelectric facilities are scheduled close to maximum peaking. However, the peaking level is established based on the economic dispatch of Sierra Nevada Region's available resources needed to follow forecasted customer loads.

Power Purchases - The no-action alternative includes an approximate average monthly capacity purchase of 478 MW assuming average hydrologic conditions.

2.3.4 Maximize Hydropower Peaking Alternative

This alternative has the following components and is referred to as "the peaking alternative" in the remainder of this 2004 EIS.

Hydropower Operations - The peaking alternative refers to scheduling the CVP hydropower facilities to maximize power generation during peak load periods within operating constraints.

Power Purchases - To characterize the reasonable range of possible alternatives, five types of power purchases are analyzed, as follows:

- no purchases
- up to 450 MW of capacity at up to a 15-percent capacity factor
- up to 450 MW of capacity at up to an 85-percent capacity factor
- up to 900 MW of capacity at up to a 15-percent capacity factor
- up to 900 MW of capacity at up to an 85-percent capacity factor.

2.3.5 Baseload Alternative

This alternative has the following components.

Hydropower Operations - The baseload alternative refers to scheduling the CVP hydropower facilities for relatively constant power output within operating constraints.

Power Purchases - To characterize the reasonable range of possible alternatives, five types of power purchases are analyzed, as follows:

- no purchases
- up to 450 MW of capacity at up to a 15-percent capacity factor
- up to 450 MW of capacity at up to an 85-percent capacity factor
- up to 900 MW of capacity at up to a 15-percent capacity factor
- up to 900 MW of capacity at up to an 85-percent capacity factor.

2.3.6 Renewable Resource Acquisition Alternative

This alternative has the following components and is referred to as "the renewables alternative" in the remainder of this 2004 EIS.

Hydropower Operations - The development of renewable resources is independent of CVP operations. For the purpose of the analysis in this 2004 EIS, it was assumed that peaking would be maximized.

Power Purchases - 50 MW of capacity acquisitions are from renewable resources. Acquisitions may come from Sierra Nevada Region power purchases, or allocations of Federal resources may be made to Sierra Nevada Region's customers active in developing renewable resources. The purchase level was established at the point where the aggregated cost of renewable and Federal hydropower would approximate the prevailing market rates forecast in 2005 ($0.032/kWh). All costs are in 2005 dollars.

Figure 2.3 shows the aggregated cost curves for renewable resources and the expected market rate for long-term firm power. An aggregated cost curve is shown for renewables comprised of 80 percent historical costs and 20 percent associated with technologically advanced costs. Technologically advanced costs incorporate assumptions about reductions in costs obtained from increases in electrical conversion efficiency. The costs shown by the curve are incorporated into the analysis. Cost assumptions for a variety of renewable technologies are presented in Appendix C.

The renewable acquisition is divided equally into four generation technologies: biomass, wind, solar photovoltaic, and geothermal. This resource mix is intended to represent a broad range of potential resources that may actually be available in 2005. The mix combines commercially proven and emerging technologies, as well as lower and higher cost options. Actual resource availability may vary considerably from the assumed mix used for this analysis; however, the effects associated with acquiring renewable resources are apparent. Specific acquisitions may require further NEPA documentation.

Figure 2.3. Melded Costs for CVP Peaking Plus Renewable Resource

2.3.7 Preferred Alternative

This alternative is similar to the maximum peaking alternative as discussed in Section 2.3.4. Additional power will be purchased if requested by customers to meet their load requirements. This alternative was chosen to provide the greatest flexibility to meet customer needs in making purchases and to economically optimize the operation of Western's and its customers' power resources.

Hydropower Operations - Similar to the maximum peaking alternative.

Power Purchases - Power may be purchased on an hourly basis to support customer requests. However, this purchase is transparent to the analysis because costs would be passed directly through to customers for power the customers would have otherwise purchased at similar costs.

2.3.8 Environmentally Preferred Alternative

NEPA requires that an environmentally preferred alternative be identified from the range of alternatives considered. Typically, the alternative that results in the least environmental damage should be selected. On balance, the peaking alternative is the environmentally preferred alternative. Peaking with no purchases results in the greatest benefits. However, none of the alternatives result in significant environmental impacts. The no-action and preferred alternatives are similar to the peaking alternative in that they incorporate peaking-type hydropower operations. The peaking, no-action, and preferred alternatives would all result in similar consequences.

These alternatives would provide the greatest load-carrying capacity and better offset the need for additional powerplants than the baseload alternative. Although it is not possible to determine when or where lost capacity would be made up, building replacement capacity in response to the baseload alternative would result in land-use impacts and the use of natural and financial resources.

In comparison with the baseload alternative, the alternatives incorporating peaking hydropower operations tend to result in different hourly air emission patterns, with more emissions occurring at night, in comparison to the baseload alternative, which would result in more daytime emissions when pollution levels are greater. In comparing these same alternatives, little difference is found in the resource areas where impacts were quantified. However, the baseload alternative could result in minor beneficial effects to fisheries, recreation, and cultural resources because of reduced pool-level fluctuations in regulating reservoirs, although these effects could not be quantified. Erosion due to wave action would be confined to the more narrow fluctuation zone. The socioeconomic analysis found that the alternatives incorporating peaking operations would result in generally neutral to positive effects, although the preferred alternative would be slightly negative. The baseload alternative would generally result in negative effects.

The analysis of the renewables alternative results in a wide band of effects, depending on the specific technologies used to generate electricity. When biomass is incorporated into the alternative, the greatest annual air pollutant levels are produced. When biomass is not incorporated, the smallest levels of air pollutants are produced. The incorporation of biomass would produce the greatest levels of ash, but if reduced landfill volume is considered, a net benefit results in solid waste production. The socioeconomic analysis found that the renewables alternatives would result in the greatest socioeconomic impacts in comparison to the other alternatives.

A summary of the impacts associated with each of the alternatives in comparison with the no- action alternative is shown in Table 2.4.

Table 2.4. Summary of Impacts Resulting from Each Alternative in Comparison with the No-Action Alternative

	Peaking	**Baseload**	**Renewables**	**Preferred**
Utility Systems	Most available load-following capacity: +317 MW (August) +346 MW (May)	Least available load-following capacity: -581 MW	Based on peaking hydropower operations with purchase of 50 MW of renewables - load-following capacity same as peaking	Ranges from -30 MW to +262 MW
CVP Water Resources	No effect on temperature - maximum pool fluctuation within limits similar to no-action	No effect on temperature - least pool fluctuation	Same as peaking	No effect on temperature - pool fluctuation similar to no-action
Fisheries	Similar to no-action	Fish in regulating reservoirs may benefit slightly	Same as peaking	Similar to no-action
Terrestrial	No change	No change	No change	No change
Threatened and Endangered Species	No change	No change	No change	No change
Recreation	Similar to no-action	Recreation in regulating reservoirs may benefit slightly	Same as peaking	Similar to no-action

Cultural Resources	Similar to no-action	Erosion from fluctuating water levels may be reduced	Same as peaking	Similar to no-action
Socioeconomics	Beneficial	Mostly negative	Most negative	Most beneficial
Air	Shifts hourly emissions to night - slightly reduces annual emissions	Shifts hourly emissions to day - slightly increases annual emissions	Hourly emissions similar to peaking; including biomass results in greatest annual emissions and without biomass results in least annual emissions	Similar to no-action
Water Consumption - non-CVP	Beneficial, similar to other alternatives	Beneficial, similar to other alternatives	Beneficial, similar to other alternatives; including biomass provides least benefit of alternatives and without biomass results in greatest benefit	Beneficial, similar to other alternatives
Wastes - non-CVP	Similar to no-action	Similar to no-action	Renewables without biomass similar to no-action; including biomass results in most ash production, but decreased need for land filling could result in net reduction in solid waste	Similar to no-action
Land use - non-CVP	Most beneficial	Most negative	Similar to baseload alternative	Similar to no-action

2.3.9 Analysis of Allocation to Customer Groups

For each of three customer groups (utilities, agriculture, and other), allocation levels are increased above current levels and also reduced to zero. When one customer group's allocation is increased, the other groups are reduced on a *pro rata* basis to free up the resource. When a group's allocation is reduced to zero, the 2004 EIS analyzes the effects of reallocating the surplus power to other groups. Customer groups, rather than individual customers, are analyzed because specific allocations will be made in a separate process.

This analysis is designed to characterize the impacts that may result from changing the quantity of resources available to different customer groups but does not result in any measurement of impacts on any one customer in particular. In this study, customer allocations are both increased and decreased for each customer group. This approach captures the range of beneficial and negative impacts that may result from changes affecting a particular customer group.

The analysis of impacts resulting from changes in the emphasis given different customer groups is treated separately. That is, rather than changing allocation levels across every single alternative, these impacts were analyzed by comparing them to the no-action alternative only. The estimates of resulting impacts are not additive with the other alternatives, but the magnitude of the impacts is comparable.

2.4 Summary of Environmental Impacts

The impact analyses follow three basic steps. Historic hydrological conditions were analyzed using the PROSIM (CVP simulation model) model. The PROSIM outputs (in the form of monthly water flows and available hydropower capacity and energy) were input to the PROSYM model, a production cost simulation model of electric utility operations. PROSYM outputs (in the form of estimated levels of electric generation, production costs, and hourly water flows in the CVP) were used to assess the environmental impacts. Table 2.5 summarizes the environmental impacts of each alternative.

The manner in which hydropower generating plants are scheduled is one of the fundamental differences across the alternatives. The PROSYM analyses show that, when operated to provide electricity at peak times (the peaking alternative), the hydropower system can offset up to 317 MW of electric generating capacity from other sources when compared to the no-action alternative. The replacement capacity needed to offset the difference between the baseload and no-action alternatives is 581 MW of load-carrying capacity. Building new capacity results in

Table 2.5. Summary of Environmental Impacts[(a)]

Environmental Resources	Impact Summary
Utility Systems	The alternatives result in offsets in generation between the CVP hydrosystem and combustion turbines (CTs) and combined-cycle combustion turbines (CCCTs). Baseload alternative reduces marketable capacity of the CVP. Peaking increases marketable CVP capacity.
CVP Water Resources	No change from existing conditions.

-Temperature Fluctuation	
CVP Water Resources - Pool-Level Fluctuation	Affects regulating reservoirs only. Peaking, no-action, renewables, and preferred alternatives very similar with a daily peak and trough. The baseload alternative results in a more constant reservoir level. The Sierra Nevada Region does not propose to schedule powerplant releases into Keswick Reservoir that would cause scouring of toxic-metal laden sediments.
Fisheries	No impact to anadromous fish. Peaking, no-action, renewables, and preferred alternatives similar to existing conditions. Fish in the regulating reservoirs may benefit slightly from baseload alternative.
Terrestrial Environment	No change from existing conditions.
Threatened and Endangered Species	No change from existing conditions.
Recreation	Peaking, no-action, renewables, and preferred alternatives similar to existing conditions. Recreation on regulating reservoirs may benefit slightly from baseload alternative.
Cultural Resources	Peaking, no-action, renewables, and preferred alternatives similar to existing conditions. Baseload alternative would reduce or minimize the impacts of erosion from pool fluctuation.
Socioeconomic Resources	Impacts are less than a fraction of 1 percent on a regional basis and are nearly indistinguishable across alternatives. The largest effect would be with the renewables alternative, which results in slightly negative effects. All alternatives would have neutral or slightly negative impacts on agricultural profit and no impacts on production.
Air Resources	The baseload and renewables (with a biomass component) alternatives slightly increase pollutant emissions; other alternatives produce slight decreases or no change in pollutant emissions. The baseload alternative results in greater emissions during the day when pollutant emissions from other sources are also high. Other alternatives are similar to the no-action alternative or shift additional emissions to the night.
Water Consumption Associated with Non-CVP Powerplants	All alternatives reduce water consumption in comparison to the no-action alternative. The slight changes found are due to shifts among the use of CTs and CCCTs.
Wastes Associated with Non-CVP	Annual waste production is relatively constant across the no-action, peaking, baseload, and preferred alternatives. The

Powerplants	renewables alternative results in the greatest annual waste production, mostly coming from biomass fuel powerplants. However, biomass-fired powerplants may consume forest or agricultural byproducts or urban wastes and result in a reduced waste volume. A test case without biomass results in waste production similar to the no-action alternative.
Land Use Associated with Non-CVP Powerplants	In comparison to the no-action alternative, the peaking alternative results in more available capacity that reduces acreage by about 50 acres needed for generation facilities. The baseload alternative requires an additional 90 acres, and the renewables alternative results in about 70 to 90 additional acres. The preferred alternative may result in up to about 5 additional acres.
Irreversible and Irretrievable Commitments of Resources	Land-use impacts may be irreversible. Substantial shifts in powerplant fuel type are not expected.
Unavoidable Adverse Impacts	Of the impacts identified, the only major effect stems from lost load-carrying capacity in the baseload alternative.
Relationship Between Short-Term Uses and Long-Term Productivity	No alternatives result in substantial land being taken out of production or a loss of river-system long-term productivity. Adding new capacity to make up for lost CVP load-carrying capacity could result in small regional impacts.
Direct and Indirect Effects	Direct effects are limited to those related to possible changes in electric power production at some CVP facilities. All others are indirect.
Cumulative Effects	2004 EIS analyses incorporate cumulative effects to the extent they can be identified, such as the effects on the operation of power resources in the areas where power purchases may be made. In large part, any cumulative impacts have already been felt, as CVP power has been marketed in the past. Most analyses describe potential shifts in impacts, rather than new or additional impacts.

[a] The analysis indicates that potential impacts to fisheries, terrestrial environment, threatened and endangered species, recreation, and cultural resources are restricted to regulating reservoirs (see Section 3.4).

land-use impacts and the use of the natural and financial resources needed to build the powerplant and connect it with the interconnected transmission grid. Western is not currently planning to build such a powerplant.

The CVP hydropower system does not require additional facilities or modifications to change from baseload to peaking operations or vice versa. Thus, the lost load-carrying capacity from baseload operations would be retrievable for CVP operations if a decision to subsequently implement peaking operations was made. However, if the baseload alternative is implemented and replacement capacity is built, replacement capacity is expected to remain in place. If this occurs, a potential shift from baseload back to peaking CVP operations would likely result in temporary surplus capacity in the region.

Impacts resulting from CVP water releases within Sierra Nevada Region's discretion are limited. The Sierra Nevada Region's discretion is described in the introduction to Chapter 3. In comparison to the no-action alternative, the peaking alternative results in only slightly greater pool-level fluctuation in regulating reservoirs. Impacts are restricted to the regulating reservoirs at Lewiston, Keswick, Lake Natoma, and Tulloch because the regulating dams are operated to control releases downstream. As discussed in Section 3.4.2, the Sierra Nevada Region has assumed for purposes of this 2004 EIS that Keswick Reservior can fluctuate up to 11 ft with the removal of contaminated sediment in the Spring Creek arm of Keswick Reservoir. If this problem is not resolved by 2005, the Sierra Nevada Region will schedule powerplant operations within the then current normal operating level, which would reduce the potential effects on water temperature and pool fluctuation.

The baseload alternative would result in relatively constant water releases from the main dams that would avoid pool-level fluctuation and potentially improve recreation and resident fisheries slightly in the regulating reservoirs. The hourly water releases from the main dams, whether operating for peaking or baseload, affect temperature fluctuation a very minor amount. The temperature differences are so small that, although they can be calculated, they could not be measured in the regulating reservoirs or the rivers downstream.

Given these findings about pool-level and temperature fluctuations, in comparison with the no-action alternative, no alternative would result in adverse impacts to fisheries, threatened and endangered species, recreation, the terrestrial environment, or cultural resources.

The more constant flows of the baseload alternative may result in minor beneficial effects to fisheries, recreation, and cultural resources associated with the regulating reservoirs. A reduction in pool-level fluctuation may improve habitat for resident fish and improve boating conditions. Stable pool elevations would also reduce erosion at shoreline cultural resource sites by minimizing the zone of impact due to pool fluctuations. Erosion due to wave action would be confined to this zone.

Impacts to air quality, solid waste, and wastewater would be related to the generation of electricity at powerplants apart from the CVP. The variation across the alternatives comes from changes in operation of CTs and CCCTs that may be located throughout northern and central California, the Pacific Northwest, or the Desert Southwest. The most substantial air quality impacts would come from changes in hourly operations of other non-hydropower plants in response to the manner in which the CVP hydroelectric facilities are scheduled (peaking or baseload). Generally, compared to the no-action alternative, scheduling the hydropower system as a baseload system would result in an increase of emissions from other powerplants during the day when ambient levels are high because thermal generation would be needed for peaking. Peaking the hydropower system offsets daytime thermal production and reduces daytime emissions but increases nighttime thermal production and emissions, when ambient levels are less. This can be important for areas having problems meeting air quality standards during summer afternoons when industrial, utility, and transportation emissions are at their peak. During summer afternoons, the difference in oxides of nitrogen (NO_x) emissions between the peaking and baseload alternatives would reach over 400 pounds per hour (lb/h). These emissions are equivalent to those from a 400-MW combustion turbine plant.

Without biomass, the renewables alternative results in the most beneficial affects on annual air emissions. Including biomass in the renewables alternatives would produce the greatest levels of annual air emissions.

In comparison with the no-action alternative, all of the other alternatives would result in beneficial effects on wastewater production. As with annual air emissions, the renewables alternative without biomass would result in the greatest benefit in reducing wastewater production. Renewables with biomass would produce the least benefit but would still result in a reduction in wastewater production in comparison with the no-action alternative.

Solid waste production also would be most changed by the renewables alternative. Biomass-fueled plants that burn municipal solid waste produce a great deal of ash as solid waste but also reduce the quantity of solid waste, requiring disposal in a landfill. For every pound of ash produced by biomass combustion, municipal solid waste is reduced by about 5 pounds. When this reduction is taken into account, solid waste would be reduced by nearly 40,000 tons with the renewables alternative. In comparison, the other alternatives (including renewables without biomass) are very similar to the no-action alternative.

The baseload alternative results in about 90 acres of land needed for replacement capacity. The renewables alternative would result in similar acreage affected when compared with the no-action alternative. Renewables, such as solar photovoltaic and wind, may require up to about 30 times the land area per megawatt of capacity of thermal resources such as CTs. In comparison to the no-action alternative, the renewables alternative would require 70 to 90 acres of land for powerplants.

The Sierra Nevada Region's 2004 Plan would influence the overall power costs of its customers. The alternatives are structured to determine the maximum range of impacts to gauge socioeconomic effects in the areas of output, employment, and labor income. When compared to the economy of northern and central California, or of any one of four economic regions analyzed within northern and central California, the estimated impacts are very small. The impacts are typically less than a fraction of 1 percent of the economic sectors being measured, which are large and relatively stable. None of the EIS alternatives are estimated to impact agricultural productivity and employment. The economic effects of the alternatives are reported for the regional economies studied. Based on results from the power production cost analysis described in Section 4.2, the associated economic impacts of the alternatives are nearly indistinguishable in all cases and in all regions. However, the preferred alternative would result in the most beneficial effects.

All of these socioeconomic results reflect averaging across regions and customer groups and do not capture the effects on individual customers. Economic effects on Sierra Nevada Region customers who lose or gain allocations may be substantial in individual cases but cannot be determined because specific allocations have not been made. In general, however, customers who lose allocations would be balanced by other customers who gain equivalent allocations. Specific allocations will be made in a separate process under the APA.

Across the alternatives and the affected economic regions, economic impacts are minimal. The impacts are not disproportional across income or race groupings of the population. In the case of agriculture customers, low-income and minority groups make up a larger proportion of the employment in that sector. The impacts identified do not affect agricultural gross revenues or production levels. Thus, employment levels are not affected, and the impacts of alternatives do not disproportionally affect low-income or minority groups.

The effects of emphasizing the use of renewable resources (assuming technological improvements) in the generation mix have a negative economic impact compared to the same quantity of thermal purchases. Improvements in technology should occur prior to 2005 that reduce the cost of the renewable resources. The amount of renewables to be included in the renewables alternative was determined by melding the anticipated cost of renewables in 2004 together with the anticipated CVP hydropower cost. The renewables share of the mix was increased until the combined rate for Sierra Nevada Region energy equaled the anticipated market rate for energy in 2004. This resulted in melding the CVP hydropower operated to maximize peaking with 50 MW of renewable resource purchases.

3.0 Affected Environment

This chapter describes the environmental resources that may be affected by the Sierra Nevada Region's proposed action. Conditions anticipated in the year 2005 are described. The alternatives under consideration would be implemented in the year 2005, after existing power marketing contracts expire at the end of 2004. Where it is important to the analyses, descriptions are included of assumptions and projections of how the environment may appear in the year 2005.

Sierra Nevada Region's actions are limited to scheduling power from specific hydropower generating plants and the regulating reservoirs that maintain nonfluctuating flows downstream from those facilities. These regulating reservoirs include Lewiston, Keswick, Lake Natoma, and Tulloch. The Sierra Nevada Region has no discretion over how water is released from the regulating reservoirs. At the generating facilities upstream of the regulating reservoirs, the Sierra Nevada Region has discretion in the hourly release of water but cannot schedule generation in a manner that would change regulating reservoir releases. Therefore, within the CVP, the environment that may be affected by the alternatives described in this 2004 EIS is limited to the regulating reservoirs. The main reservoirs are substantially larger than the regulating reservoirs, and changes in power operations do not create noticeable fluctuations in reservoir surface elevations on a daily basis.

As described in Section 1.5, Interior is assessing environmental effects related to broader operating issues in separate NEPA processes on the CVP Improvement Act and the Trinity River Basin Fish and Wildlife Restoration Act. These other processes should be consulted as additional sources of information about CVP operations and environmental conditions.

Washoe Project marketing will also be considered in Sierra Nevada Region's 2004 Plan and is briefly described in this chapter. However, the Sierra Nevada Region has no scheduling discretion at this facility, and thus conditions will not change as a result of Sierra Nevada Region's 2004 Plan.

Sections 3.1 through 3.9 of the chapter focus on the CVP system, with brief information on the Washoe Project and other assets, such as transmission facilities. Sections 3.1 through 3.3 broadly describe and introduce the CVP and the surrounding environment. Sections 3.4 through 3.9 focus on specific resources that may be affected by Sierra Nevada Region's 2004 Plan. These include the water quality issues of temperature and pool-level fluctuation and related resources such as fisheries, threatened and endangered species, recreation, the terrestrial environment, and cultural resources.

Section 3.10 discusses the broader utility systems that are influenced by CVP operations. The section describes how Sierra Nevada Region's activities are part of a broader utility market and integrated supply and transmission system. The section also describes Sierra Nevada Region's customers, their load shape, and their generation other than the CVP. Section 3.11 on socioeconomics broadens the discussion of Sierra Nevada Region's customers to include the economies and demographic conditions in which they operate.

Sections 3.12 through 3.15 describe environmental resources other than the CVP that may be influenced by CVP operations, Sierra Nevada Region's power marketing activities, and responses to those activities. These include air quality, water quality, wastes, and land use. The potential affected environment for these resources is large. The

Pacific Northwest, northern and central California, and the Desert Southwest, all regions that may interact with the Sierra Nevada Region in supplying power, are potentially part of the affected environment.

3.1 Geography and Topography

The CVP is located within the Central Valley and Trinity River basins of California. The Washoe Project is located within the Truckee River Basin of California and Nevada.

3.1.1 Central Valley Basin

The Central Valley Basin of California extends 500 miles in a northwest-to-southeast direction, with an average width of about 120 miles (see Figure 3.1). The basin is surrounded by mountains except for a single outlet to the west at the Carquinez Strait. The Central Valley floor occupies about one-third of the basin, is about 400 miles in length, and averages 50 miles in width. The Cascade and Sierra Nevada ranges on the north and east rise in elevation to 14,000 ft and the Coast Range on the west to as high as 8,000 ft. Two major river systems exist in the basin: the Sacramento River system in the north and the San Joaquin in the south. The two river systems join at the Sacramento-San Joaquin Delta (the Delta) where the waters commingle before emerging through the Carquinez Strait into San Francisco Bay.

The climate of the Central Valley is characterized as Mediterranean, with long, warm, and dry summers that provide ideal growing conditions for a wide variety of crops under irrigation. The winters are cool and moist. Severe cold weather does not occur, but the temperatures drop below freezing occasionally in virtually all parts of the valley. Rainfall decreases from north to south, with precipitation levels much greater in the mountain ranges surrounding the valley. The average annual rainfall of the Central Valley ranges from about 5 inches in the south to 30 inches in the north. About 80 inches of precipitation, much of it in the form of snow, occur annually at higher elevations in the northern ranges and about 35 inches occur in

Figure 3.1. Central Valley and Trinity River Basins of California

the southern mountains. About 85 percent of the precipitation falls from November through April. Therefore, large variations in runoff exist throughout the year, with larger flows occurring during winter and spring and lesser flows during the summer and fall.

The Sacramento River Basin and the San Joaquin River Basin reach a common confluence at the Delta. Because the basins are operated as a system, the actions in one basin have the potential to impact water quantity and quality; habitat for fish and wildlife; and aesthetic, recreational, and socioeconomic values of the other. These basins and the Delta are described below.

3.1.1.1 Sacramento River Basin

The Sacramento River Basin includes the west drainage of the Sierra Nevada and Cascade ranges, the easterly drainage of the Coast Range, and the valley floor. The basin covers about 26,500 square miles and extends from north of Lake Shasta to Lakes Folsom and Natoma. Major tributaries to the basin include the Sacramento, Feather, Yuba, and American rivers. The greatest volume of runoff is generated by melting Sierra snowpack occurring in early spring and summer. In years of normal runoff, the Sacramento River Basin contributes about 70 percent of the total runoff to the Delta.

3.1.1.2 San Joaquin River Basin

The San Joaquin River Basin encompasses more than 11,000 square miles between the crest of the Sierra Nevada Range and the crest of the Coast Range and stretches to the divide between the San Joaquin and Kings rivers. Major tributaries in the basin are the San Joaquin, Merced, Tuolumne, and Stanislaus rivers. During normal runoff years, the San Joaquin contributes about 15 percent of the total runoff to the Delta. Water is imported into the San Joaquin River Basin through the Delta-Mendota Canal of the CVP. Major water exports are through the Friant-Kern Canal and the Hetch Hetchy Aqueduct. During the irrigation season and in January and February, much of the San Joaquin River Basin flow is made up of agricultural drainage and local surface runoff.

3.1.1.3 Sacramento-San Joaquin Delta

The Delta covers approximately 1,150 square miles at the junction of the Sacramento (north) and San Joaquin (south) rivers. This area includes about 800 square miles of agricultural lands that derive their water from the Delta. Major tributaries, in addition to the Sacramento and San Joaquin rivers, are the Cosumnes, Mokelumne, and Calaveras rivers. The Delta was originally a vast flat marsh traversed by channels and sloughs. Reclamation began in the 1860s with levee construction. Gradually the Delta was converted to farmland interlaced with dredged channels and levees. Water was directly exported from the Delta first in 1940 with the completion of the Contra Costa Canal (a unit of the CVP). In 1951, water for the Delta Mendota Canal was pumped from the CVP's Tracy Pumping Plant, and later the Delta Cross Channel Canal was constructed near Walnut Grove to allow a more efficient transfer of water to the Tracy pumps.

Flows in the Delta are affected by a combination of inflows, agricultural uses, diversions, and tides from the Pacific Ocean. When freshwater flows are low, flows often change direction. The distance of upstream movement and saline intrusion varies depending on water quantity. The flows in the Delta and Delta water quality influence Reclamation's operation of the CVP; however, Sierra Nevada Region's 2004 Plan has no effect on the flows to the Delta. Delta outflow is highly seasonal and is characterized by high winter flows from storms and low steady flows in summer from agricultural and reservoir releases.

3.1.2 Trinity Basin

The Trinity River Basin drains approximately 3,000 square miles in northwestern California before flows join with the Klamath River and drain into the Pacific Ocean. The mountainous terrain of the Trinity Basin ranges in elevation from above 9,000 ft to 300 ft at the town of Weitchpec where the Trinity River joins the Klamath River.

The average runoff in the Trinity is approximately 1,200,000 acre-ft at Lewiston and 3,800,000 acre-ft at Weitchpec. The Trinity River Basin exports water at Lewiston Dam to the Sacramento River Basin via the Clear Creek Tunnel.

3.1.3 Truckee Basin

The Little Truckee River drainage comprises about 136 square miles and is not part of the CVP, nor does it flow to the Delta. The Truckee watershed terminates in Pyramid Lake in the Nevada desert north to northeast of Reno, Nevada. Runoff occurs mostly in the winter and spring months as a result of snowmelt. Average annual flows have been estimated at 129,100 acre-ft. The Stampede Dam and reservoir, located on the Little Truckee River in Sierra County, California, are part of the Washoe Project. The reservoir, with a capacity of about 227 thousand acre-feet (TAF), impounds flows of the Little Truckee River.

3.2 Facility Description of Central Valley and Washoe Projects

The CVP is a large water control and delivery system, initially authorized by Congress in 1935, which covers approximately one-third of the State of California. The water control system consists of storage reservoirs that provide seasonal and annual flow regulation, smaller regulating reservoirs for diversion of water and smoothing of upstream dam and powerplant releases, and canals and pumping plants for the delivery of project water.

The CVP includes 18 constructed dams and reservoirs with a total storage capacity of 13 million acre-ft (MAF). The system includes 615 miles of canals, 5 pumping facilities, 11 powerplants with a maximum operating capability of about 2,045 MW, and approximately 1,120 circuit-miles of high-voltage transmission lines. Reclamation operates all of the powerplants with the exception of the San Luis Unit, which is operated by the State of California for Reclamation.

Water released from the CVP dams is controlled by regulating reservoirs situated downstream. These regulating reservoirs were designed to accept variable levels of water released from the main storage reservoirs and to maintain nonfluctuating flows downstream. In this way, water-level fluctuation is confined to the regulating reservoirs. Power operations do not control the timing or quantities of water released from the regulating reservoirs. Power resources of the CVP are shown in Table 3.1. The Federal powerplants from which the Sierra Nevada Region markets power are shown in Figure 3.2.

The CVP is organized into nine divisions established in relation to rivers or facilities within the basin: Trinity River, Shasta, American River, West San Joaquin, East Side, Sacramento River, the Delta, Friant, and San Felipe.

The Washoe Project was authorized by Congress in 1956 and is a separate project from the CVP. The Washoe Project, located in west-central Nevada and east-central California, was designed to regulate runoff from the Truckee and Carson rivers and to enhance irrigation; water drainage; municipal, industrial, and fisheries uses; flood protection; fish and wildlife habitat; and recreation. The Washoe Project generates a minor amount of electricity as a byproduct of its operations for the primary uses listed above. The CVP divisions, the Washoe Project, and Sierra Nevada Region's transmission assets are described in the following sections.

Table 3.1. Power Resources of the Central Valley Project

Plant Name	Type	Agency	Operating Location	Max. Number of Units	Max. Operating Capability (kW)
Judge F. Carr	Hydro	Reclamation	Clear Creek Tunnel	2	184,000[b]
Folsom	Hydro	Reclamation	American River	3	215,000
Keswick	Hydro	Reclamation	Sacramento River	3	105,000
Nimbus	Hydro	Reclamation	American River	2	17,000
O'Neill	Pump generating	Reclamation	San Luis Creek	6	14,000
W.R. Gianelli	Pump generating	California[a]	San Luis Creek	8	202,000[c]
Shasta	Hydro	Reclamation	Sacramento River	7	584,000
Spring Creek	Hydro	Reclamation	Spring Creek Tunnel	2	200,000[b]
Trinity	Hydro	Reclamation	Trinity River	2	140,000
Lewiston	Hydro	Reclamation	Trinity River	1	350
New Melones	Hydro	Reclamation	Stanislaus River	2	383,000
Total Installed Capacity					2,044,350
Total Number of Plants	11				

[a] Operated by the State of California for Reclamation.
[b] Limited by tunnel restrictions.

[c] Eight 53,000-kW units for a total installed capacity of 424,000 kW, of which the Reclamation share is 202,000 kW.

3.2.1 Trinity River Division

The Trinity River Division was developed for transbasin diversion of Trinity River water to the Sacramento River to augment the supply of water in the CVP. Water is stored in Clair Engle Lake, behind Trinity Dam. Downstream of Clair Engle Lake, water is regulated at Lewiston Dam and either diverted through Clear Creek Tunnel into the Sacramento River Basin or released to the Trinity River. Water diverted through Clear Creek Tunnel flows into Whiskeytown Reservoir behind Whiskeytown Dam on Clear Creek, a tributary of the Sacramento River. Water then flows through either Spring Creek Tunnel into Keswick Reservoir on the Sacramento River or through Whiskeytown Dam into Clear Creek, which enters the Sacramento River downstream of Keswick Reservoir. Of the facilities located in the Trinity Division, the Sierra Nevada Region has limited scheduling discretion at Trinity, Carr, and Spring Creek powerplants to influence water release patterns on a hourly basis.

3.2.1.1 Trinity Dam and Powerplant and Clair Engle Lake

Located on the Trinity River in northwestern California, Trinity Dam was completed in 1962, creating Clair Engle Lake with a total storage capacity of 2.4 MAF. Active storage of Clair Engle Lake is 2.1 MAF. Mean annual inflow from Trinity River to Clair Engle Lake is 1.2 MAF. Trinity Powerplant, located adjacent to the dam, houses two generators with a maximum powerplant operating capability of 140,000 kW. Maximum powerplant release is 3,693 cubic feet per second (cfs).

3.2.1.2 Lewiston Dam, Powerplant, and Reservoir

Lewiston Dam, completed in 1963, is also located on the Trinity River, 7 miles downstream from Trinity Dam. Lewiston Reservoir functions as a regulating reservoir to control flow fluctuations downstream for Trinity Powerplant and as a forebay to Carr Powerplant. The reservoir also supplies water to the California Department of Fish and Game (CDFG) at Lewiston hatchery. Releases to the Trinity River and diversions to the Sacramento River Basin are controlled at Lewiston Dam. Lewiston Reservoir has a total capacity of 14,660 acre-ft, with 2,890 acre-ft of active storage. Lewiston Powerplant has one unit with a maximum operating capability of 350 kW. When operating at maximum capacity, Lewiston Powerplant releases about 100 cfs.

3.2.1.3 Judge Francis Carr Powerplant

Carr Powerplant was completed in 1963. The powerplant is located at the outlet of Clear Creek Tunnel, at the northwest extremity of Whiskeytown Reservoir. Water is diverted by Lewiston Dam via Clear Creek Tunnel through Carr Powerplant and into Whiskeytown Reservoir. The powerplant contains two generators with a maximum powerplant operating capability of 184,000 kW. The maximum powerplant release rate is 3,565 cfs.

3.2.1.4 Whiskeytown Dam and Reservoir

Whiskeytown Dam was completed in 1963. Whiskeytown Dam and reservoir are located 9 miles west of Redding on Clear Creek. The dam and reservoir regulate Trinity River diversions from Clear Creek Tunnel and Carr powerplant and natural inflow from Clear Creek. Mean annual inflow from Clear Creek is 260 TAF. The reservoir has a total storage capacity of 241 TAF and active storage of 213.5 TAF.

Figure 3.2. Sierra Nevada Region Power and Water Resources

3.2.1.5 Spring Creek Tunnel and Powerplant

Spring Creek Powerplant, located on the Spring Creek arm of Keswick Reservoir, was completed in 1964. Spring Creek Tunnel carries water from Whiskeytown Reservoir to Spring Creek Powerplant and into the Sacramento River above Keswick Dam. The minimum operating elevation in Whiskeytown Reservoir for Spring Creek Tunnel inlet is 1,100 ft. The powerplant houses two generators, with a maximum powerplant operating capability of 200,000 kW. The maximum powerplant release rate is 4,337 cfs.

3.2.1.6 Spring Creek Debris Dam

Spring Creek Debris Dam was constructed to control sediment and debris and to regulate acid mine drainage from Iron Mountain Mine. Storage capacity behind the earth-filled dam is 5.9 TAF. There are no generation facilities installed at Spring Creek Debris Dam.

3.2.2 Shasta Division

Shasta Division includes Shasta Dam, lake, and powerplant and Keswick Dam, reservoir, and powerplant. Shasta Dam and lake on the Sacramento River were developed to provide flood control, storage of winter runoff for downstream irrigation in the Sacramento and San Joaquin valleys, maintenance of navigational flows and conservation of fish in the Sacramento River, protection of the Bay/Delta from salt water intrusion, municipal and industrial water, and generation of power. The drainage area of the Sacramento River above Shasta Dam encompasses 6,665 square miles (4,265,600 acres). The Sierra Nevada Region has limited scheduling discretion to release water on an hourly basis at Shasta Powerplant.

3.2.2.1 Shasta Dam, Lake, and Powerplant

Shasta Dam, lake, and powerplant on the Sacramento River were completed in 1945. Shasta Lake has a total storage capacity of 4.5 MAF of which 3.96 MAF is active storage. Shasta Powerplant contains seven generating units, two of which are used for station service. Water is released through five penstocks leading to the generating units, which produce a maximum powerplant operating capability of 584,000 kW. The maximum powerplant release is approximately 18,000 cfs. Mean annual inflow to Shasta Lake is 5.2 MAF.

3.2.2.2 Keswick Dam, Reservoir, and Powerplant

Keswick Dam, completed in 1950, is located approximately 8 miles downstream of Shasta Dam. Keswick is a regulating reservoir for Shasta Lake and Trinity River diversions, controlling flow fluctuations from the upstream dams and powerplants. The reservoir has a total storage capacity of 23 TAF with 7.5 TAF of active storage. Keswick Powerplant, located within the dam, houses three generating units with a maximum operating capability of 105,000 kW. Maximum release through Keswick Powerplant is approximately 16,000 cfs.

3.2.3 American River Division

The American River drainage basin encompasses 1,877 square miles (1,201,000 acres) and, at its confluence with the Sacramento River, contributes approximately 15 percent of total Sacramento River flow. The American River enters the Sacramento River at the city of Sacramento. The major unit of the American River Division is the Folsom Unit, located on the American River, which includes Folsom Dam, lake, and powerplant; Nimbus Dam and powerplant; and Lake Natoma. The American River Division was developed to provide flood control; irrigation, municipal, and industrial water; recreation; and power. The Sierra Nevada Region has limited scheduling discretion to release water on an hourly basis at Folsom Powerplant.

3.2.3.1 Folsom Dam, Lake, and Powerplant

Folsom Dam, completed in 1956, is located 30 miles upstream of the mouth of the American River. It was constructed by the U.S. Army Corps of Engineers and is operated by Reclamation. Folsom Lake has a total storage capacity of approximately 1 MAF, of which 900 TAF is active storage. Water is released through three penstocks to three generating units, which have a maximum powerplant operating capability of 215,000 kW. Maximum powerplant release is 8,603 cfs. Mean annual inflow to Folsom Lake is 2.7 MAF.

3.2.3.2 Nimbus Dam and Powerplant and Lake Natoma

Nimbus Dam, completed in 1955, is located on the American River, 7 miles below Folsom Dam. Nimbus Dam backs up Lake Natoma, controlling flow fluctuations from Folsom Powerplant. The dam also serves as a diversion dam for Folsom South Canal. Nimbus Powerplant is housed within the dam and includes two generating units with a maximum powerplant operating capability of 17,000 kW. Maximum powerplant release is 5,100 cfs.

3.2.4 West San Joaquin Division

The West San Joaquin Division provides off-stream storage and distribution facilities for excess Bay/Delta water. The developed water supply helps to meet the water demands (e.g., irrigation, municipal, and industrial) of the west side of the San Joaquin Valley and provides irrigation, municipal, and industrial water to the San Felipe Division through the Pacheco Tunnel and Pumping Plant. The San Luis Unit, a joint-use project of Reclamation and the State of California, is the only facility of the West San Joaquin Division. Sierra Nevada Region's scheduling discretion is limited to the O'Neill and W.R. Gianelli pumping-generating plants. O'Neill has a maximum operating capability of 14,000 kW, and the Federal share of W.R. Gianelli is 202,000 kW.

3.2.5 East Side Division

This division consists of the New Melones Unit, located on the Stanislaus River, and includes New Melones Dam, lake, and powerplant. This unit was designed for flood control, irrigation, municipal and industrial water supply, power generation, and fisheries enhancement. The Sierra Nevada Region has limited scheduling discretion at New Melones Powerplant to release water on an hourly basis.

3.2.5.1 New Melones Dam and Powerplant

New Melones Dam, built by the U.S. Army Corps of Engineers in 1979, is located on the Stanislaus River, 60 miles upstream of the confluence with the San Joaquin River. New Melones Lake has a total storage capacity of 2.4 MAF, of which 2.1 MAF is active storage. New Melones Powerplant consists of two generating units with a maximum operating capability of 383,000 kW. Mean annual inflow to New Melones Lake is approximately 1.1 MAF. Maximum powerplant release is 8,928 cfs.

3.2.5.2 Tulloch Reservoir

Although not part of the CVP, Tulloch Reservoir, downstream of the New Melones Dam, regulates water releases from New Melones Dam. Tulloch Reservoir has a total storage capacity of 68.4 TAF, of which 10 TAF is used for flood control between October and April. About 4 TAF of storage is used for controlling fluctuations in water releases from New Melones. Tulloch Reservoir is owned and operated by the Tri-Dam Project.

3.2.6 Other Divisions

Other divisions of the CVP include the Sacramento River, Delta, Friant, and San Felipe. These divisions are involved primarily in diversion and transportation of water through CVP pumping plants, canals, and cross channels and do not provide CVP power generation to the Sierra Nevada Region. Power required at CVP pumping plants within these divisions is included within Project Use loads. The Sierra Nevada Region has no scheduling discretion within these divisions, and no further discussion of them is included in this 2004 EIS.

3.2.7 Washoe Project

The Washoe Project includes Prosser Creek Dam and reservoir; Stampede Dam, reservoir, and powerplant; Marble Creek Dam; and Pyramid Lake Fishway. Stampede

Reservoir backs up behind the dam with a total storage capacity of approximately 227 TAF. Stampede Dam was completed in 1975; however, the Stampede power facilities were completed in 1987. Stampede Powerplant has a maximum powerplant operating capability of 4,000 kW and generates approximately 10 gigawatt hours (GWh) of energy annually. The Stampede facility is located within the service area of the Sierra Pacific Power Company (SPPC), which owns and operates the only transmission system for distribution of the power that is generated at the Stampede Powerplant.

3.2.8 Sierra Nevada Region Transmission

The Sierra Nevada Region operates an electric transmission system as part of the CVP, which consists of approximately 831 miles of 230-kV transmission lines. Also, the Sierra Nevada Region owns approximately 94 miles of 500-kV transmission lines on the Pacific Intertie and has transfer rights of 400 MW through the year 2004. The Sierra Nevada Region also has 194 miles of COTP joint ownership and a transmission entitlement to the COTP of 150 MW (as well as layoff right-to-use of an additional 116 MW, a portion of which will expire in 1998). Some of Sierra Nevada Region's existing customers have no direct access to Sierra Nevada Region's transmission lines and receive service over transmission lines owned by other utilities. Sierra Nevada Region's principal transmission facilities are illustrated in Figure 3.3.

The Sierra Nevada Region's transmission system is also used to deliver power purchased from the Pacific Northwest, as described in Section 2.1.2. Currently, the Sierra Nevada Region has adequate transmission capacity to purchase about 666 MW from the Pacific Northwest. In 1998, some of the contracts for layoff capacity will terminate, reducing Sierra Nevada

Figure 3.3. Sierra Nevada Region's Principal Transmission Facilities

Region's transmission capacity to the Pacific Northwest by 88 MW to 578 MW. Access to the Desert Southwest is currently constrained by available transmission.

3.3 Hydropower Resources Operations and Constraints

To anticipate hydrological conditions for 2005, assumptions about river operations and constraints were developed. These assumptions are specified in the modeling report (Western 1997) and in Appendix D. Described here are general operating constraints on hydroelectric generation. Specific CVP divisions and Washoe Project constraints on hydropower resources are described in this section, as are other obligations affecting hydropower.

The CVP powerplants have a maximum operating capability of approximately 2,045 MW. The historical generation of the CVP since New Melones (the most recent generating facility addition in the CVP) became operational is an average of 4.6 billion kWh/year (Figure 3.4). Forecasted monthly CVP generation and instantaneous capacity in 2005 from PROSIM are shown in Figure 3.5. The Sierra Nevada Region currently coordinates operations with PG&E to meet area loads and to efficiently use CVP generating facilities, within the operating constraints for each of the divisions described below. The timing and amount of CVP

Figure 3.4. Historical Annual CVP Generation from 1979 to 1995

Figure 3.5. Forecasted Monthly CVP Generation and Instantaneous Capacity in 2005

generation are dictated by these constraints. As described in Chapter 1, EISs are being prepared on CVP and Trinity River flows and operations. Decisions based on these EISs could affect Sierra Nevada Region's ability to generate electricity or change the timing of flows.

3.3.1 Trinity River Division

Operations of this division are largely dictated by water rights and environmental constraints related to fisheries, old mine deposits, suspended solids, and the facilities' physical constraints. Energy production from the Trinity River Division is highly dependent on the amount of diversions to the Sacramento River and releases to the Trinity River. Under normal operating conditions, 1 acre-ft of diversion to the Sacramento River generates approximately 1,100 kWh as water is released through Carr, Spring Creek, and Keswick powerplants. Water released through Lewiston Powerplant generates 48 kWh/acre-ft. Trinity Powerplant generates between 175 and 425 kWh/acre-ft depending on reservoir water surface elevation.

Clair Engle Lake, Lewiston Reservoir, and Whiskeytown Reservoir are operated to meet target storage levels, flows, and temperature requirements as stipulated in Reclamation's operating policy, based on the agreements of 1960 and 1967 with the CDFG and the National Park Service, respectively. Operations are being modified by actions implementing the CVPIA and are specific to Kokanee salmon; fall-, late-fall, and spring-run chinook salmon; and steelhead. The CVPIA requires a minimum annual flow rate of 340 TAF to the Trinity River. Changes to this annual flow rate are included in the Trinity River studies discussed in Section 1.6.3. In addition to flow regulation, a temperature curtain in Lewiston Reservoir and two temperature curtains in Whiskeytown Reservoir contribute to temperature management for fisheries and influence operations in the Trinity Division. These temperature curtains are designed to provide cool water releases to the Sacramento River over a longer portion of the year than could otherwise be accommodated, which improves conditions for fish survival.

Operation of Spring Creek Powerplant is at times limited by the need to control the effects of metal concentrations in releases downstream from Keswick Dam. Dilution of toxic mine drainage from Spring Creek Debris Dam is maintained by regulation of diversions from the Trinity Basin via Spring Creek Powerplant and by Shasta outflows.

Clair Engle Lake storage is limited to 2.1 MAF from November 1 through March 31 in accordance with dam safety requirements. Minimum fall carryover storage of 600 TAF in

Clair Engle Lake provides for retention of a 300 TAF pool, which is used to meet water temperature criteria in the Trinity River.

Power production at Carr Powerplant depends on reservoir elevation at Whiskeytown and capacity of Clear Creek Tunnel, which varies depending on frequency of maintenance. Production at Carr varies with the surface elevation at Whiskeytown Reservoir and ranges from 540 to 565 kWh per acre-ft. Lewiston Lake must be maintained at an elevation above 1,898 ft to avoid developing a vortex at the Clear Creek Tunnel inlet. Like Carr, the capacity of Spring Creek Powerplant is affected by the elevation of Whiskeytown Reservoir, which must be operated at an elevation above 1,100 ft to avoid developing a vortex at Spring Creek Tunnel. Production at Spring Creek Powerplant varies from 425 to 575 kWh per acre-ft depending on reservoir level.

3.3.2 Shasta Division

The Shasta Division is operated to meet flood control objectives, water supply demands along the Sacramento River and in the Bay/Delta, and water quality and minimum flow requirements in the Sacramento River and the Bay/Delta. One acre-ft of water generates 295 to 475 kWh. During the period from October 1 to June 15, Shasta Lake is operated to provide up to a maximum of 1.3 MAF of flood control space.

Keswick Reservoir is operated as a regulating reservoir for upstream powerplants and controls downstream flow fluctuations in the Sacramento River related to power operations. Minimum flows are identified in the *Long Term Central Valley Project Operations Criteria and Plan* (Reclamation 1992), and generally releases are held constant for periods of 1 week or longer. The operation of Keswick Reservoir and Spring Creek Powerplant is coordinated to prevent scouring of metal sludge deposited from the Iron Mountain Mine in the Spring Creek arm of the reservoir. Operation of Keswick Dam would not change for purposes of electric generation. For Keswick Powerplant, 1 acre-ft of water generates approximately 75 kWh.

SWRCB Water Right Orders 90-5 and 91-01 stipulate daily average Sacramento River water temperature targets at downstream monitoring areas. Shasta Lake is the largest source of water available for improving Upper Sacramento River water temperatures. Due to reservoir temperature stratification and the location of the powerplant intake structures, releases for temperature control are often made through either the upper- or lower-level outlets in Shasta Dam that bypass the hydroelectric generators. Bypass operations at Shasta Dam have been used since 1987 to maintain water temperature in the Sacramento River at the expense of hydroelectric power. The Shasta Dam temperature control device (TCD) was recently completed and will reduce the need to bypass the generators. Temperature fluctuation is described in Section 3.4.

3.3.3 American River Division

The American River Division is operated to meet flood control, water supply, water quality, fish and wildlife, and recreation objectives and to generate power. Water quality criteria stated in several SWRCB decisions and flood control objectives dictate operation of the American River Division. Because of its close proximity to the Bay/Delta (1-day water travel time), Folsom Dam and reservoir are often operated to accommodate quick response to changing water conditions in the Delta. One acre-ft of water generates 270 to 347 kWh.

Lake Natoma is operated as a regulating reservoir for Folsom Powerplant and eliminates downstream fluctuations in the American River. Operation of Lake Natoma provides water for the downstream fish hatchery that was developed to mitigate fishery impacts of project construction.

3.3.4 West San Joaquin Division

Water supply demands dictate the operation of the West San Joaquin Division. Overall, these facilities are net users of power. During the winter months, O'Neill and Gianelli pumping-generating plants are used to pump water into San Luis Reservoir for release during the summer months to meet water supply demands and generate power. These plants can be used in the standard pump-storage mode (releasing water for generation during the on-peak period and pumping the water back into the reservoir during the off-peak period).

3.3.5 East Side Division

The East Side Division consists of the New Melones Unit. The division is operated for flood control, water rights, water quality, water supply, seepage problems, and fisheries. During the flood control season, a maximum of 450 TAF of storage space is reserved for flood control.

Operation of the New Melones facilities to meet water quality criteria for the San Joaquin and Stanislaus rivers is dictated by standards set by the SWRCB. These criteria are stated as provisions of the water rights for New Melones; therefore, operation cannot affect the ability to meet *a priori* water right obligations. Compliance with Federal Clean Water Act standards for water quality objectives at Vernalis and in-basin flow objectives in the Stanislaus and San Joaquin rivers contribute to meeting fisheries management objectives in the Bay/Delta. To the extent possible, New Melones is operated within these constraints. The 4-TAF regulation capacity in Tulloch Reservoir allows peaking operations at New Melones generating facility by controlling flow fluctuations downstream. One acre-ft generates 222 to 436 kWh.

3.3.6 Washoe Project

The Washoe Project is operated to meet water requirements on the Truckee River. Power generation is a by-product of water operation. Power is used to serve Project Use load in the area, and surplus power is marketed by the Sierra Nevada Region on an as-available basis.

3.3.7 Other Obligations Affecting Hydropower Availability for Preference Sales

The following obligations are deducted from generation prior to determining the amount of power available for the Sierra Nevada Region to market.

3.3.7.1 Station Service

Station service is power that CVP and Washoe facilities use to operate generating station equipment, lighting, heating, and ventilation. The amount of station service required is typically less than 1 percent of gross generation.

3.3.7.2 Project Use

Project Use is the power, including station service, required to deliver project water to CVP water customers and for fish and wildlife needs. Project Use accounts for approximately 20 to 30 percent of annual gross energy generation of the CVP. Project Use requirements for Washoe include fish and wildlife facilities at Lahontan National Fish Hatchery and Marble Bluff Fish Facility. Power to these facilities is provided by SPPC through an exchange arrangement.

3.3.7.3 System Losses

System losses of energy and capacity occur on the transmission system in delivery of power from generator to load. Presently, the CVP transmission system loss is 1.6 percent.

3.3.7.4 Project Facility Maintenance

Facility maintenance, scheduled or unscheduled, may at times affect the net available capacity. Reclamation is responsible for operation and maintenance of CVP and Washoe generating facilities, while the Sierra Nevada Region is responsible for transmission facilities. Major maintenance requiring a long down time is usually scheduled during the fall and winter. Reclamation cooperates with the Sierra Nevada Region in developing an annual maintenance schedule.

3.3.7.5 CVP Reserves

CVP reserve requirements will be the same as required by Western Systems Coordinating Council (WSCC) and North American Electric Reliability Council (NERC).

3.4 CVP Water Resources

An important issue related to water resources in and below the regulating reservoirs is temperature. Reservoir operations potentially influence the temperature downstream. Because anadromous fish species are blocked from migrating upstream beyond regulating dams to their historic spawning grounds, water releases for temperature management are often needed to improve suitability of downstream river habitat for anadromous fish spawning and rearing.

Pool-level fluctuation is an issue only within the regulating reservoirs. The main reservoirs above the regulating reservoirs are substantially larger than the regulating reservoirs, and changes in power operations do not create noticeable fluctuations in their surface elevations on a daily basis. The regulating reservoirs are used for regulation of rapidly varying releases from upstream storage projects and as collection points for flow diversions, consistent with downstream water requirements. As shown in Figure 3.6, the regulating reservoirs are designed to control daily flow fluctuations downstream from regulating dams. Figure 3.6 is a schematic representation of the daily flow fluctuations for typical CVP main and regulating reservoirs. The Sierra Nevada Region's operations may affect pool fluctuations in the regulating reservoirs (Lewiston, Keswick, Lake Natoma, and Tulloch). Although Whiskeytown Reservoir regulates flows from Carr Powerplant, due to its size, it is not affected overall by hourly flows.

3.4.1 Lewiston Reservoir

Lewiston Reservoir is located on the Trinity River immediately downstream from Trinity Dam. In 1992, the SWRCB established water temperature objectives for the Trinity River downstream from Lewiston Dam. Reclamation maintains a coldwater pool at Clair Engle Reservoir. Low-level outlet releases from Trinity Dam are made to cool releases to the Trinity River below Lewiston Dam and to cool exports to the Sacramento River. Pool levels at Lewiston vary about 2 feet.

3.4.2 Keswick Reservoir

Keswick Reservoir is located on the Sacramento River, beginning approximately 0.5 mile downstream from Shasta Dam. Bordered by a steep canyon, the reservoir is approximately 9 miles long, with a surface area of 640 acres and 19 miles of shoreline. In 1990 and 1991, the SWRCB established temperature objectives for the Sacramento River below Keswick Reservoir. Reclamation attempts to meet this temperature criteria on the Sacramento River by regulating releases from Shasta Lake and Whiskeytown Lake. As part of the *Biological Opinion for the Operation of the Federal Central Valley Project and the California State Water Project*, dated February 12, 1993 (NMFS 1993), Reclamation is required to maintain Keswick Reservoir at or above the normal operating level during operation of the Spring Creek Powerplant to prevent the scouring of toxic metal-laden sediments in Keswick Reservoir. Reclamation has defined the normal operating range as 8 ft (elevation 578 to 586 ft). In a July 10, 1996, letter to EPA, Reclamation states that they expect EPA to pursue a remedy that also

Figure 3.6. Example of Daily Flow Fluctuations for CVP Reservoirs

addresses the contaminated sediments that are located in the Spring Creek arm of Keswick Reservoir as part of the cleanup process for the Iron Mountain Mine Superfund Site. For the purposes of this EIS, the Sierra Nevada Region has assumed that the contaminated sediment in the Spring Creek arm of Keswick Reservoir will be removed and that Keswick Reservoir can fluctuate between elevations of 576 and 587 ft, for a maximum reservoir change of 11 ft. If this problem is not resolved by 2005, the Sierra Nevada Region will schedule powerplant operations within the then current normal operating level. Whether the Sierra Nevada Region schedules to the present Keswick normal operating level or the maximum level does not impact how the Sierra Nevada Region will market the CVP resource but will impact the amount of capacity available to market.

3.4.3 Lake Natoma

Lake Natoma, a 500-acre reservoir, is approximately 6 miles downstream from Folsom Dam. During most of the year, Lake Natoma receives controlled releases from Folsom Lake. The shutter system at Folsom Dam permits some flexibility in management of water temperature of releases for fishery purposes. Therefore, coldwater releases for fish are generally made from June through December, when possible.

Reclamation attempts to preserve a coldwater pool at Folsom Lake to maintain cool temperatures for fish in the American River below Lake Natoma. However, the limited capacity of the coldwater pool at Folsom Lake is often inadequate to maintain an optimal temperature for the downstream fishery. The normal operating range is 4.5 ft; however, pool fluctuations at Lake Natoma can vary as much as 6 ft.

3.4.4 Tulloch Reservoir

Tulloch Reservoir regulates the releases from New Melones Dam. Tulloch Reservoir is located immediately downstream from the New Melones Dam on the Stanislaus River. This 1,240-acre reservoir is owned and operated by the Tri-Dam Project. There are no established water temperature criteria for releases on the Stanislaus River downstream of Tulloch Reservoir, although some efforts have been made to control temperatures in the Stanislaus River. The pool elevations at Tulloch Reservoir do not generally fluctuate by more than 12 ft. During the summer months, the pool is held within 2 ft of full pool. In September, the pool is drawn down about 10 ft for flood control and remains at that level until spring when it gradually returns to full pool.

3.5 Fisheries

The rivers, reservoirs, lakes, and estuaries of the Central Valley Basin and Trinity River Basin support a variety of native and introduced fish. Some fish are valued for their recreational, commercial, and other uses; and some are protected by State and Federal law because their sustained existence is threatened or endangered. These fish include both anadromous (i.e., those that spawn and complete their early life history in freshwater followed by 1 to 4 years in the ocean) and resident species. This section describes fisheries found throughout the Central Valley and Trinity river basins, with specific descriptions of each of the fisheries in the four regulating reservoirs. The main storage reservoirs are not part of the affected environment because Sierra Nevada Region's power generation activities have no discernible effects on these reservoirs.

The Sacramento River currently provides important habitat for diverse anadromous and resident species. Anadromous fish include chinook salmon (*Oncorhynchus tshawyscha*), steelhead[(1)] (*O. mykiss*), striped bass (*Morone saxatilus*), American shad (*Alosa sapidissima*), green sturgeon (*Acipenser medirostris*), and lamprey (*Lampetra* spp.). Resident fish can be separated into warmwater game fish (such as bass [*Micropterus* spp.], crappie [*Pomoxis* spp.], catfish and bullheads [*Ictalurus* spp.], and sunfish [*Lepomis* spp.]), coldwater game fish (such as rainbow trout[(a)] [*O. mykiss*] and brown trout [*S. Trutta*]), and nongame fish (such as Sacramento squawfish [*Ptychocheilus grandis*], Sacramento sucker [*Catastomus occidentalis*], and golden shiner [*Notemigomus crysoleucas*]).

The upper Sacramento River is the largest, most important salmon stream in California, providing more spawning habitat for chinook salmon than any other river in the State. The Sacramento River supports four separate chinook salmon runs including the winter-run chinook salmon, which is Federally and State listed as an endangered species. Portions of the Sacramento River below Keswick Dam have been designated by State and Federal governments as critical habitat for winter-run chinook salmon. Water temperature in the upper Sacramento River has been identified as a critical factor in the decline of the winter-run chinook salmon (Hallock and Fisher 1985). Generally, the farther upstream the winter-run chinook salmon spawn, the more favorable the temperature conditions are for reproduction and survival.

Salmon migration was blocked by construction of Shasta Dam and later by Keswick Dam. Also on the upper Sacramento River, the Red Bluff Diversion Dam is a major impediment to upstream migration of adult salmon. Raising the Red Bluff Diversion Dam gates during the nonirrigation season is currently being implemented to facilitate upstream migration passage of adult salmon. Other fish passage problems on the Sacramento River occur at the Anderson-Cottonwood Irrigation District Diversion Dam.

The American River historically provided habitat for steelhead and chinook salmon that spawned principally in the watershed above the valley floor. Completion of Folsom and Nimbus dams in 1955 blocked access to the historical spawning and rearing habitat for both species. Resident fish of the American River include both native (e.g., prickly sculpin [*Cottus asper*], hitch [*Lavinia exilicauda*], Sacramento squawfish, and introduced species (e.g., crappie, bass, bullhead, and goldfish [*Carassius auratus*]). Fish migration is blocked on the American River at Nimbus Dam.

The San Joaquin River's major eastside tributaries (Stanislaus, Tuolumne, and Merced) support limited chinook salmon spawning and rearing. Goodwin Dam, La Grange Dam, and Crocker-Huffman Dam block access to historical spawning and rearing habitat in the Stanislaus, Tuolumne, and Merced watersheds, respectively. Like the other rivers of the Central Valley, the San Joaquin River supports a diverse community of native and introduced species, including sculpins, squawfish, bass, crappie, and bullheads.

In the tributaries of the San Joaquin River, dams block salmon migration to the upper reaches of these rivers. Reduced flows often block or impede migration in the middle or lower reaches of these rivers. Attraction flows from the Merced River have been inadequate during October, resulting in straying of adult salmon into agricultural drainage ditches. Inadequate attraction and migration flows during October and November have resulted in poor adult returns to the Molelumme River.

Declines in habitat and anadromous fish populations in the Trinity River Basin followed completion of the Trinity and Lewiston dams in 1963, which prevented access to an estimated 59 miles of spawning habitat above Lewiston Dam (Service 1980). However, chinook salmon, coho salmon, and steelhead still use much of the Trinity River Basin and are species of primary social and economic importance. Chinook salmon spawn in the mainstem Trinity River and major tributaries. Steelhead and coho salmon spawn primarily in tributaries, although major portions of the coho salmon runs are believed to be of hatchery origin (Service 1980).

Reservoirs have become a major fish habitat since the advent of the CVP. The nature of each reservoir and its fish fauna is determined by many factors, such as its elevation, size, location, and water quality. CVP reservoirs generally lie at mid-elevations in the foothills and can have characteristics of both warmwater and coldwater impoundments (Moyle 1976). Reservoirs with warmwater habitat are probably more suitable for bass, sunfish, and catfish and nongame fish. Reservoirs with coldwater habitat are in most cases more suitable for trout. Seasonally stratified reservoirs contain both warmwater and coldwater habitats and support warmwater and coldwater species.

Species composition in each CVP reservoir varies with native species survival and the history of species introductions. Some introduced species are now almost universal in their occurrence: largemouth bass (*Micropterus salmoides)*, bluegill (*L. macrochirus*), carp (*Cyprinus carpio*), golden shiner, black crappie (*P. nigromachulatus*), brown bullhead (*I. nebulous*), mosquito fish (*Gambusia affinis*), and hatchery strains of rainbow trout. A complete list of fish species for CVP rivers and reservoirs is provided in Table 3.2.

Of the State or Federally listed endangered and threatened fish species known to reside in California's waters, only two species may be affected by operation of the CVP. The Sacramento River's winter-run chinook salmon is listed as endangered. The delta smelt (*Hypomesus transpacificus*) is listed as threatened. Additionally, the Central Valley evolutionarily significant unit (ESU) of West Coast steelhead (*Oncorhynchus mykiss*) and the Sacramento splittail (*Pogonichthys macrolepidotus*) are proposed for protection as threatened under the Federal Endangered Species Act. Threatened and endangered species are discussed in Section 3.7.

As previously described in Chapter 3.0, Sierra Nevada Region's lack of effect on the main storage reservoir and limited discretion in operating the CVP hydrosystem confines any potential impacts on fisheries to four specific regulating reservoirs (Lewiston, Keswick, Lake Natoma, and Tulloch) and rivers downstream of these reservoirs. Since the dams at the regulating reservoirs are barriers to upstream migration, no anadromous fish species exist within these reservoirs.

The following sections discuss the fisheries issues within the regulating reservoirs.

3.5.1 Lewiston Reservoir

Lewiston Reservoir is a coldwater impoundment dependent on Trinity Dam releases. Lewiston supports a coldwater fishery including rainbow trout, brown trout, and brook trout.

3.5.2 Keswick Reservoir

Keswick Reservoir is a coldwater impoundment dependent on Shasta Dam releases and water diverted from the Trinity River through the Spring Creek Tunnel. This reservoir supports a rainbow trout fishery and some brown trout. An occasional warmwater fish from Shasta Dam releases may be present.

Table 3.2. Fish Species of Central Valley Rivers and Reservoirs

FISH SPECIES		**River Basin of Occurrence**	**Species Origin** [a]	**In CVP Reser-voirs** [a,d]	**Affected by Water-Level Fluctuations in Regulating Reservoirs** [d]	**Fish Species Comments** [g]
Common Name	**Scientific Name**					
Pacific Lamprey	*Lampetra tridentata*	S, T, SJ	native	no	yes	Occurs in low numbers in the Trinity River watershed. [a]
River Lamprey	*Lampetra ayresi*	S, SJ	native	no	yes	Occurs in the Central Valley, less abundant than Pacific lamprey. [h]
Pacific Brook Lamprey	*Lampetra pacifica*	S, SJ	native	no	yes	Access to spawning streams may be affected by fluctuating water levels. [d]
Pit-Klamath Brook Lamprey	*Lampetra lethophaga*	T	native	no	yes	Access to spawning streams may be affected by fluctuating water levels. [d] Found primarily in Klamath and Pit Rivers. [d]
White Sturgeon	*Acipenser transmontanus*	S, T, SJ	native	no	no	Occurs in low numbers in the Trinity River watershed: Grays Falls is believed to be a complete barrier to upstream migration of sturgeon. [a]

Green Sturgeon	*Acipenser medirostris*	S, T, SJ	native	no	no	Occurs in low numbers in the Trinity River watershed, but in greater numbers than white sturgeon. [(a)] Seldom found in fresh water; prefers salt or brackish water. [(c)]
American Shad	*Alosa sapidissima*	S, SJ	introduced	no	no	Occur seasonally in the Sacramento and San Joaquin Rivers and Delta. [(a)]
Threadfin Shad	*Dorosoma petenense*	T, SJ	introduced	yes	no	Occupy open waters of reservoirs. They are forage fish for larger predators. [(d)]
Chinook Salmon	*Oncorhynchus tshawytscha*	S, T, SJ	native	no	no [(f)]	Sacramento Basin - fall-run chinook up to Clear Creek. 92,800 late-fall run adults passed Red Bluff Dam in 1995 but only 8,600 spring and 1,300 winter. Trinity Basin - fall-run Chinook important to fishing industry, spring run in 1994 was 6,788. 1995 Trintiy fall run was the second highest on record since 1977.
Coho Salmon	*Oncorhynchus kisutch*	T	native	no	no	Coho maintain a small population in the Trinity River System of less than 1,000 individuals.
Kokanee Salmon	*Oncorhynchus nerka*	S, T, SJ	introduced	yes	yes	Kokanee are stocked in some Sacramento/Trinity Basin reservoirs, namely Shasta, Whiskeytown, and Clair Engle. [(a)] Access to spawning streams may be affected by fluctuating water levels. [(d)]
Brook Trout	*Salvelinus fontinalis*	S, T, SJ	introduced	yes	yes [(1,2)]	Access to spawning streams may be affected by fluctuating water levels. [(d)]
Cutthroat Trout	*Oncorhynchus clarki*	T	native	yes	unknown	Access to spawning streams may be affected by fluctuating water levels. [(d)]
Brown Trout	*Salmo trutta*	S, T, SJ	introduced	yes	yes [(1)]	Access to spawning

						streams may be affected by fluctuating water levels. [d]
Rainbow Trout (freshwater)	*Oncorhynchus mykiss*	S, T, SJ	native	yes	yes [1]	Access to spawning streams may be affected by fluctuating water levels. [d]
Winter- and Summer-run Steelhead (anadromous)	*Oncorhynchus mykiss*	S, T, SJ	native	no	no [f]	Dams have blocked most steelhead spawning access throughout the valley. [a] These are also known as West Coast steelhead (Klamath Mountains Province ESU and Central Valley ESU).
Carp	*Cyprinus carpio*	S, SJ	introduced	yes	yes	Introduced minnow that occurs throughout the Sacramento-San Joaquin basin. [h]
Goldfish	*Carassius auratus*	S, SJ	introduced	likely	no	Prefer warm water; spawn several times per year. [d]
Golden Shiner	*Notemigonus crysoleucas*	S, T, SJ	introduced	likely	yes	Shallow inshore waters of creeks, ponds, lakes, reservoirs and sloughs. [h]
Sacramento Blackfish	*Orthodon microlepidotus*	S, SJ	native	no	yes	Shallow waters with dense vegetation, mostly in reservoirs and sloughs. [h]
Hardhead	*Mylopharodon conocephalus*	S, SJ	native	not likely	yes	Pools and side pools of rivers and creeks. [h]
Hitch	*Lavinia exilicauda*	S, SJ	native	likely	yes	Non-tidal creeks, channelized ditches, irrigation canals. [h]
Sacramento Squawfish	*Ptychoceilus grandis*	S, SJ	native	not likely	yes	Gravel riffle streams, tributaries of Sacramento and San Joaquin rivers. [h]
Blue Chub	*Gila coerulea*	T	native	yes	yes	Spawns in shallow rocky areas during late spring and summer. (d)
Tui Chub	*Gila bicolor*	S, T, SJ	native, extinct	yes	native	Spawns in shallow sandy areas during late spring and summer. Multiple spawning occurs and eggs don't ripen at the same time. [d] Considered virtually extinct in the Sacramento Basin. [a]
Sacramento Splittail	*Pogonichthys macrolepidotus*	S, SJ	native, practically extinct	no	yes	Though historically found as far north as Redding, California, they

						are now rarely found more than 5-10 miles above the upstream boundaries of the Sacramento-San Joaquin Delta. [a]
Delta Smelt	*Hypomesus transpacificus*	S, SJ	native, endangered	no	no	They are very uncommon in the upper Sacramento River Basin. (a)
California Roach	*Hesperoleucas symmetricus*	S, SJ	native	not likely	no	Prefer to spawn in intermittent streams. Absent from upper San Joaquin River and its tributaries. [d]
Speckled Dace	*Rhinichthys osculus*	S, T, SJ	native	yes	yes [2]	Spawns in shallows over gravel. [d]
Lohontan Redside	*Richardsonius egregius*	S, SJ	introduced	not likely	yes	Loon Lake, upper American River system [h]
Red Shiner	*Notropis lutrensis*	S, SJ	introduced	likely	no	Thrive in unstable environments like intermittent streams. Present mostly as introduced bait fish. Can be expected anywhere [d].
Fathead Minnow	*Pimephales promelas*	S, SJ	introduced	likely	no	Can spawn repeatedly throughout the summer [d].
Klamath Small-scale Sucker	*Catostomus rimiculus*	T	native	yes	yes	Migrates upstream in spring to spawn. [d]
Klamath Large-scale Sucker	*Catostomus snyderi*	T	native	yes	yes	Migrates upstream in spring to spawn. [d]
Sacramento Sucker	*Catostomus occidentalis*	S, SJ	native	likely	yes	Tributary streams, cool-water rivers or streams. [h]
Channel Catfish	*Ictalurus punctatus*	S, SJ	introduced	yes	yes	Shallow, warm water spawner. [d]
White Catfish	*Ameiurus catus*	S, SJ	introduced	yes	yes	Shallow, warm water spawner. [d] The white catfish is widely abundant in the Sacramento and San Joaquin Reservoirs. [c]
Yellow Bullhead	*Ameiurus natalis*	S, T, SJ	introduced	not likely	yes	Uncommon in California. Shallow, warm water spawner. [d]
Brown Bullhead	*Ameiurus nebulosus*	S, T, SJ	introduced	yes	yes	Shallow, warm water spawner. [d]

Black Bullhead	*Ameiurus melas*	S, SJ	introduced	likely	yes	Shallow, warm water spawner. (d)
Mosquitofish	*Gambusia affinis*	S, SJ	introduced	yes	no	Can have several broods per year. (d)
Threespine Stickleback	*Gasterosteus aculeates*	S, T, SJ	native	yes	no	Shallow weedy areas of the Sacramento-San Joaquin estuary. (h)
Sacramento Perch	*Archoplites interruptus*	T?, SJ	native, rare	no	no	Weedy ponds and lakes, spawns in Delta sloughs. (h)
Striped Bass	*Morone saxatilis*	S, SJ	introduced	yes	no	The main population is in the Sacramento-San Joaquin estuary and river system. Most of the reservoir populations are replenished by juveniles that are pumped through canals from the Delta or by restocking programs.
Black Crappie	*Pomoxis*	S, T, SJ	introduced	yes	yes (1,2)	(e)
White Crappie	*Pomoxis annularis*	S, T, SJ	introduced	yes	yes (1,2)	(e)
Warmouth	*Lepomis gulosus*	S, SJ	introduced	likely	yes (1,2)	Relatively uncommon. (a,e)
Green Sunfish	*Lepomis cyanellus*	S, T, SJ	introduced	yes	yes (1,2)	(e)
Bluegill	*Lepomis macrochirus*	S, T, SJ	introduced	yes	yes (1,2)	(e)
Pumpkinseed	Lepomis gibbosus	T	introduced	yes	yes (1,2)	(e)
Redear Sunfish	*Lepomis microlophus*	S, SJ	introduced	yes	yes (1,2)	(e)
Largemouth Bass	*Micropterus salmoides*	S, T, SJ	introduced	yes	yes (1,2)	The Sacramento River Basin has a limited largemouth bass fishery. (a,e)
Spotted Bass	*Micropterus*	S	introduced	likely	yes (1,2)	(e)
Smallmouth	*Micropterus dolomieu*	S, T, SJ	introduced	yes	yes (1,2)	(e)
Yellow Perch	*Perca flavescens*	T	introduced	likely	no	Freshwater sloughs and irrigation ditches. (h)
Bigscale Logperch	*Percina macrolepida*	S, SJ	introduced	not likely	no	Spawn many times over an extended period. (d)
Tule Perch	*Hysterocarpus traski*	S, SJ	native	no	no	Livebearers. They are practically extinct in the San Joaquin River. (d)
Sharpnose	*Clinocottus*	T, SJ	marine/	no	no	Not likely to be present

Sculpin	*acuticeps*		estuarine			near reservoirs. [a]
Coastrange	*Cottus aleuticus*	S, T	native	no	no	Rare in lakes. [d]
Prickly Sculpin	*Cottus asper*	S, T, SJ	native	yes	no	Freshwater of the Sacramento-San Joaquin system. [h]
Riffle Sculpin	*Cottus gulosus*	S, SJ	native	likely	no	Mostly small streams. [h]

[a] Bureau of Reclamation. February 1994. Central Valley Project Improvement Act Programmatic EIS: Appendix Fisheries Existing Conditions, Draft.
[b] Bureau of Reclamation. 1992. Long-Term Central Valley Project Operations Criteria and Plan CVP-OCAP. U.S. Department of the Interior, Bureau of Reclamation, Mid-Pacific Region, Sacramento, California.
[c] U.S. Army Corps of Engineers. 1990-91. Fisheries Handbook of Engineering Requirements and Biological Criteria. Fish Passage Development and Evaluation Program, Corps of Engineers, North Pacific Division, Portland, Oregon.
[d] Moyle, P.B. 1976. Inland Fishes of California. University of California Press, Berkeley and Los Angeles, California. Life stage affected: (1) = spawning; (2) = juveniles.
[e] Fluctuating water levels may cause nests to be located in deeper water. Renesting may occur if first brood is unsuccessful. Flooding may kill eggs. Juveniles have been positively correlated with water temperature, aquatic macrophytes, and the amount of littoral habitat (<2 m deep). Macrophyte distribution may be limited because of fluctuating water levels; taken from footnote [c].
[f] Chinook salmon and Steelhead trout are potentially affected by fluctuations in the American River. Reduction in flows can expose redds [b]. Juveniles can become stranded in the lower American River in non-connecting side channels if flows are reduced [b].
[g] Threatened and endangered fish species are also listed in Table 3.4.
[h] Wang, J.C.S. 1986. Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Histories. California Department of Water Resources, Sacramento, California.
River Basins: S = Sacramento, SJ = San Joaquin, T = Trinity. <h43.5.3 Lake Natoma </h4

Lake Natoma is a coldwater impoundment dependent on Folsom Dam releases. The cold temperature and rapid turnover of Lake Natoma reduce food available for fish. With combined daily water-level fluctuations, limited food production, and coldwater temperatures, Lake Natoma is marginally suitable for natural warmwater or coldwater fish production. To partly compensate for these deficiencies, the CDFG conducts a limited "put and take" rainbow trout stocking program. Some recruitment of warmwater and coldwater fish likely comes from Folsom Dam releases.

3.5.4 Tulloch Reservoir

Tulloch Reservoir is an impoundment dependent on outflows from New Melones Dam. Tulloch Reservoir's ratio of storage volume to flow is high relative to other regulating reservoirs causing it to stratify into warmwater and coldwater pools during the summer. Rainbow trout, brown trout, smallmouth bass, bluegill, crappie, catfish, carp, threadfin shad, and suckers inhabit Tulloch Reservoir. Rainbow trout are planted in the reservoir annually.

3.6 Terrestrial Environment

This section describes the potentially affected terrestrial environment in the Central Valley and upper Trinity River basins. While both basins are within the CVP, they are described separately because they are two distinct vegetative regions. The descriptions of the terrestrial environment focus on the dominant vegetation types and associated animal species known to occur within, or adjacent to, the affected environment. Section 3.6.1 describes the terrestrial vegetation types generally surrounding the affected regulating reservoirs of the Central Valley region. The terrestrial vegetation types of the upper Trinity River Basin (which encompasses Lewiston Reservoir) are described in Section 3.6.2. Regulating reservoirs are more specifically characterized in Section 3.6.3 by representative plant and wildlife species.

3.6.1 Central Valley Basin

Terrestrial vegetation types in the Central Valley and adjacent foothills are generally a function of annual precipitation. In the Central Valley, annual precipitation increases with increasing elevation and also increases from south to north. The valley floor receives the least amount of precipitation and is dominated by non-native annual grassland. Trees on the valley floor are most prevalent in narrow bands of riparian forest that occur along the margins of rivers and streams. Wetland vegetation types in the Central Valley occur where the soils are seasonally or perennially saturated. Specific wetland types include vernal pools, freshwater marsh, and shrub or tree-dominated riparian wetlands (Mason 1957). Higher elevations along the margins of the Central Valley region receive slightly more annual precipitation and are dominated by northern yellow pine forest, chaparral, and blue oak-foothill pine woodland (Barbour and Major 1977).

Northern yellow pine forest is a tall, rather open, conifer forest with a lower layer of broad-leaved deciduous trees and evergreen shrubs (Sawyer and Keeler-Wolf 1995; Kuchler 1977). Northern yellow pine forest is dominated by ponderosa pine (*Pinus ponderosa*). Other characteristic species of this vegetation type include black oak (*Quercus kelloggii*) and manzanita species (*Arctostaphylos* spp.) (Kuchler 1977). Northern yellow pine forest occurs on well-drained soils at the lower margin of the montane conifer forests (Sawyer and Keeler-Wolf 1995). At lower elevations, this vegetation type integrates with the chaparral and blue oak-foothill woodland vegetation types (Holland 1986).

Chaparral refers to a range of vegetation types dominated by shrubs with evergreen leaves (Keeley and Keeley 1988). Within the vicinity of the affected environment, the chaparral vegetation type is typically dominated by species of manzanita (*Arctostaphylos* spp.), ceanothus (*Ceanothus* sp.), scrub oak (*Quercus dumosa*), or chamise (*Adenostoma fasciculatum*) (Kuchler 1977). Chaparral species possess a number of adaptations to frequent fires, and some species require burns to initiate germination. Understory plants are uncommon in mature chaparral, but herbaceous species dominate this plant community during early stages of recovery following fire.

Blue oak-foothill pine woodlands are dominated by blue oak (*Quercus douglasii*) and foothill pine (*Pinus sabiniana*). Other associated species include interior live oak (*Quercus wislizenii*), whiteleaf manzanita (*Arctostaphylos viscida*), and annual grasses (Kuchler 1977). Blue oak-foothill pine forests occur in uplands on shallow, infertile soils that are often rocky (Sawyer and Keeler-Wolf 1995). At lower elevations and south-facing slopes the blue oak-foothill pine woodland integrates with annual grasslands.

Annual grasslands are dominated by non-native grass and herb species including bromes (*Bromus* sp.), oats (*Avena* sp.), filaree (*Erodium* sp.), and star thistle (*Centaurea solstitalis*). Composition can vary depending on site history, grazing, soils, fall temperatures, precipitation, and other factors (Sawyer and Keeler-Wolf 1995). Annual grasslands occur throughout the low elevations of the Central Valley and integrate with blue oak-foothill pine woodland at slightly higher elevations or north-facing slopes.

Riparian forests occur in narrow bands along the major streams and rivers of the Central Valley. This vegetation type is typically composed of Fremont cottonwood (*Populus fremontii*), willow (*Salix* spp.), box elder (*Acer negundo*), Oregon ash (*Fraxinus latifolia*), and California grape (*Vitis californica*) (Sawyer and Keeler-Wolf 1995). Riparian forest vegetation is an important habitat type for wildlife, providing feeding, resting, and escape cover (Barbour et al. 1993). More species of birds nest in the riparian forests of the Central Valley than in any other California plant community (Barbour et al. 1993). It has also been estimated that 25 percent of California's 502 species of native land mammals utilize the riparian forest vegetation type (Barbour et al. 1993). Much of this habitat has been modified by levee construction, flow modification, and rip-rapping banks for erosion protection. Only about 6 percent of the estimated 920,000 acres of riparian forest that existed before settlement is still present today (Barbour et al. 1993).

Wetlands in the Central Valley include freshwater marsh, riparian wetlands dominated by trees and shrubs, and vernal pools. These three wetland types are differentiated based on duration of saturation and inundation. Freshwater marsh occurs where the soil is saturated or inundated for substantial periods of time during the growing season while vernal pools occur where saturation or inundation of the soils during the growing season may be ephemeral. Although wetlands account for less than 2 percent of the Central Valley's total area today, an estimated 4 million acres of wetlands occupied approximately 26 percent of the total area in 1850 (Barbour et al. 1993).

Approximately 2 million acres of the Central Valley's original wetland area was freshwater marsh (Barbour et al. 1993). Freshwater marsh is dominated by emergent plant species including tules and bulrushes (*Scirpus acutus, S. californicus*) and cattails (*Typha latifolia, T. angustifolia*) that grow from rhizomes (Barbour et al. 1993). This vegetation type occurs where there is seasonal or perennial inundation such as the margins of rivers, lakes, streams, and irrigation ditches (Sawyer and Keeler-Wolf 1995).

Riparian wetlands occupy slightly higher positions along the banks of rivers, streams, and lakes where inundation and soil saturation occur less frequently and for shorter duration (Barbour et al. 1993). Riparian wetlands are typically dominated by species of willow (*Salix* spp.), Fremont cottonwood (*Populus fremontii*), or white alder (*Alnus rhombifolia*) (Sawyer and Keeler-Wolf 1995). Like riparian forest, riparian wetlands are important for the cover, nesting habitat, and forage that they provide to wildlife.

Vernal pools are seasonal wetlands that are dominated by herbaceous plant species. This wetland type occurs in shallow topographic depressions that are underlain by an impermeable soil layer that restricts the movement of water. Surface runoff from winter precipitation saturates the soil above this layer, inundating the depressions. The hydrology of vernal pools consists of three phases: an aquatic phase when the pool is filled with water from winter rains, a drying phase during early to mid-spring, and a dry phase during the summer and fall. Vernal pools are closely associated with annual grasslands and the areas between the grasslands and blue oak-foothill pine woodlands. Due to the unique ecological characteristics of vernal pools, many of the associated plant and wildlife species are native to and occur only in this habitat.

In the southern Sacramento Valley and most of the San Joaquin drainage, large areas of riparian forest, freshwater marsh, and grasslands have been converted to agricultural cropland. Although agriculture limits the availability of these habitats to wildlife during the growing season, large areas flooded in winter provide extensive wetland habitat for migratory and wintering waterfowl. In winter, California has more waterfowl than all other Pacific flyway states combined, and the Central Valley remains an attractive area for millions of migrating swans, geese, diving and dabbling ducks, gulls, and shorebirds (Terres 1980).

3.6.2 Trinity River Basin

The Trinity River Basin is situated on the ocean side of the Coast Range mountains. The upper Trinity River Basin receives about 20 percent more precipitation per year than the northern Central Valley (NOAA 1972). This additional precipitation supports a dense mixed evergreen forest. Dominant plant species include Douglas fir (*Pseudotsuga menziesii*), madrone (*Arbutus menziesii*), giant chinquapin (*Chrysolepsis chrysophylla*), tanbark oak (*Lithocarpus densiflora*), and canyon live oak (*Quercus chrysolepis*) (Kuchler 1977). Wetland vegetation types that occur along the margins of the reservoir include white alder riparian forest and freshwater marsh emergent wetlands (Sawyer and Keeler-Wolf 1995). White alder riparian forest wetlands are dominated by white alder (*Alnus rhombifolia*), bigleaf maple (*Acer macrophyllum*), with an understory shrub canopy of Himalaya blackberry (*Rubus procerus*).

Mixed evergreen forest is important habitat for many wildlife species. Mature conifers provide habitat for bald eagles (*Haliaetus leucocephalus*), the northern goshawk (*Accipiter striatus*), California spotted owl (*Strix occidentalis occidentalis*), and northern spotted owl (*Strix occidentalis caurina*). Pileated woodpeckers (*Dryocopus pileatus*), Williamson's sapsuckers (*Sphyrapicus thyroideus*), white-headed woodpeckers (*Picoides albolarvatus*), and hairy woodpeckers (*Picoides villosus*) forage on insects and nest within tree cavities (Mayer and Laudenslayer 1990). Ospreys (*Pandion haliaetus*) are found around the lakes in northern California (Schoenherr 1995). Mammals such as red fox (*Vulpes vulpes*), pine marten (*Martes americana*), black bear (*Ursus americanus*), mule deer (*Odocoileus hemionus*), Douglas tree squirrel (*Tamiasciurus douglasii*), long-tailed vole (*Microtus longicaudus*), northern flying squirrel (*Glaucomys sabrinus*), and yellow-pine chipmunk (*Tamias amoenus*) also occur in this habitat (Mayer and Laudenslayer 1990).

3.6.3 Regulating Reservoirs

Within the Central Valley and Trinity River basins, the Sierra Nevada Region's proposed action, the marketing of Federal hydropower generated by the CVP and Washoe Project, has the potential to affect the terrestrial environment in the vicinity of four regulating reservoirs as described in Section 3.4. The following paragraphs characterize the features of the terrestrial environment at these locations.

3.6.3.1 Lewiston Reservoir

Lewiston Reservoir occurs within the mixed evergreen forest habitat type. Some associated riparian and freshwater marsh habitat occurs along the margins of the reservoir. Plant species include white alder and bigleaf maple, with an understory shrub canopy of Himalaya blackberry. Common associated wildlife species include northern goshawk, California and northern spotted owl, bald eagle, osprey, black bear, mule deer, and yellow-pine chipmunk (Mayer and Laudenslayer 1990).

3.6.3.2 Keswick Reservoir

Keswick Reservoir is bordered by extensive stands of chaparral dominated by whiteleaf manzanita (*Arctostaphylos viscida*). Isolated stands of riparian wetland border the margins of the reservoir that are composed primarily of white alder with an understory of Himalaya blackberry. Common wildlife species associated with vegetation types in this area include deer mouse (*Peromyscus maniculatus*), yellow-rumped warbler *(Dendroica magnolia*), and northern alligator lizard (*Elegaria coeruleus*) (Mayer and Laudenslayer 1990).

3.6.3.3 Lake Natoma

Vegetation in the vicinity of Lake Natoma is a mixture of annual grassland, blue oak-foothill pine woodland, and chaparral. The margins of Lake Natoma support riparian forest and riparian wetland vegetation. Examples of representative wildlife species associated with the dominant vegetation types include California quail (*Callipepla californica*), scrub jay (*Aphelocoma coerulescens*), mule deer (*Odocoileus hemionus*), California ground squirrel (*Spermophilus beecheyi*), western fence lizard (*Sceloporus occidentalis*), and northern alligator lizard (*Elegaria coeruleus*). The upland habitat adjacent to the reservoir supports populations of the host plant of the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), a Federally listed threatened species (CNDDB 1996).

3.6.3.4 Tulloch Reservoir

Tulloch Reservoir is situated in the blue oak-foothill pine woodland and annual grassland belt of the Sierra foothills. The blue oak-foothill pine woodland surrounding Tulloch Reservoir supports a wildlife community similar to Lake Natoma. Bald eagles are regular winter visitors to the region (Jones & Stokes 1990).

3.7 Threatened and Endangered Species

This section describes State and Federally listed threatened and endangered species; Federally listed candidate species, species of concern, proposed endangered species, and proposed threatened species; State regulated species and species of concern; and sightings of all listed species at regulating reservoirs.

3.7.1 Central Valley and Trinity River Basins

This section describes the threatened and endangered species in the Central Valley and Trinity river basins. Wildlife and plant species may occur within the affected area that have been designated as endangered, threatened, or as candidates for listing under the Endangered Species Act of 1973 (16 USC 1531 et seq.). This Act provides protection for threatened and endangered plants and animals and their critical habitat, and establishes the requirement that these species be considered when a Federal action is proposed. In 1984, the State of California passed a similar act, the California Endangered Species Act, that established sections 2050 through 2098 of the California Fish and Game Code (CCR section 670.5). Individual species that are determined to be threatened or endangered by the Fish and Game Commission are listed under Title 14 of the California Code of Regulations. Table 3.3 includes a list of the Federal and State listed threatened or endangered species that have the potential to occur in the affected area.[2]

The affected environment under the four alternatives is limited to the zone of active pool fluctuation surrounding the four regulating reservoirs (Lewiston, Keswick, Lake Natoma, and Tulloch). As previously described, Sierra Nevada Region's operations do not affect water levels in the storage reservoirs. The regulating reservoirs were designed to accept variable levels of water released from the storage reservoirs. In this way, water-level fluctuations are confined to the regulating reservoirs, and do not affect the rivers downstream.

Table 3.3. Federal and State Threatened and Endangered Species Within the Central Valley and Trinity River Basins

Common Name	Scientific Name	Federal Status	State Status
Invertebrates			
Trinity Bristle Snail	*Monadenia setosa*		ST
Shasta Crayfish	*Pacifastacus fortis*	FE	SE
Conservancy Fairy Shrimp	*Branchinecta conservatio*	FE	
Longhorn Fairy Shrimp	*Branchinecta longiantenna*	FE	
Vernal Pool Fairy Shrimp	*Branchinecta lynchi*	FT	
Vernal Pool Tadpole Shrimp	*Lepidurus packardi*	FE	
Valley Elderberry Longhorn Beetle	*Desmocerus californicus dimorphus*	FT	
Delta Green Ground Beetle	*Elaphrus viridis*	FT	
Kern Primrose Sphinx Moth	*Euproserpinus euterpe*	FT	
Fish			
West Coast Steelhead (Klamath Mountain Province ESU)	*Oncorhynchus mykiss*	FPT	
West Coast Steelhead (Central Valley ESU)	*Oncorhynchus mykiss*	FPE	
Winter-Run Chinook Salmon	*Oncorhynchus tshawytscha*	FE	SE

Delta Smelt	*Hypomesus transpacificus*	FT	
Reptiles and Amphibians			
Shasta Salamander	*Hydromantes shastae*		ST
Red-Legged Frog	*Rana aurora draytonii*	FT	
Blunt-Nosed Leopard Lizard	*Gambelia silus*	FE	
Giant Garter Snake	*Thamnophis couchi gigas*	FT	ST
Alameda Whipsnake	*Masticophis lateralis euryxanthus*	FC1	ST
Birds			
Aleutian Canada Goose	*Branta canadensis leucopareia*	FT	
Bald Eagle	*Haliaeetus leucocephalus*	FT	
Peregrine Falcon	*Falco peregrinus*	FE	
American Peregrine Falcon	*Falco peregrinus anatum*	FE	SE
California Clapper Rail	*Rallus longirostris obsoletus*	FE	SE
Western Snowy Plover	*Charadrius alexandrinus nivosus*	FT	
California Least Tern	*Sterna antillarum browni*	FE	SE
California Black Rail	*Laterallus jamaicensis coturniculus*	FSC	ST
Northern Spotted Owl	*Strix occidentalis caurina*	FE	
Little Willow Flycatcher	*Empidonax trailii*	FSC	SE
Mammals			
Tipton Kangaroo Rat	*Dipodomys nitratoides nitratoides*	FE	SE
Fresno Kangaroo Rat	*Dipodomys nitratoides exilis*	FE	SE
Salt-Marsh Harvest Mouse	*Reithrodontomys raviventris*	FE	
San Joaquin Kit Fox	*Vulpes macrotis mutica*	FE	ST
Giant Kangaroo Rat	*Dipodomys ingens*	FE	SE
Sierra Nevada Red Fox	*Vulpes vulpes necator*	FSC	ST
California Wolverine	*Gulo gulo luteus*	FSC	ST
Riparian Brush Rabbit	*Sylvilagus bachmani riparius*	FC	ST
Plants			
Rawhide Hill Onion	*Allium tuolumense*	FPT	
Large-Flowered Fiddleneck	*Amsinckia grandiflora*	FE	SE
Alameda Manzanita	*Arctostaphylos pallida*	FPT	SE
Clara Hunt's Milk Vetch	*Astragalus clarianus*	FPE	ST
Chinese Camp Brodiaea	*Brodiaea pallida*	FPE	SE
Pine Hill Ceanothus	*Ceanothus roderickii*	FE	SR
Stebbins Morning Glory	*Calystegia stebbinsii*	FE	

Hoover's Spurge	*Chamaesyce hooveri*	FPT	
Suisun Thistle	*Cirsium hydrophilum* var. *hydrophilum*	FPE	
Springville Clarkia	*Clarkia springvillensis*	FPT	SE
Soft Bird's-Beak	*Cordylanthus mollis* ssp. *mollis*	FPE	SR
Palmate-Bracted Bird's-Beak	*Cordylanthus palmatus*	FE	SE
Kern Mallow	*Eremalche kernensis*	FE	
Hoover's Woolly-Star	*Eriastrum hooveri*	FT	
Contra Costa Wallflower	*Erysimum capitatum* var. *angustatum*	FE	SE
Pine Hill Flannelbush	*Fremontodendron decumbens*	FE	SR
El Dorado Bedstraw	*Galium californicum* ssp. *sierrae*	FPE	SR
Layne's Butterweed	Senecio layneae	FE	
Contra Costa Goldfields	*Lasthenia conjugens*	FPE	
San Joaquin Wooly-Threads	*Lembertia congdonii*	FE	
Butte County Meadowfoam	*Limnanthes floccosa* ssp. *californica*	FE	SE
Kelso Creek Monkeyflower	*Mimulus shevockii*	FPE	
Piute Mountains Navarretia	*Navarretia setiloba*	FPT	
Colusa Grass	*Neostapfia colusana*	FPT	SE
Antioch Dunes Evening-Primrose	*Oenothera deltoides* ssp. *howellii*	FE	SE
Bakersfield Cactus	*Opuntia basilaris* var. *treleasei*	FE	SE
San Joaquin Valley Orcutt Grass	*Orcuttia inaequalis*	FPE	SE
Hairy Orcutt Grass	*Orcuttia pilosa*	FPE	SE
Slender Orcutt grass	*Orcuttia tenuis*	FPT	SE
Sacramento Orcutt Grass	*Orcuttia viscida*	FPE	SE
Hartweg's Golden Sunburst	*Pseudobahia bahiifolia*	FPE	SE
San Joaquin Adobe Sunburst	*Pseudobahia peirsonii*	FPE	SE
Greene's Tuctoria	*Tuctoria greenei*	FPE	SR
Solano Orcutt Grass	*Tuctoria mucronata*	FE	SE
Merced Clarkia	*Clarkia lingulata*		SE
Ione Buckwheat	*Eriogonum apricum* var. *apricum*		SE
Irish Hill Buckwheat	*Eriogonum apricum* var. *prostratum*		SE
Mason's Lilaeopsis	*Lilaeopsis masonii*		SR
Scadden Flat Checkerbloom	*Sidalcea stipularis*		SE

FC = Federal Candidate
FT = Federal Threatened
FE = Federal Endangered
SE = State Endangered
FPE = Federal Proposed Endangered
SR = State Regulated
FPT = Federal Proposed Threatened
ST = State Threatened
FSC = Federal Species of Concern

For each species listed in Table 3.3, the habitat and cause for decline are briefly discussed. Threatened and endangered species are presented in the following order: invertebrates, fish,

reptiles and amphibians, birds, mammals, and plants. A listing of candidate species is included after the discussion of listed species.

3.7.1.1 Invertebrates

Trinity Bristle Snail *(Monadenia setosa*). The Trinity bristle snail occurs in the mainstream and tributaries of the Trinity River. The decline of its population is attributed to habitat changes occurring from development and other human activities on the shoreline that the snail inhabits.

Shasta Crayfish (*Pacifastacus fortis*). The Shasta crayfish is restricted to Shasta County in the Pit River Drainage and is found in and along the streams. It competes for food and space with exotic crayfish species. The total population of the Shasta crayfish is less than 2,000.

Conservancy Fairy Shrimp (*Branchinecta conservatio*). This species is native to grassland vernal pools in the northern portion of the Central Valley. Populations are known from only three separate localities: Vina Plains of Tehama County, Jepson Prairie Reserve in Solano County, and near Haystack Mountain.

Longhorn Fairy Shrimp (*Branchinecta longiantenna*). The longhorn fairy shrimp is native to vernal pools along the eastern margin of the Central Coast Mountains Region. Its distribution includes Concord in Contra Costa County and Soda Lake in San Luis Obispo County.

Vernal Pool Fairy Shrimp (*Branchinecta lynchi*). The vernal pool fairy shrimp is distributed among vernal pools in the Central Valley, Central, and South Coast Mountains. There are 29 known vernal pool sites that range from the Vina Plains of Tehama County to the mountain grasslands north of Santa Barbara.

Vernal Pool Tadpole Shrimp (*Lepidurus packardi*). The vernal pool tadpole shrimp is native to vernal pools. This species occurs primarily in the Central Valley and coast ranges. Habitat destruction is believed to have led to this species' decline.

Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*). The valley elderberry longhorn beetle is found in the grasslands and oak woodlands along some of the Central Valley rivers. This species emerges after the elderberry bushes open their spring blossoms. Their diet consists of flowers and other foliage found nearby. Females lay their eggs in crevices in the elderberry bark not far from ground level. The valley elderberry longhorn beetle is known to occur in the elderberry plants around Lake Natoma (WWF 1994).

Delta Green Ground Beetle (*Elaphrus viridis*). The Delta green ground beetle inhabits the grassy edges of vernal pools during the rainy season. These pools dry up by late summer. Populations of this species are restricted to the Jepson Prairie in Solano County. The decline in populations is associated with the degradation of vernal pool habitat from agricultural and urban development, flood control, grading, and grazing.

Kern Primrose Sphinx Moth (*Euproserpinus euterpe*). The Kern primrose sphinx moth is distributed in the Walker Basin. The most important plant for the moth's eating habits is the evening primrose. The decline of the moth is associated with the introduction of non-native plants into the habitat.

3.7.1.2 Fish

Winter-Run Chinook Salmon (*Oncorhynchus tshawytscha*). The winter-run chinook salmon spawns in the upper Sacramento River. A significant decline in the population is the result of entrainment, predation, over harvest, and changes in the habitat. Designated critical habitat for this run includes the Sacramento River reach immediately below Keswick Dam.

West Coast Steelhead (*Oncorhynchus mykiss*). West Coast steelhead presently occur from Malibu Creek in Southern California to the Kamchatka Peninsula in northeastern Asia. Several distinct populations are recognized along the coasts of California, Oregon, and Washington. These populations are recognized by the Service as ESUs. Two ESUs occur within the project area: the Klamath Mountains Province ESU, which is proposed as threatened, and the Central Valley ESU, which is proposed as endangered. Steelhead typically migrate to marine waters after spending 2 years in fresh water. After about 2 to 3 years, the steelhead return to their natal stream to spawn. Existing dams at the regulating reservoirs and further downstream restrict the steelhead to portions of the rivers downstream of the regulating reservoirs. Neither of the listed ESUs of this species would be affected by the proposed actions since potential impacts are limited to the regulating reservoirs.

Delta Smelt (*Hypomesus transpacificus*). The Delta smelt occurs in the estuaries, sloughs, and rivers of the Delta. Changes in the pattern of the Delta outflows, entrainment, water pollution, reduced food availability, and competition from introduced species have resulted in a decline of the Delta smelt.

3.7.1.3 Reptiles and Amphibians

Shasta Salamander *(Hydromantes shastae)*. Shasta salamanders are found within the chaparral, woodland habitats, and conifer habitats that occur on the limestone formations in the vicinity of Shasta Lake. This species stays within the limestone fissures and caves during the dry season and can be found above ground during the rainy season. Though the population appears to be stable at this time due to the isolated nature of its preferred habitats, highway road construction and development of limestone quarries are the primary threats to the species.

Blunt-Nosed Leopard Lizard (*Gambelia silus*). This lizard was once distributed throughout the San Joaquin Valley from San Joaquin County south and east into San Luis Obispo County. Urbanization and agricultural development in the plains, alkali flats, low foothills, and open washes of these regions have eliminated nearly all of the habitat for this species. Its population has been reduced to isolated habitat islands in the eastern Central Valley and the grasslands and sparsely vegetated plains of the eastern coast ranges, including the Carrizo plains.

Red-Legged Frog (*Rana aurora draytonii*). The red-legged frog is a Federally listed threatened amphibian species. This species is found primarily in wetlands and streams with riparian components in California. The historical range of this species extends inland from the vicinity of Point Reyes National Seashore, in Marin County, to the vicinity of Redding, in Shasta County, and southward to northwestern Baja California.

Giant Garter Snake (*Thamnophis gigas*). This snake is closely associated with aquatic habitats in California and formerly occupied most of the Central and Sacramento Valley in freshwater marshes and low-gradient streams. Currently, the American River Basin supports the most important remaining habitat for this species. Already severely depleted, the giant garter snake population is considered to be declining. This is primarily due to modification of habitat, such as flood control projects, and loss of habitat due to urban development.

Alameda Whipsnake (*Masticophis lateralis euryxanthus)*. Urbanization has been the main threat to the Alameda whipsnake, which lives in Alameda and Contra Costa County grasslands and rocky chaparral slopes.

3.7.1.4 Birds

Aleutian Canada Goose (*Branta canadensis leucopareia*). The Aleutian Canada goose occurs in California only during the winter period. It is found among large flocks of Canada geese wintering along the shores of San Pablo Reservoir and other coastal bodies of water as far south as the Bay Area. Primary threats to this species include hunting and increased predator pressure in their breeding range.

Bald Eagle (*Haliatus leucocephalus*). This species was recently moved from the Federal endangered species status into the threatened status, a move which signifies that threats to its continued existence have been reduced. Bald eagles breed in the northern third of California along lake edges in conifer forests in mountain regions. During the winter, bald eagles occur throughout most of California along reservoirs and lakes. This species occurs near Lewiston and Keswick reservoirs.

Peregrine Falcon (*Falco peregrinus*)/American Peregrine Falcon (*F. peregrinus anatum*). A variety of habitats can support this species, including wetlands, woodlands, and forested areas, and in some cases urban structures. The decline of the species is believed to have occurred as a result of pesticide contamination which resulted in eggshell thinning and poor reproductive success. As with the bald eagle, this species' population appears to be stabilizing or increasing.

California Clapper Rail (*Rallus longirostrinus obsoletus*). The reason given for the rapid decline of this species is the loss of tidal marsh habitats. Current threats include pollution of tidal marshes from urban runoff, fragmentation of remaining habitat, and predation by introduced species such as the red fox.

Western Snowy Plover (*Charadrius alexandrinus nivosus*). Snowy plovers breed on beaches, dry mud or salt flats, and the sand margins of rivers in California. They winter in South America. The population appears to be declining due to habitat loss and habitat fragmentation.

California Least Tern (*Sterna antillarum browni*). Least tern colonies rely upon a very specialized habitat type: coastal strand. Development in coastal areas has led to a dramatic drop in population. Human disturbance and predation by domestic animals threaten nesting colonies of terns.

California Black Rail (*Laterallus jamaicensis coturniculus*). Coastal populations of the California black rail remain in Morro Bay and San Diego, although historically it was believed to occur in the San Francisco Bay Area and the Sacramento-San Joaquin Delta. Habitat loss is believed to have led to the species' decline and/or extirpation over large portions of its former range.

Northern Spotted Owl (*Strix occidentalis caurina*). These owls prefer dense conifer forests where pairs show strong loyalty to a single nest site which is used consistently for several years. Spotted owls require large home ranges, and their primary threat is habitat loss and habitat fragmentation. This species occurs in the forest around Lewiston Reservoir.

Little Willow Flycatcher (*Empidonax trailii*). Only five populations of this species are known, and these occur primarily along large rivers in southern California, including the Kern, Santa Ynez, Santa Margarita, and San Luis Rey rivers. Loss of riparian habitat in California has resulted in the decline of this species.

3.7.1.5 Mammals

Tipton Kangaroo Rat (*Dipodomys nitratoides nitratoides*). The Tipton kangaroo rat is distributed in shrub habitats in the Tulare Lake Basin, Fresno, Kings, and Kern counties. The population decline of the Tipton kangaroo rats is caused by the increase of intensely irrigated agricultural crops.

Fresno Kangaroo Rat (*Dipodmys nitratoides exilis*). This kangaroo rat is distributed in valley and foothill grassland and shrub habitats from northcentral Merced County to southwestern Madera and central Fresno counties. The population size has decreased due to increased agricultural development.

Salt Marsh Mouse *(Reithrodontomys raviventris raviventris)*. The salt marsh mouse inhabits the marshes of the Delta. The decline of the salt marsh mouse has occurred because habitat alteration has resulted in marsh subsidence, changes in salinity, plowing, mowing, burning, and artificial control of water levels and flow within the marshes.

San Joaquin Kit Fox (*Vulpes macrotis mutica*). The San Joaquin kit fox occurs in valley and foothill grasslands and among sparsely vegetated scrub lands. The decline of this species is due to urban expansion onto surrounding agricultural areas and where extensive oil exploration occurs.

Giant Kangaroo Rat (*Dipodomys ingens*). The giant kangaroo rat is distributed in open areas on the southwest side of the San Joaquin Valley, Merced, Kern and Santa Barbara counties. The population of this species has declined with the increase of cultivation of its range.

Sierra Nevada Red Fox (*Vulpes vulpes necator*). The Sierra Nevada red fox occurs in montane forests in the Sierra Nevada Mountain Range. The population is distributed above 4,500 ft of elevation. Habitat disturbance and human activities appear to have contributed to the species' decline.

California Wolverine (*Gulo luteus*). The California wolverine is distributed among the montane forests in the High Sierra of South Lake Tahoe, Humboldt, Del Norte, Shasta, and Trinity counties. Population pressure in the Lake Tahoe Basin is believed to have contributed to the species' decline in that area; elsewhere in its range the population appears to be stable.

Riparian Brush Rabbit (*Sylvilagus bachmani riparius*). The riparian brush rabbit occupies a very specialized habitat in the riparian forest within the Caswell Memorial State Park region in southern San Joaquin County. Due to its limited distribution, this species is susceptible to local extirpation when habitat loss occurs.

3.7.1.6 Plants

A number of threatened and endangered plant species occur in the vicinity of the affected environment. The Federal and State listing status of these plants is summarized in Table 3.3. Many of these plant species are native to specific habitat types. Rather than discuss each of the plants individually, the following section describes the ecological characteristics and distribution of each habitat type in relation to the affected environment.

Vernal Pools. A substantial number of special status plant species are native to vernal pool habitats. It is believed that vernal pools owe their unique flora to the isolation of these habitats from each other. Individual pools and groups of pools function like islands. Like plant species on oceanic islands, vernal pool plant species may have diverged as they adapted to slightly different environmental conditions. Environmental characteristics of vernal pools are described in Section 3.6.1. The physical features that define a vernal pool habitat are the hardpan or claypan soils and seasonal hydrology. Vernal pool habitats occur throughout the Central Valley. Known occurrences of special status vernal pool plants are documented from the vicinity of Lake Natoma and Tulloch Reservoir. These include slender orcutt grass

(*Orcuttia tenuis*), Sacramento orcutt grass (*Orcuttia viscida*), and Colusa grass (*Neostapfia colusana*). Other special status vernal pool plant species known from the vicinity of the regulating reservoirs include Hoover's spurge (*Chamaesyce hooverii*), Contra Costa goldfields (*Lasthenia conjugens*), San Joaquin wooly-threads (*Lembertia congdonii*), Butte County meadowfoam (*Limnanthes floccosa californica*), San Joaquin Valley orcutt grass (*Orcuttia inaequalis*), hairy orcutt grass (*Orcuttia pilosa*), Greene's tuctoria (*Tuctoria greenei*), and Solano orcutt grass (*Tuctoria mucronata*).

Blue Oak-Foothill Pine Woodland. Blue oak-foothill pine woodlands are a widespread vegetation type along the margins of the Central Valley. This vegetation type is generally replaced by northern yellow pine forest at higher elevations and by annual grasslands at lower elevations. Plant species composition is dominated by an overstory of blue oak and foothill pine with occasional understory of chaparral shrubs or annual grassland species. The two special status plant species associated with blue oak-foothill pine woodlands are native to serpentine soils. Both species, Congdon's lomatium (*Lomatium congdonii*) and Rawhide Hill onion (*Allium tuolumense*), occur in Tuolumne County in the vicinity of Tulloch Reservoir and New Melones Dam.

Chaparral. Chaparral consists of dense stands of evergreen shrubs associated with steep slopes and poorly-developed soils. Chaparral occurs throughout the margins of the Central Valley. Chaparral vegetation is described in detail in Section 3.6.1. Six special status plant species are associated with chaparral habitat in the vicinity of the affected environment: Alameda manzanita (*Arctostaphylos pallida*), Pine Hill ceanothus (*Ceanothus roderickii*), Pine Hill flannelbush (*Fremontodendron decumbens*), El Dorado bedstraw (*Galium californicum sierrae*), Ione buckwheat (*Eriogonum apricum* var. *apricum*), and Irish Hill buckwheat (*Eriogonum apricum* var. *prostratum*). Each of these species is native to distinct soil types associated with the Pine Hill gabbro and serpentine formations.

Northern Yellow Pine Forest. Northern yellow pine forest which is dominated by ponderosa pine (*Pinus ponderosa*) occurs in the lower and middle elevations of the Sierra Nevada, foothills of the Cascades, and the northern portion of the inner Coast Ranges. Special status species associated with northern yellow pine forest include McDonald's rock cress (*Arabis Macdonaldiana*), a Federal and State listed endangered species; Pleasant Valley mariposa lily (*Calochortus clavatus* var. *avius*), a Federal candidate for listing; El Dorado bedstraw (*Galium californicum* ssp. sierrae*),* a Federal endangered species and a State listed rare plant species; Wolf's evening primrose (*Oenothera wolfii*), a federal candidate for listing; and Tahoe yellow cress (*Rorippa subumbellata*), a Federal candidate for listing and a State listed endangered species (Skinner and Pavlik 1994). There are no known occurrences of special status plant species associated with this habitat in the vicinity of the affected environment. For a detailed description of this habitat type, refer to Section 3.6.1.

Annual Grassland. Annual grasslands dominate the low elevations of the Central Valley. Dominant species are introduced grasses and herbs. For a detailed description of this habitat type, refer to Section 3.6.1. Native plant species in this habitat have been largely replaced by aggressive introduced species. Special status species associated with annual grasslands include Chinese Camp brodiaea (*Brodiaea pallida*), a Federal proposed endangered species and a State listed endangered species; Hartweg's golden sunburst (*Pseudobahia bahiifolia*), a Federal proposed endangered species and a State listed endangered species; and California vervain (*Verbena californica*), a Federal proposed threatened species and a State listed threatened species (Skinner and Pavlik 1994).

Inland Dunes. The inland dunes habitat consists of small, isolated occurrences of stabilized and partially stabilized sand dunes in northern Contra Costa County adjacent to the confluence of the Sacramento and San Joaquin rivers. Contra Costa wallflower (*Erysimum capitatum* var. *angustatum*) and Antioch Dunes evening primrose (*Oenothera deltoides howellii*) occur among inland dunes.

Freshwater Marsh. Freshwater marsh occurs throughout the Central Valley where soils are saturated or inundated for substantial periods. Typical locations include margins of lakes, rivers, streams, or sloughs. Plants associated with this habitat type are adapted to living in saturated soils. Mason's lilaeopsis

(*Lilaeopsis masonii*) is associated with freshwater marshes. Another species associated with freshwater marshes is the Scadden Flat checkerbloom (*Sidalcea stipularis*).

Salt Water/Brackish Marsh. Salt water-brackish marsh habitats occur in the lower portions of the Sacramento and San Joaquin Delta. This plant habitat is associated with hydrologic conditions similar to freshwater marsh but is subjected to salt water or brackish water for at least a portion of the year. Herbaceous and woody plants distributed in this habitat are adapted to soils that are seasonally or permanently saturated as well as soil and water salinity. Special status plant species associated with salt water or brackish marsh habitat include Suisun thistle (*Cirsium hydrohpilum var. hydrophilum*) and Soft bird's-beak (*Cordylanthus mollis* ssp. *mollis*).

3.7.2 Species of Special Concern

The term "Species of Special Concern" is used by the State to refer to species that have not yet declined to the point of being listed as threatened or endangered but that are believed to show significant decline and should be considered at a later time if decline continues. Similarly, species that are designated as Category 1 and 2 under the Federal law are those taxa which are candidates for listing as threatened or endangered. These species are listed in Table 3.4 along with three plant communities that are proposed for protection by the State.

3.7.3 Threatened, Endangered, and Species of Concern Present at Regulating Reservoirs

The CDFG reports sightings of three Federally threatened or endangered species in the vicinity of the regulating reservoirs (letter from CDFG to L. Vail, March 25, 1996). Bald eagles have been sighted in the forest around Lewiston and Keswick reservoirs. There are additional reports of bald eagle sightings near Tulloch Reservoir (JSA 1990). Northern spotted owls have been sighted around Lewiston Reservoir. The valley elderberry longhorn beetle is known to occur in the elderberry plants around Lake Natoma (WWF 1994). The CDFG also states that 19 either Federal or State species of concern have been sighted near the regulating reservoirs. Additionally, the three plant communities of special concern can be found in the vicinity of the regulating reservoirs.

The absence of a plant or animal from the above-mentioned sightings does not necessarily mean that they are absent from the vicinity of the regulatory reservoirs, only that no occurrence data are currently entered in the CDFG Natural Diversity Data Base.

3.8 Recreation

The recreational resources and activities in Lewiston Reservoir, Keswick Reservoir, Lake Natoma, and Tulloch Reservoir are described in this section. Recreational resources include

the reservoirs, boat ramps, marinas, campgrounds, fishing areas, picnic areas, and scenic vistas. Recreation fishing activities downstream of the reservoirs could be indirectly affected if temperature fluctuation is impacted. Recreation resources of the Delta and along the lengths of the Trinity, Sacramento, American, and Stanislaus rivers are described in Appendix E.

3.8.1 Lewiston Reservoir

The 750-acre reservoir lies within the Whiskeytown-Shasta-Trinity National Recreation Area. The U.S. Forest Service manages recreation at this Reclamation-owned regulating reservoir. Recreation use at Lewiston Reservoir totaled 82,500 visitor hours in 1991. Nonlocal visitors account for approximately 84 percent of total visitation to the reservoir. Camping is the most popular activity at the reservoir, followed by fishing and boating. Facilities at the reservoir include campgrounds, a picnic area, boat ramp, and marina. Fishing is the most popular water-dependent activity; common fish species include rainbow, brook, and brown trout.

Table 3.4. Federal and State Candidates for Protection as Threatened and Endangered Species Within the Central Valley and Trinity River Basins

Common Name	Scientific Name	Federal Status	State Status
Invertebrates			
Molestan Blister Beetle	*Lytta molesta*	FCC	
Siskyou Ground Beetle	*Nebria gebleri siskiyouensis*		SSC
Trinity Alps Ground Beetle	*Nebria sahlbergii triad*		SSC
Antioch Dunes Anthicid Beetle	*Anthicus antiochensis*		SSC
Sacramento Anthicid	*Anthicus sacramento*		SSC
Sacramento Valley Tiger Beetle	*Cicindela hirticollis abrupta*		SSC
Ricksecker's Water Scavenger Beetle	*Hydrochara rickseckeri*		SSC
Curved-Foot Hygrotus Diving Beetle	*Hygrotus curvipes*		SSC
San Joaquin Dune Beetle	*Coelus gracilis*		SSC
Fish			
Sacramento splittail	*Pogonichthys macrolepidotus*	FPT	
Reptiles and Amphibians			
Northwestern Pond Turtle	*Clemmys marmorata marmorata*	FSC	
California Horned Lizard	*Phrynosoma coronatum frontale*	FSC	
Legless lizards	*Anniella pulchra*		SSC
Tailed Frog	*Ascaphus truei*	FSC	
Foothill Yellow-Legged Frog	*Rana boylii*	FSC	
Cascades Frog	*Rana cascadae*		SSC
Spotted Frog	*Rana pretiosa*	FC	
Western Spadefoot Toad	*Scaphiopus hammondi*		SSC
California Tiger Salamander	*Ambystoma californiense*	FC	
Birds			
Ferruginous Hawk	*Buteo Regalis*	FC	
Western Burrowing Owl	*Speotyto cunicularia*		SSC
California Spotted Owls	*Strix occidentalis occidentalis*	FC	SSC

Tricolored Blackbird	*Agelaius tricolor*	FSC	SSC
Coopers Hawk	*Accipiter cooperii*		SSC
White-Tailed Kite	*Elanus leucurus*		SSC
Great Blue Heron	*Ardea herodias*		SSC
Northern Goshawk	*Accipiter gentilis*	FSC	
Mammals			
Pygmy Rabbit	*Brachylagus idahoensis*	FSC	SSC
Spotted Bat	*Enderma maculatum*	FSC	SSC
Small-Footed Myotis Bat	*Myotis leibii*	FSC	
Long-Eared Bat	*Myotis evotis*	FSC	
Fringed Myotis Bat	*Mytois thysanodes*	SC	
Long-Legged Bat	*Mytois volans*	FSC	
Yuma Mytois Bat	*Myotis yumanensis*	FSC	
Townsend's Big-Eared Bat	*Plecotus townsendii townsendii*	FSC	SSC
Pale Big Eared Bat	*Plecotus townsendii pallescens*		SSC
Greater Western Mastiff Bat	*Eumops perotis*	FSC	SSC
California Mastiff Bat	*Eumops perotis californicus*	FSC	SC
Pacific Fisher	*Martes pennanti*	FSC	SSC
Marysville Heerman's Kangaroo Rat	*Dipodomys heermanni*	FSC	SSC
San Joaquin Valley Woodrat	*Neotoma fuscipes riparia*	FC	SSC
San Francisco Dusky-Footed Woodrat	*Neotoma fuscipes annectens*	FSC	SSC
Suisun Ornate Shrew	*Sorex ornatus sinuosus*	FC	SSC
Plant Communities			
Valley Needlegrass Grassland	NA		SC
Northern Hardpan Vernal Pool	NA		SC
Northern Volcanic Mud Flow Vernal Pool	NA		SC
Plants			
California Linderiella	*Linderiella occidentalis*		SSC
Monadenia Mormonum Hirsuta	*Monadenia mormonum hirsuta*	FSC	SSC
Congdon's Lomatium	*Lomatium congdonii*	FSC	SSC
Hoover's Calycadenia	*Calycadenia hooveri*	FSC	SSC
Veiny Monardella	*Monardella douglasii venosa*	FSC	SSC
Pincushion Navarretia	*Navarretia myersii myersii*		SSC

Red Hills Soaproot	*Chlorogalum grandifolrum*	FSC	SSC
Henderson's Bent Grass	*Agrostis Hendersonii*	FSC	SSC
Sacramento Orcutt Grass	*Orcuttia viscida*	FPE	SSC

FC = Federal Candidate
FSC = Federal Species of Concern
FPE = Federal Proposed Endangered
SC = State Candidate
FPT = Federal Proposed Threatened
SSC = Species of Special Concern (California)

Low water temperature limits water-contact activities. Boating activities are limited by the 10-mph speed limit, which was established for boater safety and to help maintain a quality fishing experience.

3.8.2 Keswick Reservoir

Keswick Reservoir is just outside the Whiskeytown-Shasta-Trinity National Recreation Area. Shasta County manages the one boat ramp at this Reclamation-owned regulating reservoir. In 1991, recreation use at Keswick Reservoir totaled 10,000 visitors. Local residents accounted for more than 80 percent of total visitation to the lake in 1991. Fishing, boating, and sightseeing are the primary reservoir activities. Other activities include hunting and off-road vehicle use. Of these activities, fishing for rainbow trout is the most popular. Water-contact activities at the reservoir are limited because of the cold temperature of the water released from Shasta Lake and Whiskeytown Reservoir. Facilities at Keswick Reservoir are limited to a boat launch ramp, parking lot, and pit toilets, located just upstream of Keswick Dam. An unpaved access road running along a portion of the west bank of the reservoir provides additional reservoir access.

Keswick Reservoir regulates releases from Shasta Lake and diversions from Whiskeytown Reservoir. The Keswick Reservoir level can fluctuate daily. The primary recreation activities are not sensitive to fluctuations in reservoir level.

3.8.3 Lake Natoma

Lake Natoma is a part of the Folsom Lake State Recreation Area and is managed by the California State Department of Parks and Recreation for public recreation. Recreation activities include fishing, nonmotorized boating, and windsurfing.

Lake Natoma has limited fish productivity because of limited littoral habitat. The littoral habitat is limited by low water fertility, high flushing rate, limited shallow habitat, and daily water fluctuations. To compensate for these deficiencies, the CDFG conducts a limited "put and take" trout stocking program. Several of the species found in Folsom Lake also exist in Lake Natoma, but at much reduced levels. Day-use facilities provide picnic and camping areas and a boat ramp at Negro Bar, camping at Mississippi Bar, and boat launch facilities near Nimbus Dam and Willow Creek. The western lake shoreline also features an 8.4-mile portion of the popular American River bicycle trail. It is estimated that 435,000 visitors come to the lake annually. Approximately 95 percent of Lake Natoma's day-use recreationists and roughly 33 percent of overnight recreationists originate from the Sacramento Valley. The remainder of overnight users originate from the San Francisco Bay Area and elsewhere.

3.8.4 Tulloch Reservoir

Tulloch Reservoir includes a state-operated public campground with 130 campsites, a boat ramp, and concessions. Recreation on the reservoir includes fishing, sightseeing, sailing, and water skiing. Sports fishing includes bass, rainbow trout, and brown trout.

Boating on Tulloch Reservoir peaks during the 3-day weekends in the summer. Estimates of the number of boats during peak weekends range from 250 to 600 boats. During drought years, the severe drop in water levels at nearby large storage projects, such as New Melones, makes Tulloch a desirable alternative for boaters. During the summer, water skiing and jet skiing are the most popular activities on the reservoir. During other seasons, fishing and sightseeing are the predominant activities. Detailed visitor use data are not available for Tulloch Reservoir.

3.9 Cultural Resources

Cultural resources are described in this section. Section 3.9.1 describes the regulatory setting and analytical methods. The remaining sections describe resources at each of the regulating reservoirs.

3.9.1 Introduction

The regulatory setting and analytical methods are described below.

3.9.1.1 Regulatory Setting

Cultural resources include archaeological and historic sites, structures, buildings, features and districts, and areas or features of spiritual or religious significance to an ethnic group. Impacts to important or significant cultural resources are addressed under the National Historic Preservation Act (NHPA) and the California Environmental Quality Act (CEQA). Section 106 of NHPA requires the lead Federal agency (Sierra Nevada Region) to take into account the potential effects of its undertakings on historic properties. For Federal purposes, a historic property is a cultural resource that is at least 50 years old and is deemed significant under the criteria of eligibility for the National Register of Historic Places (NRHP). As defined under 36 CFR 60.4, a historic property is a significant resource that retains integrity and is associated with important events in our history or prehistory; or is associated with the lives of an important person or persons; or represents the work of a master, or a high level of artistic achievement, or is exemplary of its type; or has the potential to yield data important to the study of history or prehistory.

The CEQA, as amended by AB 2881, requires consideration of cultural resources that are eligible for or listed on the California Register of Historic Resources (CRHR). Properties that are listed on or have been determined eligible for the NRHP are automatically included in the CRHR, as are properties that have been determined significant through certified local studies. For practical purposes, compliance with NHPA will also result in compliance with CEQA for cultural resources.

In addition to these regulations, compliance is necessary with the Native American Graves Protection and Repatriation Act (NAGPRA) and with the American Indian Religious Freedom Act (AIRFA). Under NAGPRA, local Native American tribes must be consulted to develop agreements on the disposition of human remains and associated artifacts encountered by a project on Federal lands and Indian lands. If human remains are encountered on these lands and no agreement has been developed, work in the area must halt for up to 30 days to provide an opportunity for consultation. Under AIRFA, consideration must be given to traditional cultural properties, including sacred and ceremonial sites, and places where traditional resources (such as native basketry materials) are collected. It is advisable to begin Native American consultation early for any project with potential physical impacts so that agreements for burial treatment and disposition can be reached in advance, and to address sacred sites as necessary. These consultations and agreements would be the responsibility of the Federal agencies involved.

3.9.1.2 Area of Potential Effects

As discussed above, the first step in assessing potential project effects is to determine the area of potential effects (APE) for the project. This becomes the relevant assessment area for the project. Because no new facilities or facility expansions in the reservoir pools are proposed, the APE for this project is defined as the "zone" along the shoreline of each reservoir which lies at elevations between the current minimum gross pool and the current maximum gross pool waterlines. It is anticipated that any effects to cultural resources which will accrue as the results of power marketing operations under any of the alternatives will be confined to this zone. This zone consists of the area currently being affected by power marketing operations and is identical to the APE for the no-action alternative. Section 4.8 assesses the potential of each alternative to result in changes in use within the working APE defined here.

3.9.1.3 Data Sources and Analytical Approach

The baseline research provides a context for the identification of the relative potential of each project alternative to affect significant or important cultural resources. This analysis is based on two data sources: input from general background sources on the cultural resources, prehistory, and history of each reservoir area; and data derived from records searches in the files of the Northeast, North Central, and Central California Information Centers of the California Historical Resources File System. The records searches examined a 1-mile (1.61 km) radius around each reservoir for previous archaeological survey and known archaeological sites. These data provide an understanding of the current archaeological database for each area and the types of resources known in each, by characterizing as accurately as possible without additional fieldwork the resource base of each area.

To estimate the population of known sites within the APE for each reservoir, a determination was made that there was no potential for Sierra Nevada Region's 2004 Plan to affect sites more than 165 ft (50 m) from the current reservoir high water line, outside the reservoir. Site counts in the text therefore represent known sites from within the reservoir to a point 55 yards (50 m) outside the reservoir, as measured on USGS 7.5-minute maps. Appendix F lists these sites and also includes additional sites up to 1/2 mile (0.8 km) from the reservoir high water line to provide context.

It should be understood that the archaeological database varies in coverage thoroughness from area to area. Most of the surveys completed in the reservoir areas were undertaken in the 1940s and 1950s, and neither records nor mapping are adequate by current standards. No new archaeological inventory was deemed necessary for this study. Additional sites almost certainly are present in the basins. An attempt is made below to predict the archaeological manifestations that would be expected to be present in each reservoir pool, based on a generalized characterization of the culture history of each reservoir area.

The following sections provide a regional cultural background for each reservoir area and then describe known and predicted archaeological and historic resources near each of the four regulating reservoirs. A full listing of sites within 1/2 mile (0.8 km) of each reservoir is included in Appendix F.

3.9.2 Lewiston Reservoir

Lewiston Reservoir, constructed between 1956 and 1962, is a long, narrow pool situated between the Trinity and Lewiston dams on the Trinity River. The shoreline around Lewiston Reservoir is approximately 17 miles (27.4 km) long. The 750-acre (300-hectare) reservoir lies within the Whiskeytown-Shasta-Trinity National Recreation Area.

3.9.2.1 Prehistory

The earliest human occupation of California has not been firmly established. Although the Calico site in southern California has been estimated by some researchers to be more than 200,000 years old, most scholars believe the "artifacts" from this site are naturally occurring phenomena. Other sites may represent later Pleistocene (Ice Age) human occupation in California (a culture period variously labeled a "pre-projectile point tradition" [Krieger 1962], "chopper-chopping tool tradition" [Bryan 1965], and "core tool tradition" [Carter 1952] among other characterizations), but many of the artifacts from these sites have been recovered in suspect contexts, or the dates themselves are from materials that may not even be associated with the find. The Farmington complex, located east of Stockton and not far from Tulloch Reservoir, contains possible core and flaked stone tools representative of the pre-projectile point horizon. However, studies by Ritter, Hatoff, and Payen (1976) demonstrated the lack of a clearly associated date with the supposed flaked stone materials. The Lewiston Reservoir area has not yielded sites from this period.

There is much stronger evidence for human occupation in California at the end of the Pleistocene period, around 11,000 to 12,000 years ago. It is believed that populations were focused on hunting large animals that became extinct at the end of the Pleistocene. Distinctive fluted projectile points used by these big game hunters have been found in direct association with Ice Age fauna. No materials suggestive of this period have been found in the Lewiston area, with the exception of a single fluted point at Samwel Cave in Shasta County (Beck 1970).

The transition from the Pleistocene to the Holocene (modern climatic period) may be characterized as a time of marked environmental change. The late-Pleistocene climates were cool and moist, supporting glaciation and pluvial lake formation. Following the end of the Pleistocene, large remnant bodies of water were attractive to human populations as these areas provided a diverse array of plant and animal resources. No sites clearly representative of this time period have been found in the Lewiston Reservoir area.

The mid- to late-Holocene period can be characterized as one of slow but steady change in subsistence strategies, with increasing emphasis on plant resources and specialized adaptations to local environments (Wallace 1978). This focus in the project area is characterized by the presence of mortars, pestles, chipped stone tools dominated by obsidian, and a variety of other objects such as beads and charmstone. In central California, the chronology of this period has been well established by the pioneering work of Heizer (1949) and others, with more recent modifications by Fredrickson (1974). However, chronology is not well established in the Lewiston Reservoir area. The sites found in the general project area are mainly representative of the late prehistoric period (Elsasser 1978). These known sites appear to have linkages with both central California cultures and those to the northwest.

3.9.2.2 Ethnography

Lewiston Reservoir is located within the traditional territory of the Wintu people. Sources consulted for preparation of this section include the *Handbook of the Indians of California* (Kroeber 1976) and the *Handbook of North American Indians* (LaPena 1978).

The Wintu occupied the valleys of the upper Trinity River, upper Sacramento and McCloud rivers, and their tributaries north of Cottonwood Creek, including areas now inundated by Lewiston and Keswick reservoirs. Linguistically the Wintu language belongs to the Penutian language group. Subsistence activities of the Wintu focused on the procurement of a broad range of resources subject to seasonal and regional availability. Fish and acorns were key staples for the Wintu, but a wide variety of plant and animal food sources were exploited, including deer, rabbit, quail, rodents, and grasshoppers.

The residence pattern of the Wintu is characterized as semi-subterranean huts and dance houses built in permanent or semi-permanent villages on major rivers and creeks, with summer residences of much less substantial structures built in the surrounding mountains. This results in large sites found along watercourses with less substantial Wintu sites found in upland areas away from major bodies of water. Archaeological materials would be expected to include midden deposits with house remains and abundant evidence of fishing and of obsidian working and tool manufacture. Ornaments of coastal shell also are not uncommon. Bedrock and portable mortars were used. Inhumations were generally flexed.

The first Euroamerican contacts with the Wintu occurred in the 1820s. Introduced diseases and hostility from the newcomers contributed to the reduction of Wintu populations and traditional lifeways.

3.9.2.3 History

Historic information is drawn from Bauman (1981); Hoover, Rensch, and Rensch (1990); Irwin (1960); Jones (1981); O'Brien (1965); Smith (1995); and Johnson and Theodoratus (1982).

The first significant incursions into the Redding area by non-indigenous people occurred only a little more than 150 years ago. Although native populations may have had occasional contacts with Spanish explorers from outposts to the south, people in this area lived in virtual isolation from the new Anglo populations on the coast. In 1828, Jedidiah Smith blazed the trail across the northern end of the Sacramento Valley, west then north into Oregon. This route, originally used by trappers and explorers, saw a trickle of immigrants in the next two decades.

In 1848, lifeways in California changed dramatically with the discovery of gold, first at Sutter's Mill in Coloma (see Lake Natoma, below), then at scattered locations throughout the lode belt, as prospectors fanned out through the Sierra Nevada and Shasta-Trinity. The years 1848 through 1852 saw a massive population influx into California. The population influx had severe impacts on the native Wintu, who were displaced from their homes and restricted in their access to resources by mining on the rivers. Conflicts, often violent, arose between miners and natives, as miners pushed the Wintu off their now-valuable riverside lands. Although a few Wintu went to work as laborers for the miners, many did not survive. Some Wintu fled to more isolated regions around Mt. Lassen, Mt. Shasta, and perhaps the Pit River.

Placer gold mining quickly became ubiquitous along the rivers and subsidiary creeks during this period. Gold was mined in the Lewiston area by 1850. Hydraulic mining was established throughout the area by 1855, and river dredging for gold started shortly thereafter. Massive tailing accumulations along the bank of virtually every river and creek attest to these practices. Thriving towns along the rivers and on major trails served the miners. Lewiston, established in 1853, had a substantial Chinese community. A ferry operated across the Trinity River at Mooney Gulch (now on Lewiston Reservoir), carrying travelers on the road from Clear Creek in Shasta County to Weaverville. By 1867, hard rock gold mines had been established throughout the Sacramento and Trinity drainages. As these played out in the 1880s, copper replaced gold in local mineral production. Placer gold mining saw renewed economic importance in this area during the economic depression of the 1930s as prospecting was renewed, and mines were reopened.

In 1938, construction began on Shasta Dam, keystone in the CVP. In the next three decades, reservoirs were constructed for power generation at Trinity Dam and Lewiston, Spring Creek and Keswick, and Whiskeytown. Reservoirs innundated numerous archaeological sites, historic and prehistoric, and traditional occupation sites and sacred places of the surviving Wintu. Because contact was historically recent, it is likely that some traditional knowledge, such as locations where ancestors were buried, may continue among Wintu descendants.

3.9.2.4 Previous Archaeological Investigations

The earliest archaeological investigations on the Trinity and Sacramento rivers were spurred by the initiation of reservoir projects in these drainages. Five archaeological surveys have been conducted to within 219.8 yards (200 m) of Lewiston Reservoir, but only three of the survey areas included portions of the shoreline. The latter surveys were conducted near the northern end of Lewiston Reservoir and included approximately 3.7 miles (6 km) of shoreline. The Treganza survey (1953) described below probably covered additional areas but did not employ modern coverage standards or criteria for site recordation. Very little is known about the presence or absence of archaeological sites along the approximately 13.3 miles (21.5 km) of unsurveyed shorelines near the southern portion of the reservoir. However, the broad valley partially flooded by Lewiston Reservoir is a setting that would have been amenable to both prehistoric and historic settlement.

Archaeological surveys and excavations of sites were conducted by Adan Treganza at seven reservoirs in the Shasta-Trinity area between 1952-1960. Treganza recorded five archaeological sites at Lewiston

Reservoir. On the basis of limited information, it is assumed that most of these sites, described as "habitation" or "village" sites, were archaeological midden deposits. Excavations yielded information primarily on manifestations of the late prehistoric/protohistoric period, termed by Meighan (1955) as the Shasta Complex; but these investigations provide the primary body of site data available for the reservoir areas. Characteristic of many of the sites investigated were deep middens, Gunther-Barbed and Desert Side-Notched projectile points, clam shell disk beads, the presence of both pestles and manos in the grinding tool assemblage, and cairn burials. Projectile points made of bottle glass co-occurred with the obsidian points traditionally used at one site.

Eight historic sites close to Lewiston Reservoir were recorded in the 1980s, in conjunction with Forest Service undertakings. Three of these are ditches, presumably related to historic mining; one is described as a water transmission feature (presumably a historic flume or ditch); one is a vineyard site; one is described as "Petlawn" (possibly a pet cemetery); and one is noted only as "historic mining." The "Minersville School Site" has an Indian place name, although the site record indicates that there is no archaeological evidence of Wintu occupation there.

In total, only one site, CA-TRI-019, appears to have been recorded within 55 yards (50 m) of the Lewiston shoreline (see Appendix F). Located on the bank of the Trinity River, the site as reported in 1952 had already been "mostly destroyed" by erosion; cairn burials were eroding out of the site at that time. If that site has not been completely destroyed by erosion or innundated, it can be presumed that it lies within the project APE at Lewiston Reservoir. It is probable that TRI-019 is the Wintu-named spot named *boh khenk'odi puywagat*, meaning "down at foot of hill east creek." This flat was reported to be a campground site for watching salmon and gathering berries (Bauman 1981).

With respect to the other sites recorded in 1952, the maps available to Treganza were 15-minute (1:62,500) USGS quads. Even the sites recorded in the 1980s were mapped on 15-minute maps, rather than on the 7.5-minute (1:24,000) maps now available. The site records may not be sufficient to accurately locate sites within the project's narrow APE without field verification.

No assessments have been made with respect to the eligibility to the NRHP of sites within or near the Lewiston APE. It is assumed for the purpose of impact analysis (Section 4.8) that any site within the APE qualifies as a historic property under NHPA.

3.9.2.5 Summary Characterization and Archaeological Expectations

Lewiston Reservoir can be characterized as sensitive for both prehistoric and historic resources. The sites for which information is available appear to represent late prehistoric or protohistoric Wintu occupation, probably riverside village sites or camps, archaeologically discernible as midden deposits. At least two sites in the close vicinity are reported to contain cairn burials. Earlier prehistoric sites have not been reported in the reservoir area. Historic mining and associated occupation accounts for most of the reported historic remains in the vicinity. Water conveyance features, as well as adits, tailings, and structural remains, are reported. Most seem to lie well above the maximum pool. Sites related to mining and related occupation and travel, dating from 1850 through at least the 1930s, can be expected. Industrial and habitation remains relating to the construction of Trinity and Lewiston dams can also be expected in this area, although these remains would be less than 50 years old and would not be expected to qualify as historic properties unless deemed particularly significant.

3.9.3 Keswick Reservoir

Keswick Dam, located about 9 miles downstream of Shasta Dam, flooded a relatively steep and narrow canyon of the Sacramento River in 1949 to within about 1/2 mile (0.8 km) downstream of Shasta Dam. The 9-mile-long (14.5-km) reservoir covers 640 acres (256 hectares) and has about 19 miles (30.6 km) of shoreline.

3.9.3.1 Prehistory

The general prehistory outline described above in Section 3.9.2.1 also applies to the Keswick Reservoir area.

3.9.3.2 Ethnography

The stretch of river that falls within the confines of Keswick Reservoir is an area that was traditionally occupied by the Wintu people. The ethnographic discussion provided in Section 3.9.2.2 also applies to this area.

3.9.3.3 History

For general history of the Keswick area, see Section 3.9.2.3. The Sacramento River in the Keswick area, like the Trinity River around Lewiston, was placer mined intensively in the period immediately after the discovery of gold in the area.

However, the most notable mining activity in local history centered around Mountain Copper Company which, between 1896 and 1905, operated a major smelter at Keswick (a short distance west of Keswick Reservoir's current location) to process copper ore from the Iron Mountain Mine. Components of the massive smelting operations at Keswick included two large blast furnaces, 80 "roasting stalls" (open-air smelters), a pipeline from the Sacramento River, a railroad, and lumber processing facilities. Contemporary photos of the activity (Smith 1995) show extensive earth works, terracing, and other facilities along the river. A thousand people lived at Keswick in 1900. After Federal investigations confirmed that smelter fumes were killing the vegetation on the surrounding hills, the Keswick smelter was shut down in 1905, and all smelting there ceased in 1907. After this, the town declined, and its Post Office ceased operations in 1923. The town saw a brief resurgence in the 1960s but today consists of only a few houses and a single store. Copper mining continued in Shasta County until 1969, but its peaks were between 1896 and 1919 and between 1924 and 1925.

The construction of Shasta Dam, starting in 1938, marked the beginning of a long period of hydroelectric development in the region. Keswick Dam was completed and the reservoir filled by 1950. Work associated with dam, reservoir, and powerhouse construction probably obscured many of the traces of the earlier mining activity.

3.9.3.4 Previous Archaeological Investigations

There has been very little archaeological surveying at Keswick Reservoir. However, one site, SHA-35, which purportedly contained a burial, was recorded during Treganza's (1953) early reservoir surveys. The site was reported to lie at the 600-ft (182.8-m) elevation, which would place it just above the high water mark of 586 ft (178.6 m). Distance from the high water mark is uncertain. A number of prehistoric archaeological sites have been recorded more recently in the reservoir vicinity, although none within the project APE. These include lithic scatters and evidences of small camps, which include groundstone artifacts and middens.

No historic archaeological sites have been identified within 714.3 ft (200 m) of the reservoir. This is probably due to a lack of survey in this area, since background research indicates abundant historic activity in the area. Keswick and Shasta dams have been determined eligible for inclusion in the NRHP. The Keswick Smelter, although located less than a mile from the Sacramento River, is outside the APE for this project.

No assessment of the NRHP eligibility of SHA-35 has been completed. It is assumed for the purpose of impact analysis (Section 4.8) the site is within the Keswick APE and qualifies as a historic property under NHPA.

3.9.3.5 Summary Characterization and Archaeological Expectations

The deep and narrow configuration of Keswick Reservoir, which is set in a steep, narrow canyon, confined inundation to a relatively small surface area. It would be expected that the sites which would be present near the shoreline are primarily of the types which might be found on steep slopes, small canyon shelves, or narrow river margins. These might include evidences of placer mines and other mining features such as tailings and adits, bedrock milling features, rock art, and possible rock shelters. There may have been broader river terraces at the canyon mouths. These could have sheltered more substantial midden deposit occupation sites of the Wintu and possibly earlier residents of the area. Archaeological evidences of ephemeral occupations along the river shore would be anticipated to have been scoured from the river canyon by seasonal flooding; those which might have survived are likely deeply innundated.

Thus, the anticipated archaeological inventory along Keswick Reservoir margins (given the lack of survey data) might include mining features, rock art, and small-scale occupational debris deposits, such as lithic or trash scatters. Also to be expected might be remnant industrial architectural features such as might be associated with the known lumber processing and copper milling activities at Keswick. Near Lake Shasta, any historic remains associated with construction of the dam which might still be present could also require consideration as historic properties.

3.9.4 Lake Natoma

Lake Natoma extends 6 miles (9.7 km) along the North Fork of the American River from a point about 1.5 miles (2.4 km) downstream of Folsom Dam, with an impoundment of 500 acres (200 hectares). The historic town of Folsom stands on the east bank of the lake near its north end, and the eastern suburbs of the city of Sacramento abut the reservoir on the west. The extent of the shoreline of this long, narrow reservoir is about 15.8 miles (25.5 km).

3.9.4.1 Prehistory

The general chronology provided in Section 3.9.2.1 also applies to this region. As in the areas to the north, there has been a paucity of archaeological evidence documented to date to firmly support human occupation of the region encompassed by Lake Natoma during the late- Pleistocene to early-Holocene period. The chronology of occupation during the last 5,000 to 6,000 years has been more firmly established archaeologically through the pioneering work of Robert F. Heizer (1949) and other researchers, who conducted extensive archaeological investigations in the Sacramento Valley prior to and immediately following World War II. These investigations contributed to a tripartite scheme that chronologically characterized the archaeological data into "Early, Middle, and Late" horizons. This scheme has been subsequently modified and refined but remains a useful device for classifying sites in time.

Generally speaking, Early Horizon sites in the Sacramento Valley date from 7,500 to 4,000 years ago and are characterized by extended burials associated with numerous grave goods, shell beads with forms specific to the period, ornamental artifacts such as slate and abalone shell pendants, stemmed and leaf-shaped projectile points, baked clay objects, and an apparent emphasis on hunting over procurement of plant resources (inferred on the basis of the absence of milling equipment).

The Middle Horizon dates from approximately 4,000 to 1,500 years ago. Sites from this period contain flexed burials, some associated with stone cairns; various shell beads with forms specific to the period; "charmstones" of indeterminate function; bone tools; awls for basketry manufacture; large projectile points;

milling equipment; and by inference, a more broad-based procurement focus on both plant and animal resources.

The Late Horizon in the Sacramento Valley dates from approximately 1,500 years ago to the time of Euroamerican contact. Sites from this period are quite numerous throughout the general region where Lake Natoma is located. These sites are characterized by a variety of burial positions but frequently flexed; shell beads with forms specific to the period; small serrated obsidian projectile points; use of the bow and arrow, inferred by the decrease in size of projectile points; and a broad-based diet with a greater focus on acorn procurement.

3.9.4.2 Ethnography

The sources described in Section 3.9.2.2 were also used for preparation of this section. The territory of the Nisenan (also referred to as the Southern Maidu) included the drainages of the Yuba, Bear, and American rivers and the lower drainage of the Feather River. The western boundary was the west bank of the Sacramento River from a few miles above the mouth of the Feather River to a few miles below the mouth of the American River. Lake Natoma falls within this area. Linguistically the Nisenan language belongs to the Penutian language group.

Subsistence activities of the Nisenan focused on the procurement of a broad range of resources subject to seasonal and regional availability. Food procurement activities occurred throughout the year but reached a peak in intensity in late summer and early fall (Wilson and Towne 1978). Acorns and fish were principal staples, but subsistence was augmented by other resources including deer, roots, seeds, rabbit, freshwater shellfish, birds, and grasshoppers.

The river plain was densely populated, with numerous large villages, principally on or near the Sacramento River bank or near river confluences. The often marshy valley plain between the Sacramento River and the foothills was relatively sparsely populated, being used instead as hunting and gathering grounds for the river people. Valley Nisenan built their villages of dome-shaped earth and tule houses, with up to 50 houses in a village, on low natural rises along streams and rivers or on gentle slopes with southern exposures. Hill Nisenan villages were located on ridges or large flats along major streams. Villages often included a large dance house. Seasonal camps, quarries, rock shelters, ceremonial grounds, trading sites, fishing stations, cemeteries, river crossings, and battle grounds are also known ethnographically. The Nisenan were also reported to have named most physical features. Smaller, more ephemeral settlements, such as fishing stations and quarries, were associated with special and seasonal procurement activities.

The archaeological evidence of this residence pattern is large midden deposits found along watercourses and ridgelines, with less substantial Nisenan sites found in upland areas away from major bodies of water. In southern Nisenan territory, it is expected that many prehistoric sites, particularly along creeks and rivers, were destroyed or obscured by 19th century mining activity.

Archaeological materials in these sites would be expected to include midden deposits with house remains, bedrock mortars, abundant fish bones, and remains from stone tool manufacture and maintenance. The dead were typically cremated.

3.9.4.3 History

The indigenous population of the area that was to become Sacramento had few first-hand contacts with Europeans and Americans before 1800, and there probably was no Anglo settlement of the area before the late 1820s. Indirect contacts through Native Americans who had fled mission life introduced previously unknown diseases to local populations, with devastating effects. By some accounts, over 50 percent of the native population was killed by introduced diseases during the Spanish and early American occupations of California (Cook 1976). Around 1805, Spanish soldiers began to pursue runaways who fled from the

Spanish Colonial missions into the valleys and foothills and to conduct incursions into these areas in search of new converts and to punish raids against the mission flocks.

In 1828, Jedidiah Smith traveled up the Sacramento River to the Redding area, opening "the Sacramento Trail." This route was subsequently used by Hudson Bay trappers and other travelers in California. The first non-indigenous settlement of the Sacramento area was founded in 1839. In that year, John Sutter, with the blessing of California's Mexican government, traveled up the Sacramento River and established a fort and ranch at the site of Sacramento. In 1848, Sutter began construction of a lumber mill at Coloma, a few miles east of Sacramento on the American River.

The fateful discovery of gold in Sutter's millrace triggered the great California Gold Rush of 1848 through 1851. The massive influx of population into California, much of it descending on the fort at Sacramento, triggered explosive development throughout the region. Towns and settlements sprang up on every river and creek. The development of mining in this region followed the pattern described above for the Redding area: ubiquitous small-scale placer mining on rivers and creeks, extensive development of water diversions for "dry diggings," hydraulic mining and river dredging on a large scale, and by the 1860s, hard-rock mining. Most obvious along the American River today are evidences of extensive and intensive hydraulic dredging operations, evidenced by deposits of tailings.

An interesting feature of the Gold Rush is the well-documented multi-ethnicity of the gold-seeking population. People came to California from throughout the world. Once in California, many ethnic groups, through choice or otherwise, established ethnic mining enclaves, often detectable archaeologically not only by the artifacts associated with related habitation deposits but also by distinctive mining techniques. The Chinese miners are known to have engaged in secondary mining in the tailings in some instances, as documented at Lake Natoma.

The young cities of California grew apace with the mines, in large part because there was a strong demand for mining supplies. As gold production decreased, city and associated rural populations increasingly turned to the rich farm lands of the Sacramento Valley. Rice became a major large-scale crop. Railroad development and water control became significant activities in this part of California. By the 1930s, it had become clear that there was a need for redistribution of California's mountain waters to supply irrigation to the farms of the valley and water control, flood control, and electrical power to the cities. Folsom Dam and Lake Natoma were built as links in the Central Valley Project for these purposes.

3.9.4.4 Previous Archaeological Investigations

The early archaeology of Lake Natoma is characteristic of the archaeological salvage efforts of the 1940s and 1950s, when it was first widely recognized among California archaeologists that the database was deteriorating. Lake Natoma was included in the survey of seven reservoirs by Treganza (1953), but as Treganza (1954) noted, "survey work was started far too late in this reservoir and the only two good sites present had already been destroyed." Excavation was undertaken at one site in 1953, with minimal results. As Treganza (1954) noted, "If nothing else it could serve as a prime example of how much loss can actually occur when preliminary survey and excavations are delayed....No important finds were anticipated at Nimbus and the work undertaken was more in the nature of a positive check against earlier conclusions."

Although Treganza (1953) recorded a number of presumed habitation sites, most were concluded to have been destroyed previous to recordation, through lake clearing and inundation. Work subsequent to this revisited a number of the previously reported sites; some could not be relocated, some were confirmed as destroyed, and others were known to have been innundated as the lake filled.

As discussed above, the bias of this period was toward large prehistoric midden deposits, and historic sites often were not recorded at all. However, between Treganza's work and more recent surveys, most of the lake margin has been examined. A current records search at the North Central Information Center revealed 21 recorded cultural resources within 55 yards (50 m) of the USGS-mapped shoreline: 12 previously recorded apparently prehistoric sites (including those recorded by Treganza), a site described as a protohistoric/historic Indian cemetery, 3 "diggings" locales recorded as historic archaeological sites (one with three loci within 50 m of shoreline), the Folsom Hydropower Plant, the Folsom Historic District (old town Folsom), 2 bridges, and the remains of a historic bridge. It should be noted that the entire area along the banks of the American River below Folsom Lake was a historic mining district, with many named "diggings" and a wide variety of mine features, primarily relating to placer mining, many attributed to specific ethnic groups. No mention is made of historic structural remains, midden deposits, or artifacts in the available data. A number of architectural historic properties are present within 55 to 110 yards (50 to 100 m) of the shoreline, primarily within the town of Folsom. None of these are within the project's APE.

The majority of the sites that appear to be within or near the Lake Natoma APE have not been assessed with respect to eligibility to the NRHP. Two sites within 55 yards (50 m) of the Lake Natoma shoreline have been assessed as eligible: the Rainbow Bridge, PHI-017 (Negro Bar diggings), and PHI-010 (Natoma Station Ground Sluicing). Four sites have been assessed as not eligible: Bridge 24CO189, SAC-427H (American River Granite Bridge abutments), and SAC-414 and SAC-415 (two undescribed prehistoric archaeological sites). Two sites recorded by Reclamation may be the same as the ineligible sites SAC-414 and SAC-415 but are counted separately. Determinations have not been made for the remaining 14 sites. Of these, five of the prehistoric sites appear to have been destroyed, partially destroyed, or inundated. The project has no potential to affect two additional properties, the Folsom Historic District in the town of Folsom, and the Folsom Hydropower System (SAC-4289H). However, it is assumed that all properties within 55 yards (50 m) of the Lake Natoma shoreline may qualify as historic properties under NHPA.

3.9.4.5 Summary Characterization and Cultural Resource Implications

Mining features, primarily tailings and tailings works of various kinds, are ubiquitous along Lake Natoma. These appear to consist primarily, if not solely, of tailing features of various kinds. The prehistoric/protohistoric occupation of the lake area is represented by midden sites (including human remains) and bedrock milling features. The former appear to have suffered impacts as the result of lake construction and filling; the current condition of these sites is unknown.

3.9.5 Tulloch Reservoir

Tulloch Reservoir, constructed in 1957, is located between the New Melones and Tulloch dams (5 miles downstream) on the Stanislaus River, in the foothills of the central Sierra Nevada. Tulloch Reservoir is a 1,240-acre impoundment, with about 37.3 miles (60 km) of shoreline.

3.9.5.1 Prehistory

The prehistoric chronology described in Section 3.9.4.1 generally applies to the region encompassed by Tulloch Reservoir. The Farmington Complex, a possible early man, pre-projectile point site(s) is located less than 20 miles (32.2 km) from Tulloch Reservoir. Upriver from the reservoir and along a stretch of river now inundated by the New Melones Reservoir, excavations at a site at Clark's Flat yielded data that suggest human occupation of the area as much as 8,000 to 9,000 years ago. The Skyrocket site near Copperopolis, about 6 miles (9.7 km) from Tulloch Reservoir, has also yielded a basal date approximately 9,000 years before present. In the general area surrounding Tulloch Reservoir are a number of mortuary caves containing numerous skeletal remains and associated shell, bone, and stone beads, projectile points, and other materials. These sites appear to date to the Middle Horizon. Rock art sites are also common in the mountains to the east of the reservoir, and bedrock mortars are found along almost every stream. Prehistoric sites specifically associated with Tulloch Reservoir appear to be associated with the Middle and Late Horizon.

3.9.5.2 Ethnography

The sources described in Section 3.9.2.2 were also used for preparation of this section. Central Sierra Miwok territory included the drainages of the foothill and mountainous regions of the Stanislaus and Tuolumne river drainages (Levy 1978). The Central Sierra Miwok are linked to a larger Miwok entity known as the Eastern Miwok, comprised of five groups, each with a distinct language and culture. Linguistically, the Central Sierra Miwok were members of the Utian language family.

Subsistence activities of the Central Sierra Miwok focused on the procurement of a broad range of resources subject to seasonal and regional availability. Although based in permanent settlements, the Central Sierra Miwok would traverse their territory to obtain seasonally available food resources. The principal focus was on hunting deer, antelope, and tule elk and gathering acorns and other wild plant foods including roots and seeds. The Miwok manipulated their environment by annual burning to encourage the growth of plants that would attract deer. Fish were also an important element of their diet.

The Central Sierra Miwok typically constructed conical houses of tule matting. During the winter, semi-subterranean earth-covered dwellings were also used. Large semi-subterranean assembly houses or roundhouses were also built by the Miwok. Although based in permanent or semi-permanent settlements, the Miwok would make seasonal forays into the mountains and the valleys to procure other resources not available in close proximity to their more permanent settlements.

The archaeological evidence of this residence pattern is larger village sites found along watercourses and ridges with smaller, satellite sites found in upland areas and valley margins where specialized food procurement and other activities took place. Archaeological materials in the larger, permanent settlements would be expected to include midden deposits with house remains, bedrock mortars, and remains from fishing and stone tool manufacture and maintenance. The geographic situation of the Central Sierra Miwok was such that they carried on trade with valley and coastal groups to the west and Great Basin groups to the east, transmitting shell and obsidian in particular. This extensive trade network augmented their material culture and would be expected to be reflected in the archaeological record.

3.9.5.3 History

The Tulloch Reservoir region reflects the same historic events that are evident in the history of the Lake Natoma area. Although no major urban settlements grew up near Tulloch, this stretch of the Stanislaus was part of a major route from the town of Sonora to the so-called "Southern Mines" of the Mother Lode in 1849 and the 1850s. A major river crossing on the route lay within the area inundated by Tulloch Reservoir. A covered bridge, which had been used for passage across the Stanislaus for over 100 years, was removed for the construction of the reservoir. The bridge was a replacement for a prior chain cable bridge, which in turn had supplanted O'Byrne's Ferry, which operated from the earliest days of the Gold Rush to transport miners across the Stanislaus River. Some writers maintain that Tulloch Reservoir was also the site of Poker Flat, a large 49ers gold camp memorialized in the writings of Bret Harte, a California author of the period.

The discovery of copper in 1860 at Copperopolis, 7 miles (11.3 km) north of Tulloch, brought a second economic boom to the region. The town was important during the Civil War, both for copper supply and as a troop training site; however, the mine closed and most of the town burned in 1867. The primary economy of the region since that time has included lumber milling, tourism, and hydraulic power development.

3.9.5.4 Previous Archaeological Investigations

Very little of the Stanislaus River shoreline has been surveyed for historic properties between the New Melones and Tulloch dams, although there is a massive quantity of site data regarding sites innundated by the New Melones Reservoir, upstream. Approximately 37.3 miles (60 km) of shoreline surrounds the Tulloch Reservoir. Some surveys have been completed in the areas immediately surrounding the reservoir, including portions of the reservoir shoreline.

One prehistoric archaeological site has been recorded in the Tulloch Reservoir area. Recorded relatively recently, the site is situated on the downriver side of the Tulloch Dam and is outside the project APE. Data regarding site type are not available.

Two historic archaeological sites, reported as a historic mine flume and mine features and tailings, have been recorded within 55 yards (50 m) of the Tulloch Reservoir shoreline. Three additional mine-related sites are present nearby outside the project APE. The historic site of the O'Byrne's ferry and subsequent bridges lie under the reservoir, although the last bridge was removed prior to reservoir construction. No historic architectural properties are present in the APE.

No assessments have been made with respect to the eligibility to the NRHP of sites within or near the Tulloch APE. It is assumed for the purpose of impact analysis (Section 4.8) that any site within the APE qualifies as a historic property under NHPA.

3.9.5.5 Summary Characterization and Archaeological Expectations

A wide range of sites could be expected in the vicinity of Tulloch Reservoir. Evidence from the Skyrocket site at Copperopolis and Clark's Flat suggest occupation of this foothill zone of the Sierran river drainages as early as 9,000 years before present. Archaeological deposits relating to prehistoric occupations throughout the chronological range could be expected. Major rivers such as the Stanislaus are known to have been favored for long-term occupation and archaeological middens, lithic scatters, and bedrock milling features. In addition, rock art could be expected in the Tulloch vicinity. More recently, the Stanislaus River was a focus of extensive and intensive gold mining, including both large- and small-scale placer and hard rock industries, and a variety of water diversion projects. Evidences of occupations associated with travel along the road to the southern mines, such as settlements at the site of the O'Byrne Ferry, might also be expected, although it is likely that these in large part have been innundated by the reservoir.

3.10 Utility Systems Description

CVP facilities and operations were described in Sections 3.2 and 3.3. In addition to these Federal facilities, there is a much broader system of electric generation and transmission that the Sierra Nevada Region interacts with in its marketing program. For perspective, Sierra Nevada Region power makes up less than 10 percent of the total power marketed in northern and central California. However, Sierra Nevada Region's interactions could extend over the entire West Coast and into the interior Desert Southwest. Other than northern and central California, the Sierra Nevada Region has historically been active in the Pacific Northwest with purchases and exchanges of power.

In addition to Sierra Nevada Region resources, most utility customers have their own generation resources and contracts. These resources include the customers' existing and planned powerplants and power purchases. These resources, along with the CVP, are the resources that are most likely to be affected in the analyses for this 2004 EIS. The resource types are listed in Table 3.5.

The western states include hundreds of powerplants that may contribute energy to the Sierra Nevada Region and its customers. The Sierra Nevada Region's marketing plan is likely to affect only those generation resources that might be used to firm its Federal hydropower or make up for lost generation or capacity. The remaining parts of this section give additional information about utility interactions and describe how firm and economy purchases are treated in the analyses within this 2004 EIS.

3.10.1 Utility System Integration

The Sierra Nevada Region is part of an interconnected power system called the Western Systems Coordinating Council (WSCC) system. All major electrical loads and generators within the WSCC boundaries are synchronized to operate as a single cohesive system. One of nine North American Reliability Council (NERC) regions, WSCC provides a framework for ensuring reliability. The WSCC covers all or part of 13 western states, the Canadian provinces of Alberta and British Columbia, and Baja California. Each member of the WSCC is responsible for operating its own utility system in accordance with the rules and guidelines of the WSCC.

Table 3.5. Resource Categories Modeled in PROSYM

Resource Category	Notes
Sierra Nevada Region Hydropower	11 CVP hydropower plants.
Sierra Nevada Region Contract	Blended resources made up of CCCTs and CTs.
Sierra Nevada Region Economy	Blended as above - includes renewables for the renewables alternative
Combustion Turbine	Composite of public utility-owned CTs in northern and central California
Combined Cycle Combustion Turbine	Composite of public utility-owned CCCTs in northern and central California
Geothermal	Composite of public utility-owned geothermal resources in northern and central California
Utility Hydropower	Composite of public utility-owned (non-Federal) hydropower generators in northern and central California
Pacific Northwest Firm Utility	Pacific Northwest blend
Utility Contract	Northern and central California blend
Pacific Northwest Coal	Pacific Northwest coal powerplant
Desert Southwest Firm Utility	Desert Southwest blend
Desert Southwest Coal	Coal
Gas	Northern and central California steam turbine
Solar Photovoltaic	Composite of existing public utility-owned solar resources in northern and central California
Wind	Composite of existing public utility-owned wind resources in northern and central California
Renewables	Assumed new resources made up of biomass, wind, geothermal, and solar photovoltaic
Demand Side Management	Composite of existing public utility-owned DSM resources in northern and central California
Other Firm Resources	Northern and central California blend

Market	Blended market resources

Transmission constraints within the WSCC limit the maximum amount of power that may be exchanged through certain corridors. These limits are based on the physical capability of the transmission lines and WSCC reliability criteria. The reliability criteria are established to ensure timely system recovery in the event of a major disturbance (contingency) and to minimize impacts to neighboring systems. The Sierra Nevada Region's transmission assets are described in Sections 3.2 and 3.3.

In 2005, the total annual WSCC load is projected to be nearly 834,000 GWh (WSCC 1995). By comparison, the Sierra Nevada Region's customers are projected to have a total load of about 27,000 GWh or 3 percent of the total WSCC load.

The Sierra Nevada Region's customers are allocated power from the Sierra Nevada Region's hydroelectric resources, which are currently melded with power that the Sierra Nevada Region obtains from outside sources. The Sierra Nevada Region's customers routinely meet their remaining power needs through their own generation or purchases from others.

Decisions made by the Sierra Nevada Region on how and when to supply power to its customers may influence the operation of other power suppliers within the WSCC. If the Sierra Nevada Region chooses to change the amount of power available to its customers at a certain time of the day, the customers would need to change their own power generation or purchases from other power suppliers. While the overall demand for power would not change as a result of the Sierra Nevada Region's 2004 Plan, an incremental change in the power generating resources operated within the WSCC could result from the Sierra Nevada Region's decisions.

Incremental resources are projected to be comprised primarily of CTs and CCCTs and modeled as a function of the season and on-peak/off-peak times of day. (See Appendix G for additional information.) These two types of power generating facilities account for nearly half of all WSCC resource additions projected over the next 10 years (WSCC 1995). Natural gas is a predominant fuel for use in electric generation and is growing in importance. For purposes of the analyses in this 2004 EIS, all CTs and CCCTs are assumed to be powered by natural gas. Marginal heat rates were used as basis for determining the incremental resource from each region. Because power may come from a number of sources over time, a change in the operation of the hydropower resource may affect the operation of many individual powerplants.

Large central baseload powerplants, renewable resources, and cogeneration resources have relatively low operating costs and are typically dispatched to maximize energy production, usually independent from hourly load variations or cost fluctuations in the marketplace.

Hydroelectric resources are limited by natural, engineering, economic, and environmental constraints. Hydroelectric resources are relatively inexpensive to operate. As a result, all the hydroelectric power that can be produced during peakload periods by Federal and private hydroelectric resources will be dispatched dependent on planned water availability. The Sierra Nevada Region's marketing decisions will not influence or impact non-Sierra Nevada Region hydropower generation.

Recent California Legislation (AB 1890 of 1996) and ongoing planning that will restructure the California electric utility industry will, among other things, result in the development of a Power Exchange and ISO. The ISO is mandated with providing open access to the California transmission system. This will result in Sierra Nevada Region's customers all having equal access to the transmission system. The Power Exchange could offer an hour-to-hour source of power for Sierra Nevada Region customers at market price. In order for the Sierra Nevada Region to competitively supply power to customers, it will need to price its power at or below the market price. To the extent a customer is unable to purchase sufficient Sierra Nevada Region power economically, the customer may purchase energy from the market.

The power market is in transition to a generally open market condition. In this market, which this analysis anticipates will be in place by 2005, the Sierra Nevada Region and its customers are assumed to have the same market access and face the same price structure in their power purchases. As a result, if the Sierra Nevada Region chooses not to purchase additional power from other suppliers to meld with its hydroelectric resources, Sierra Nevada Region's customers could go into the market and buy power from the same suppliers at the same price. This new marketplace is expected to consist primarily of power brokers, independent power producers, and utility companies. These organizations will make power available to both individual entities such as the Sierra Nevada Region and to organizations such as power exchanges. Currently, it is thought that these organizations will meet their power supply commitments from a portfolio of resources that will be distributed throughout California, the Pacific Northwest, and the Desert Southwest.

Exactly how power transactions will contractually take place in 2005 is unknown. Power markets are evolving that will allow more competitive wholesale and retail purchases of electricity. These changes will likely give more consumers access to more electricity suppliers. The Sierra Nevada Region's 2004 Plan is not going to affect the outcome of how these markets develop. Potential market structures are described in the CRS (Western 1995b).

3.10.2 Sierra Nevada Region's Customers and Loads

The Sierra Nevada Region currently serves 77 preference customers as shown in Appendix B. These, together with Project Use customers and investor-owned utilities, amount to about 115 customers.

For purposes of this analysis, Sierra Nevada Region customers were classified into three categories: utility, agriculture, and other. Project Use loads were included in the analysis. Utility loads were defined to be the loads served by the Northern California Power Agency (NCPA), City of Redding, City of Santa Clara, Sacramento Municipal Utility District (SMUD), Turlock Irrigation District, Modesto Irrigation District, and several other small municipal utilities served by the Sierra Nevada Region. Agriculture loads were composed of the irrigation and water storage districts in the Central Valley that rely on the Sierra Nevada Region to supply at least a portion of the power required to pump water. Any load served by the Sierra Nevada Region that did not fit into either of these two categories was classified as "other." These loads consist mostly of Federal or State facilities such as Travis Air Force Base and Folsom Prison. Project Use loads are made up primarily of the power used to carry out the pumping and other authorized requirements of the CVP.

Classifying the customers into three categories was necessary to analyze differences in the load patterns for the respective categories and to analyze the ability of each customer group to access other power sources. For example, agriculture loads vary depending upon the month of the year. Classifying the loads permitted the analysis of how changes in Sierra Nevada Region's allocation levels may affect the three customer groups in terms of economics and electric power operations and/or purchases.

Estimates of power requirements for each of the customer groups for the year 2005 were prepared using either the respective CEC ER-94 report (CEC 1995) or the utility's most current integrated resource plan. For the agriculture and other loads, current loads and load forecasts up to the year 1999 were taken from customer information supplied by the Sierra Nevada Region. The average growth rates between 1995 and 1999 for the agriculture and other customer groups were used to escalate the 1999 forecast to the year 2005. The estimated 2005 monthly loads for the utility, agriculture, and other customer groups were then used in conjunction with the current hourly load shape for the corresponding month to estimate the 2005 hourly loads for the respective group. Table 3.6 shows the forecasted monthly loads used in the analysis for each customer group.

Table 3.6. Monthly Load Forecasts for Each Customer Group

Utilities

	1994		2005	
Month	**Peak (MW)**	**Energy (GWh)**	**Peak (MW)**	**Energy (GWh)**
January	2,654	1,543	3,349	1,900
February	2,551	1,345	3,224	1,659
March	2,386	1,389	3,013	1,704
April	2,382	1,342	3,016	1,647
May	2,799	1,454	3,588	1,795
June	3,540	1,572	4,339	1,937
July	3,750	1,761	4,628	2,188
August	3,807	1,781	4,663	2,197
September	3,382	1,556	4,182	1,917
October	2,479	1,438	3,158	1,758
November	2,633	1,465	3,331	1,803
December	2,787	1,568	3,511	1,940
Total [(a)]	**3,807**	**18,214**	**4,663**	**22,445**
Agriculture				
	1995		**2005**	
January	25	10	27	12
February	30	14	28	14
March	52	22	47	23
April	66	33	63	33
May	74	37	73	39
June	91	51	103	57
July	99	59	105	66
August	93	58	101	63
September	73	33	62	31
October	48	23	43	25
November	32	13	31	13
December	18	6	19	8

Total [a]	**99**	**362**	**105**	**385**
Others				
	1995		**2005**	
January	536	178	613	235
February	486	154	568	188
March	426	167	479	198
April	413	155	548	184
May	516	172	599	216
June	542	188	617	251
July	523	201	616	281
August	616	206	664	282
September	536	185	613	241
October	564	188	631	246
November	516	178	599	231
December	458	181	552	227
Total [a]	**616**	**2,152**	**664**	**2,781**

[a] Total energy and maximum capacity.

The utility customer group makes up Sierra Nevada Region's largest customer group with a combined 1994 peak load of 3,807 MW and an energy consumption of 18,214 GWh. The agriculture customer group, Sierra Nevada Region's smallest class of customers, is made up of many irrigation and water storage districts whose primary purpose is to deliver water to their agriculture users. The agriculture customer group had a forecasted 1995 peak load of 99 MW and projected energy consumption of 362 GWh. The "other" customer group is made up of numerous Federal and State government facilities with a forecasted 1995 peak load of 616 MW and projected energy consumption of 2,152 Gwh. Western supplies a portion of these customers' total load.

3.10.3 Utility Economic Conditions

Several economic assumptions were required as input into the analysis in this 2004 EIS to calculate the most economical dispatch of the generation resources within a given load. The following conditions were assumed or calculated for this analysis in the modeling report (see Western 1997 for more information):

- The annual inflation rate was modeled as 3.1 percent in the gross domestic product implicit price deflator of January 10, 1994, based on the California Energy Commission's 1994 Electricity Report (CEC 1995).
- Power was assumed to be available from the market priced at market rates.
- The 2005 natural gas rate was assumed to be $3.41/MMBtu as shown in Figure 3.7 (CEC 1995).

- The estimated market on-peak power costs vary from $26.7 to $41.8/MWh. Off-peak costs vary from $21.6 to $34.6/MWh.

The cost of power from the CVP hydrosystem in 2005 was estimated based on Sierra Nevada Region's requirements to repay project debt, provide operations and maintenance (O&M) funding, purchase transmission, and provide for other miscellaneous activities. These costs less Project Use revenues were used to develop rates. The per-unit energy rate was derived based on the expected average year generation, less Project Use energy. Based on the assumptions, it is estimated that the 2005 cost for CVP power would average $20.78/MWh.

Figure 3.7. Natural Gas and Coal Price Projections

3.11 Socioeconomic Resources

The Sierra Nevada Region supplies power to a region that generates, on a yearly basis, hundreds of billions of dollars in personal income and provides employment for millions of people. The Sierra Nevada Region's activities may affect 47 counties located in northern and central California. In the past 10 years, personal income in this region maintained a positive trend, while the economy experienced increases in population and substantial gains of employment in the service sector as well as substantial losses in the military, construction, and mining sectors.

3.11.1 Economic Regions

The northern and central California geographic area encompassing the Sierra Nevada Region's customers was modeled as a single economic region (see Figure 3.8). In addition, four regional economic models were developed for areas within the larger area. The Sierra Nevada Region customer base is represented within these local economies. The local regions include almost two-thirds of northern and central California's population and most of the Sierra Nevada Region's customers. The four local economic regions are as follows: the San Francisco Bay Area, Sacramento, Kern County, and Shasta County. The Kern County economic region is used as an example to represent the socioeconomic aspects of Sierra Nevada Region's agriculture customers.

Figure 3.8. Northern and Central California Subregions and Counties Used in Economic Impact Analysis

3.11.2 Environmental Justice

This 2004 EIS and its supporting documents identify potentially affected low-income populations and minority populations, pursuant to Executive Order 12898 (59 FR 7626), which orders each Federal agency to make achieving "environmental justice" part of its mission. DOE and CEQ have developed draft guidance to implement the Order (DOE 1996; CEQ 1996). The Order and the guidance require that specific attention be given to whether impacts on these populations are disproportionate. Using Census Bureau definitions generally accepted in the demographic research community, low-income and minority populations have been specifically identified within northern and central California. Lester and Anderson (1995) provide descriptions of the population characteristics of northern and central California.

3.11.3 Northern and Central California Region

The overall region was summarized at the beginning of Section 3.11. The following material provides more detailed information.

3.11.3.1 Population Characteristics

The Demographic Research and Census Data Center of the California Department of Finance (CDOF) estimates that the 1995 population of northern and central California is about 14 million (CDOF 1995) and projects the population to reach nearly 17 million by 2005 (CDOF 1994), the year for which economic impacts are estimated. Table 3.7 presents the racial breakdown of the northern and central California population. Counties within northern and central California where the population of low-income individuals is greater than the average for the overall region are shown in Figure 3.9. Counties within the Sierra Nevada Region where the population of minority individuals (nonwhite or of Hispanic decent) is greater than the average for the overall region are shown in Figure 3.10. Approximately 12 percent of the population falls below the poverty level within the Sierra Nevada Region's marketing area. Population projections to the year 2040 show a decreasing trend in the white population share of total population, while Hispanic and black population shares are projected to increase steadily. Figure 3.11 depicts the regional shares of northern and central California's 1995 population, and Figure 3.12 shows the projected growth of the population by racial group.

Table 3.7. 1990 Population Characteristics of Northern and Central California

Race	Total Persons	Percent of Total
White	7,928,633	64.3
Hispanic Descent[a]	2,244,879	18.2
Asian, Pacific Islander	1,247,986	10.1
Black	779,676	6.3
Native American	112,268	0.9
Other	19,189	0.2
Total	12,332,631	

[a] People claiming Hispanic ethnic classification.

3.11.3.2 Employment and Industry

Total employment in northern and central California reached 5.3 million jobs in 1995. The region's civilian labor unemployment rate for June 1995 was about 8.3 percent.

This is higher than the national average of 5.8 percent and higher than the state average of 7.8 percent. Since the beginning of the 1990s, the region has experienced negative employment growth rates in all major sectors of the economy, with the exception of agriculture and the service industry. Figure 3.13 illustrates 1995 employment levels and forecasts baseline employment levels by industry for 2005, the year for which economic impacts of the alternatives are estimated.

Total industrial output in the Sierra Nevada Region reached $519 billion in 1992. Projections for the year 2005 put total industrial output at $582 billion. In terms of total output, positive

growth is projected in all major industries of the economy. Figure 3.14 compares total output by industry between 1995 and 2005.

Figure 3.9. Distribution of Low-Income Population in Northern and Central California, 1990 (Lester and Anderson 1995)

Figure 3.10. Distribution of Minority Population in Northern and Central California, 1990 (Lester and Anderson 1995)

Figure 3.11. 1995 Regional Population Distribution in Northern and Central California (CDOF 1995).

Figure 3.12. Northern and Central California Population Trend Projections,
1990-2010 Employment and Industry (CDOF 1994)

Figure 3.13. 1995 and 2005 Total Employment in Northern and Central California

Figure 3.14. 1992 and 2005 Northern and Central California Total Industrial Output by Major Industry

3.12 Air Resources

The Sierra Nevada Region's marketing decisions may have air quality impacts in northern and central California and other areas because of changes in the timing and amounts of Sierra Nevada Region power purchases and exchanges. It is not possible to predict where such purchases and exchanges would be made after 2004, and specific areas cannot be identified as the affected environment within the California, Pacific Northwest, and Desert Southwest regions.

Similarly, potential air resource impacts of new capacity that could be required if the baseload alternative is selected cannot be tied to specific locations. Therefore, this section generally addresses air quality in the entire region where impacts could occur. Specifically, a description is provided in this section of regional air resources, applicable air quality regulations, and ambient air quality. The regulatory structure for air quality requirements is discussed in Appendix H. The focus of this discussion will be northern and central California, in particular, the area served by the Sierra Nevada Region.

3.12.1 California Air Quality

The air quality conditions in all of California's major air basins are in nonattainment for one or more of the Federal or State ambient air quality standards. Figure 3.15 shows the location of California's major air basins and counties. Figures 3.16 through 3.19 show areas of California that are in nonattainment with Federal or State ambiant air quality standards for several air pollutants. Figures 3.16 through 3.18 show nonattainment areas for ozone (O_3) , carbon monoxide (CO), and particulate matter less than 10 microns in diameter (PM_{10}). Figure 3.19 shows nonattainment areas for nitrogen dioxide (NO_2), hydrogen sulfide, and sulfates.

Although the mix of emission sources varies from region to region, the majority of the emissions for most types of pollutants can generally be traced to transportation sources, such as passenger car emissions. For PM_{10}, the majority of emissions are from area sources, which include road dust, fugitive dust from vacant areas, construction and demolition, and farming. Ozone is not directly emitted into the atmosphere but results from a complex photochemical reaction between volatile organic compounds, oxides of nitrogen, and solar radiation (Ahrens 1993). Thermal powerplants (including cogeneration facilities) account for less than 1 percent of the total CO and PM_{10} emissions and less than 5 percent of the total sulfurdioxide (SO_2), NO_2, and volatile organic compound emissions in the State (Dennis Goodnow, California Air Resources Board, personal communication, 1995).

Figure 3.15. California Air Basins

Figure 3.16. California Nonattainment Areas for Ozone (California 1995)

Figure 3.17. California Nonattainment Areas for Carbon Monoxide (California 1995)

Figure 3.18. California Nonattainment Areas for PM_{10} (California 1995)

<Figure 3.19. California Nonattainment Areas for Nitrogen Dioxide, Hydrogen Sulfide, and Sulfates (California 1995)

3.12.1.1 Northern and Central California Air Quality

The Sacramento Metropolitan Area is in nonattainment for O_3, CO, and PM_{10}. The status for PM_{10} and CO may soon be switched to "attainment" because Federal standards for these pollutants have been exceeded on only one occasion in the past 5 years (Kerry Sherer, Sacramento Metropolitan Air Quality Management District, personal communication, 1995). The O_3 situation is more severe; the Sacramento Metropolitan Area has one of the highest ambient O_3 concentrations in the nation. The problem is closely tied to emissions from vehicles and other mobile sources. Emissions of O_3 precursors (volatile organic compounds and nitrogen oxides) must be reduced substantially in order to attain the Federal air quality standard. A proposed regional O_3 attainment plan has been developed. This plan includes various control strategies to reduce emissions of O_3 precursors to the level required for O_3 attainment status in 2005.

The problems found in the Sacramento Metropolitan Area are also characteristic of the neighboring San Joaquin Valley Air Basin. The basin is considered to be in serious nonattainment for O_3 and PM_{10}. Within the basin, the towns of Fresno, Bakersfield, Stockton, and Modesto are considered to be in nonattainment for CO.

Air quality elsewhere in northern and central California is generally better than in the Sacramento Air Quality Management District and the San Joaquin Valley Air Basin. The Northeast Plateau and North Coast air basins are in attainment or are unclassified for all ambient air quality standards except for the State's PM_{10} standard. Lake County Air Basin is in attainment or unclassified for all ambient air quality standards. The Mountain Counties Air Basin has relatively good air quality; however, isolated portions of this region are in nonattainment for O_3, CO, PM_{10}, and hydrogen sulfide (City of Sutter Creek) standards. The San Francisco Bay Area Air Basin is in attainment or unclassified for all ambient air quality standards except CO and O_3. The Lake Tahoe Air Basin is in attainment or unclassified for all but the CO standard. The Great Basin Valleys Air Basin is in attainment or unclassified for all Federal ambient air quality standards, but portions of the basin are in nonattainment for the State's O_3 (Mono County) and PM_{10} (Inyo and Mono Counties) standards. The North Central Coast Air Basin is in attainment or unclassified for all Federal and State air quality standards except for O_3.

There are numerous Class I areas within northern and central California (typically within wilderness areas and national parks). Air quality in these National Park Service areas is carefully monitored, and emissions from outside the parks may be regulated to preserve the parks' air quality and related resources. The Class I areas in northern and central California include Kings Canyon National Park, Lassen Volcanic National Park, Pinnacles National Monument, Point Reyes National

Seashore, Redwood National Park, Sequoia-Kings National Park, and Yosemite National Park. Researchers have found forest deterioration in these areas that is thought to be the result of exposure to high concentrations of O_3 and other pollutants (Duriscue and Stolte 1989; Peterson and Daly 1989; Pederson, Arbaugh, and Robinson 1989; Petersen 1989).

3.12.1.2 Southern California Air Quality

Southern California has some of the worst air quality in the United States. All air basins within Southern California are in nonattainment for one or more pollutants. The South Coast Air Basin has ambient pollutant concentrations that exceed the Federal air quality standards more than any other area in the United States. This area is considered to be in extreme nonattainment for O_3, moderate nonattainment for CO, serious nonattainment for PM_{10}, and nonattainment for NO_2.

The South Central Coast, San Diego, and Southeast Desert air basins have significant problems with O_3, PM_{10}, and CO. All three air basins are in nonattainment for O_3 and PM_{10}. Ventura County in the South Central Coast Air Basin, San Diego Air Basin, and portions of the Southeast Desert Air Basin are in severe nonattainment for O_3. The San Diego Air Basin and the city of Calexico (in the Southeast Desert Air Basin) are in nonattainment for CO. The Searles Valley Planning Area in San Bernardino County is in nonattainment for the State sulfates and hydrogen sulfide standards.

3.12.2 Pacific Northwest Air Quality

Air quality in the Pacific Northwest is generally better than in California. This section describes the air quality in the states of Oregon, Washington, Idaho, and Montana.

3.12.2.1 Oregon Air Quality

The overall air quality in Oregon is good with only a few areas in nonattainment for various criteria pollutants. Portland is the only O_3 nonattainment area in Oregon. Seven cities are in nonattainment for PM_{10}: Eugene-Springfield, Medford-Ashland, Klamath Falls, Grants Pass, La Grande, Oakridge, and Lakeview. All but Lakeview and Oakridge are being considered for redesignation as being in attainment for PM_{10}. (Lakeview and Oakridge continue to exceed the standard as a result of wood burning and windblown dust.) Several small eastern Oregon cities are closely monitored because of their potential for exceeding PM_{10} standards. Five areas are listed as being in nonattainment for CO, although improved air quality has led all of these areas to be considered for redesignation as being in attainment for CO. No areas are in nonattainment for lead, SO_2, or NO_2.

Oregon has implemented various control strategies such as mandatory and voluntary wood burning curtailment programs, oxygenation of fuels, and vehicle emission inspections to reduce pollutants in nonattainment areas. However, additions to population and the number of cars will continue to work against pollution control strategies.

There are numerous Class I areas in Oregon including wilderness areas in the North Cascades, Central Cascades, northeastern Oregon, and Crater Lake National Park. Oregon has adopted regulations to minimize visibility impairment in the North and Central Cascade wilderness areas. The principal sources impairing visibility in these areas are wildfires and agricultural field burning (Oregon 1994a).

3.12.2.2 Washington Air Quality

A majority of Washington State has good air quality, although there are a few areas in nonattainment. Only the Seattle-Tacoma and Vancouver areas are listed as being in nonattainment for O_3, although remedial actions have resulted in both areas becoming candidates for a return to attainment status. Five areas are in nonattainment for PM_{10}: Olympia-Tumwater-Lacey, Seattle-Tacoma, Spokane, Wallula, and Yakima. Plans have been developed to address significant sources of PM_{10} in nonattainment areas. These sources include unpaved roads, paved roads (primarily snow traction material), and residential wood stoves. Windblown dust in the Columbia Plateau continues to have a major impact on eastern Washington. Seattle-Tacoma, Vancouver, and Spokane are in nonattainment for CO. Revised CO attainment plans, including emission control programs, have been submitted to the EPA, and CO concentrations should return to attainment levels by the end of 1995 (Washington 1994). There are no areas in nonattainment for lead, SO_2, or NO_2.

Class I areas within Washington State include Mt. Rainier National Park, Olympic National Park, and North Cascades National Park. Mt. Rainier has recently been cited as having visibility impairment. The possible source of pollutants may be nearby urban areas, the Centralia Powerplant, prescribed burning, and wildfires (Misha Vakoc, EPA - Seattle Office, personal communication, 1995).

3.12.2.3 Idaho Air Quality

In general, Idaho has very good air quality. Most of Idaho is in attainment for all the criteria pollutants except PM_{10}. The areas in nonattainment for PM_{10} are Boise, Sandpoint (Bonner County), Pinehurst, Pocatello, and Shoshone. The most significant source of PM_{10} in the nonattainment areas is smoke from wood-burning stoves. In some areas, fugitive dust, resuspension of particulates by vehicles (from the winter sanding of roadways), and industrial sources are also important. Boise is considered to be unclassified for CO (Matt Stahl, Idaho Division of Air Quality, personal communication, 1995).

3.12.2.4 Montana Air Quality

In general, the air quality in Montana is very good; however, a number of isolated areas are in nonattainment. Areas that are in nonattainment for PM_{10} are Butte, Columbia Falls, Kalispell, Lame Deer, Libby, Missoula, Polson, Ronan, Thompson Falls, and Whitefish. Major sources of PM_{10} include traffic on paved and unpaved roads, residential wood burning, industrial activities, coal mines, and agricultural activities. The areas of Lewis and Clark and Yellowstone are in nonattainment for SO_2. In Yellowstone, the major source of SO_2 is from powerplants and other industrial facilities. In Lewis and Clark, the major source of SO_2 is from lead smelting plants, which is also the source for Lewis and Clark being in nonattainment for lead. Missoula is in nonattainment for CO. Billings and Great Falls are also areas of concern for CO. The major source of CO is automobile emissions (Montana 1995).

3.12.3 Desert Southwest Air Quality

Air quality in the Desert Southwest is generally good; however, problems exist in specific areas. This section examines the air quality in Arizona and Nevada.

3.12.3.1 Arizona Air Quality

On the whole, Arizona has good air quality; however, a number of urban and industrial areas are in nonattainment for one or more pollutants. The Phoenix area is in nonattainment for O_3. The areas in nonattainment for PM_{10} are Ajo, Bullhead City, Douglas, Hayden-Miami, Nogales, Paul Spur, Payson, Phoenix, Rillito, and Yuma. The Phoenix and Tucson areas are in nonattainment for CO. Areas that are in nonattainment for SO_2 are Ajo, Douglas, Hayden, Miami, Morenci, and San Manuel.

Phoenix's problem with ozone is largely due to vehicular traffic, although the release of reactive gases from consumer products and small businesses (i.e., dry cleaners) also contributes to the problem (Jacqueline Maye, Arizona Department of Environmental Quality, personal communication, 1995). Vehicle emissions are the major source of CO nonattainment. Sources of PM_{10} in nonattainment areas vary from area to area, but fugitive dust, construction, agriculture, and resuspended road dust are significant sources. In the Payson area, the major source of PM_{10} is smoke from wood-burning stoves. Sulfur dioxide mainly comes from copper smelting plants. All the nonattainment areas for SO_2 at one time had copper smelting plants, but presently only Miami, Hayden, and San Manuel have active copper smelting plants. The other areas (Ajo, Douglas, and Morenci) are no longer monitoring SO_2 (Jim Guyton, Arizona Department of Environmental Quality, personal communication, 1995).

Class I areas within Arizona include Grand Canyon National Park, Chiricahua National Monument, Petrified Forest National Park, and Saguaro National Monument. A concern in the Grand Canyon National Park is the visibility impairment due to air pollution from various sources. A major component of the haze, which affects the visibility at the Canyon, is fine sulfate particles, which are a by-product of fossil fuels (oil, gas, and coal) combustion in powerplants. These sulfate particles can also combine with precipitation to form acid rain. Pollution at the Grand Canyon is from local and distant sources. Seasonal weather patterns and local meteorological conditions determine the contribution of each source. In summer, the pollutants can come from industrial and urban sources in southern California, southern Arizona, and northern New Mexico.

3.12.3.2 Nevada Air Quality

The air quality for most of Nevada is very good; most of the state is in attainment for all the criteria pollutants. The areas around the state's two major cities, Reno and Las Vegas, are in nonattainment for various pollutants. Reno is in nonattainment for O_3, CO, and PM_{10}, although O_3 and CO levels have not exceeded the National Ambient Air Quality Standards (NAAQS) in recent years. Las Vegas is in nonattainment for CO and PM_{10}. Natural "desert" background concentrations appear to account for about 20 to 30 percent of the particulate levels in urban areas. Additional sources include dust from unpaved roads, vacant disturbed land, land under construction, sand and gravel processing operations, and other industry. The Central Steptoe Valley is considered to be in nonattainment for SO_2, although the source for the SO_2 (a copper smelting plant) has not been active for years (Steve Holshure, Nevada Division of Environmental Protection, personal communication, 1995).

3.13 Water Consumption Associated with Non-CVP Powerplants

This section describes powerplant water consumption in the states that may be affected by the Sierra Nevada Region's proposed action. A large affected environment is described because the Sierra Nevada Region and its customers may purchase power and affect powerplant operations in the Desert Southwest, northern and central California, or the Pacific Northwest. Also, certain 2004 EIS alternatives could cause new capacity to be built in one or more of these regions, requiring the consumption of water for cooling and other purposes. The specific locations and sources of water cannot be predicted.

Thermal electric power plants use water for steam generation, cooling, or waste management. The most likely powerplants affected by Sierra Nevada Region's actions are CTs and CCCTs, which typically consume approximately 25 gallons and 200 gallons per megawatt hour, respectively. Water sources are taken from rivers, groundwater, coastal waters, or reservoirs, and the water is recycled within the plant, released to the atmosphere as steam, or returned to its source. Water released by electric generating plants may contain varying levels of contaminants depending on source, generating technology, and treatment.

The data in Table 3.8 show cooling water sources for a sample of 93 individual steam powerplants (40 of which are located in California) (UDI 1994). This table shows the percentage of these plants in each state that employ a given source of cooling water.

Table 3.8. Percent of Plants in Each State Using Cooling Water Sources

Water	AZ	CA	NV	OR	WA
Brackish		8			

Condensate		12		0	
Fresh	27	12	29	75	60
Ground	66	10	42		20
Municipal		5		25	20
Saline		50			
Sewage Effluent	7	3	29		
Total	100	100	100	100	100

These data are not representative of all powerplants due to the exclusion of combustion turbine, solar photovoltaic, wind, and hydroelectric. The data are not weighted for generating capacities. The data also exclude powerplants in Idaho and Montana (although BPA 1993 does indicate that a substantial proportion of the cooling water used in Montana is from fresh sources). The data demonstrate regional consistencies in choices of cooling water sources within states located in the Desert Southwest, California, and the Pacific Northwest. Electric generators of other types should face similar constraints and options in choosing water sources to the extent they require cooling water. Many of the renewable generating resources, such as wind and photovoltaic, do not require cooling water.

Thus, the data in Table 3.8 indicate the sources of water that may be impacted by changes in powerplant operation resulting from Sierra Nevada Region's actions. For example, Table 3.8 indicates that Arizona and Nevada are more heavily reliant on groundwater as a source of cooling than are other states. This reliance may result from the types of powerplants constructed in these states (see Appendix G for information about powerplants) and from the sources of water available for development.

3.14 Waste Production Associated with Non-CVP Powerplants

This section summarizes issues related to powerplant waste production in states that may be affected by the Sierra Nevada Region's power marketing decisions. The Sierra Nevada Region does not operate the types of thermal powerplants described here. However, the Sierra Nevada Region, its customers, or others may choose to purchase power from these types of powerplants and affect the level and/or timing of the powerplants' operations. The baseload alternative may cause new powerplants to be built and operated. The issues associated with thermal powerplant production include ash production, geothermal wastes, and wastes from operating transmission facilities.

Most of the solid waste produced by thermal electric power generation is either ash from burning fuels such as coal or biomass or stack scrubber residue. Both consume landfill capacity and have the potential to contribute dissolved inorganic pollutants to surface water and groundwater.

Geothermal powerplants are another potential source of wastes. Hazardous wastes at the Geysers, a series of powerplants in northern and central California, come from drilling activities and power generation. Wastes created during drilling include drilling mud, rock cuttings, additives, lost circulation materials, cement, hydrogen sulfide abatement chemicals, and oily residues. In addition, the sludges deposited in cooling towers and produced from water treatment are contaminated with lead, zinc, arsenic, mercury, and other compounds. Because of this contamination, these wastes must be treated as hazardous. A substantial amount of sulfur is removed from the gas and is either sold as a by-product or disposed of in a landfill.

Operations at the Geysers are not anticipated to change as a result of the Sierra Nevada Region's actions. But the Geysers provides an example of the type of issues that may be encountered in developing geothermal resources. Actual energy production from geothermal resources is dependent on local conditions and technology designs.

In addition, various facilities associated with the generation and transmission of electric power produce solid and/or hazardous wastes. Those facilities include substations, O&M facilities, metering facilities, office buildings, telecommunications facilities, centralized warehouses, construction sites, and transmission lines. Among the categories of waste generated by these facilities are solvents, vehicle coolants, various ozone-depleting substances, polychlorinated biphenyls, refuse, batteries from substations, tires, used power poles, plastics, office paper, oil, and oil-contaminated soil (Woodward-Clyde 1995).

For its part, Western is engaged in an aggressive program to provide guidance for development and implementation of a facility-wide, multimedia pollution prevention program, called the POWER Plan (Prevention of Waste through Elimination and Reduction). Transmission facility operations are not expected to change as a result of the Sierra Nevada Region's power marketing decisions.

3.15 Land Use Associated with Non-CVP Powerplants

Land-use issues related to electric power generation include changes to local development, recreation, and other use patterns caused by potential powerplant and transmission facility construction, fuel source production and transportation, and waste disposal. Powerplants and associated transmission lines may be sited in a variety of landscapes that provide access to fuel, cooling water, space, or other needed resources. The baseload alternative could cause additional system capacity to be constructed to make up CVP load-carrying capacity losses. The new capacity would result in land-use impacts. The specific locations of these potential impacts cannot be predicted, but any new facilities would be covered by State or Federal facility siting processes to assess specific impacts.

Much of the existing generation capacity in the Desert Southwest, northern and central California, and the Pacific Northwest is provided by centralized powerplants that were developed as large units in order to increase efficiency. However, recent plants using CTs, CCCTs, and cogeneration facilities are based on improved technology that can be even more efficient while employing smaller units that require less space. Future powerplants may require even less acreage as cleaner and smaller-scale technologies become commercially available.

The effects of powerplants on land uses are dependent on the site, specific generating technologies, and local land forms and land-use patterns. The Sierra Nevada Region is not proposing to build any new powerplants or other facilities under the proposals described in this 2004 EIS; however, the baseload alternative could trigger the construction of replacement capacity. Any future actions of these types will be analyzed for environmental impacts in their own right.

Development of new generation and import energy resources may require construction of new or upgraded transmission facilities to integrate with the existing transmission system and to ensure continued reliable operation of the regional transmission system. However, until specific information is available on the characteristics of new or changed resources, system requirements and locations cannot be known. However, resources located farther from load centers will generally require more transmission facility construction than resources closer to load centers (BPA 1993).

Building transmission lines affects residential, commercial, agricultural, desert, and forest land. Agricultural land would be removed from production for tower sites and access roads, and structures could interfere with farming operations. Forest land would be removed from production for the right-of-way, line clearances, and access roads. Transmission lines may cross trails and are likely to be readily visible in a variety of topographies (Western 1988; BPA 1993). Construction and maintenance may cause soil erosion.

Examples of active agricultural lands that were affected by new and expanded transmission facilities were identified in the COTP EIS and include lands producing cotton, lettuce, tomatoes, grain, dryland grain, pistachios, carrots, beans, vineyards, melons, almonds, broccoli, alfalfa, safflower, and potatoes. In addition, fallow and idle fields might be affected (Western 1988).

Land use may also be affected by electric and magnetic field effects. Electric fields induce voltages and currents in conducting objects. Although shocks associated with electric and magnetic fields are well understood and largely controllable, questions have been raised as to whether there are long-term health effects from exposure to electric and magnetic fields. At this time, the body of epidemiological evidence does not establish an association between long-term exposure to electric and magnetic fields and various health effects including cancers in humans (National Research Council 1996).

Section 3.2 of this chapter describes transmission facilities that the Sierra Nevada Region operates. The Sierra Nevada Region is not proposing any changes that would affect the land-use requirements for existing facilities. Any future facility development would be analyzed under separate NEPA processes.

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1. Although steelhead and rainbow trout share the same Latin species name, they are differentiated by steelhead being anadromous and the rainbow trout life cycle occurring entirely in freshwater.

2. This information is from the Natural Diversity Database and was provided in correspondence from K. Hashagen of the California Department of Fish and Game to Lance Vail of the Pacific Northwest National Laboratory, March 25, 1996.

4.0 Environmental Consequences

This chapter describes the environmental impacts of all 2004 EIS alternatives, including the preferred alternative which was added following consideration of comments on the draft EIS. The environmental baseline is represented by the no-action alternative. The alternatives are described in Section 2.3 but are referenced throughout Chapter 4. The preferred alternative is similar to the no-action and peaking alternatives. The peaking alternative was selected as the environmentally preferred alternative. It is important to note that all the alternatives, including the no-action alternative, are modeled to estimate 2005 conditions. Impacts are projected for the year 2005 because the existing power marketing contracts expire at midnight on December 31, 2004. Operating conditions on the CVP and utility marketing arrangements are changing rapidly. The analysis of the alternatives anticipates these changes to the extent possible and incorporates many variations from historical and existing conditions. (See Sections 3.3, 3.10, 4.1, and 4.2, Appendix D, and Western 1997.)

The impact analyses follow three basic steps. Historic hydrological conditions were analyzed using the PROSIM model (the CVP simulation model), which is described in Section 4.1. The PROSIM outputs, in the form of monthly water flows and available hydropower capacity and energy, input into the PROSYM model, a production cost model of utility operations. The PROSYM model and its outputs are described in Section 4.2. PROSYM outputs, in the form of estimated levels of electricity generation, production costs, and hourly water flows in the CVP, were used to calculate the environmental impacts described in the remainder of Chapter 4. Figure 4.1 shows the relationships of the models to impact analyses.

The impacts analyzed within the CVP are focused on these potential effects that might result from the Sierra Nevada Region's influence on operations. Other NEPA processes are assessing impacts outside the scope of this 2004 EIS as described in Section 1.6. As described in Chapter 3, Sierra Nevada Region's power scheduling decisions are limited to specific hydropower generators and the regulating reservoirs that control flows downstream from those facilities. Downstream flows are not affected by Sierra Nevada Region's power scheduling, as the regulating reservoirs are operated to control downstream releases for purposes other than power generation. Analyses of potential impacts consider any effects from the proposed action and the alternatives. These potential effects stem from changing the magnitude and frequency of pool-level fluctuations in the regulating reservoirs. Potential impacts that may result from changing operations at these facilities are described in the following sections: 4.3 (CVP Water Resources), 4.4 (Fisheries), 4.5 (Terrestrial Environment), 4.6 (Threatened and Endangered Species), 4.7 (Recreation), and 4.8 (Cultural Resources). Main storage reservoirs are large enough so that changes in hydropower operations do not produce noticeable reservoir fluctuations or effects attributable to Western's actions.

Figure 4.1 Relationship of the PROSIM and PROSYM Models to the Impact Analyses

Developing renewable resources, as described in the renewables alternative, is independent of CVP operations. For analyzing the effects associated with development of renewable resources in this 2004 EIS, it is assumed the CVP will be operated to maximize peaking. Thus, impacts resulting from CVP operations are identical to the peaking alternative. If renewables were developed in conjunction with other CVP modes of operation, the impacts of such operations would be similar to those of the corresponding alternatives. Effects within the CVP from the renewables alternative are similar to the effects of the peaking alternative described in Section 4.2. They are not described separately in Sections 4.3 through 4.8.

Socioeconomic impacts are described in Section 4.9. These impacts were analyzed for all of northern and central California. This analysis addresses the impacts of changing CVP operations, as well as various types and levels of power purchases, including acquisitions under the renewables alternative. This analysis also assesses the impacts of changing allocations across customer groups.

Changing CVP operations affects the capacity and timing of the energy available to market. Impacts resulting from broad changes in thermal powerplant operations or possible construction are described in the following sections: 4.10 (Air Resources), 4.11 (Water Consumption Associated with Non-CVP Powerplants), 4.12 (Waste Production Associated with Non-CVP Powerplants), and 4.13 (Land Use Associated with Non-CVP

Powerplants). Impacts for generic powerplants are described in these sections because it is not possible to determine which specific powerplants would be involved in power purchases or where new capacity may be built.

To the extent that developing renewable resources is land intensive, the terrestrial environments, endangered species, recreation, and cultural resources could be impacted. Anticipated acreage requirements from developing renewables under the renewables alternative are described in Section 4.13. However, impacts to specific resources are dependent on sites that may be developed and surrounding circumstances. Although acreage requirements were forecasted, it was not possible to identify site-specific impacts. In any case, State facility siting laws and Federal laws require environmental analysis and documentation before these facilities could be built.

This chapter concludes with Sections 4.14 (Irreversible and Irretrievable Commitments of Resources), 4.15 (Unavoidable Adverse Impacts), 4.16 (Relationship Between Short-Term Uses and Long-Term Productivity), 4.17 (Direct and Indirect Effects), and 4.18 (Cumulative Effects).

4.1 PROSIM Hydrologic Model

To analyze potential environmental impacts of Sierra Nevada Region's actions, the power resources available from the CVP and the power requirements of the CVP have to be forecasted. The project simulation model (PROSIM) for the CVP was used to determine monthly energy and capacity available from the CVP and the monthly Project Use load that will need to be served. PROSIM is a hydrologic model developed by Reclamation to simulate the operation of the CVP.

PROSIM simulates the monthly operation of the CVP using historical hydrologic information, physical system parameters, water demands, and operating rules and agreements. For the purposes of this study, the standard 70-year period of record was used (water years 1922 through 1992). The model and data set are described in Appendix D.

The monthly power resource data were calculated based on the simulated reservoir storages and releases through each CVP powerplant for the 70-year period of study. Monthly Project Use load was calculated based on the simulated water deliveries that require pumping through project pumps. In addition to calculating power data, PROSIM water data were used in Reclamation's monthly temperature model to predict water temperatures at various reservoirs.

4.2 PROSYM Production Cost Model

The PROSYM model was used to calculate power production costs, hourly powerplant generation and capacity, and hourly water flows through the CVP. Total power costs are discussed in Section 4.9.2. For the purposes of this 2004 EIS, the electrical systems of the Sierra Nevada Region's utility group of customers were modeled together with the CVP hydropower system and access to the power markets. The major output from this standard, commercially available, production cost model provides the amount and timing of generation from each resource, the variable cost of generation by resource, the total amount and timing of energy generated by each resource, and the total variable cost of generation to serve the system load.

PROSYM requires data describing the electric power system being modeled. These include a set of historic hourly loads for a year, projections of annual load peaks and energy, economic variables, and physical and operating characteristics of resources (i.e., capacities, type of unit, fuel type, variable and fixed cost of generation, etc.). This information is discussed in Chapter 3 and in the modeling report (Western 1997).

The PROSYM model was configured in a star format (i.e., a central node with transmission links to other nodes containing loads). CVP generation and Project Use loads were modeled within the central node. The central node was connected via three branches to the utility, agriculture, and other loads and resources of Sierra Nevada Region's customers. Only transmission from the CVP to the branches, and not from the branches to the system, was permitted. The nominal transmission limits for each case are shown in Table 4.1. The transmission limits were used to simulate the maximum hourly rate of energy delivery to each of the customer groups, as currently represented by the contract rate of delivery (CRD). All three Sierra Nevada Region customer groups (utility, agriculture, and other) were assumed to also have access to the power markets as an additional supply source. All of the utility-owned generation and contracts were modeled as part of the respective node.

Output from the PROSIM hydrologic model is used as input into the PROSYM production cost model. Specifically, monthly generation and available capacity at each of the CVP powerplants were modeled in the production cost model. Modeling was carried out under average and adverse hydrological conditions. Development of the average and adverse generation data is described below.

Table 4.1 Transmission Limits

Customer Group	**Transmission Limits (MW)[(a)]**
Utility	1,057.5
Agriculture	78.7
Other	313.9
Total	1,450.1

[(a)] Figures used in modeling study.

CVP generation under average hydrologic conditions was extracted from the PROSIM output for each CVP powerplant. This was calculated on a monthly basis by averaging the CVP generation over the period of study, reduced by the average system-wide losses over the period. The result of this approach is that the "average year generation" is a composite year based on the average of all generation in January, all generation in February, etc. The maximum monthly available capacity at each powerplant and the Project Use energy and capacity quantities also come from the PROSIM output and are based on the same month and year used in setting the energy value.

The CVP generation under adverse hydrologic conditions for each CVP powerplant also was extracted from the PROSIM output on a monthly basis. For study purposes, it was decided to base the "adverse year" on a 90-percent exceedance value, a fairly common measure of adverse hydrologic performance. For example, to determine the value for January, the total CVP generation in each January over the 70 years of the study was sorted in ascending order and a generation level selected from the list that was exceeded 90 percent of the time. The January in which this generation occurred was then used to represent the generation at each of the CVP powerplants and the associated system-wide losses. The values for generation in each month February through December were determined in the same manner.

This approach results in an adverse year that is a composite year based on January generation that is exceeded in 90 percent of the January months, February generation that is exceeded in 90 percent of the February months, etc. The adverse year maximum monthly available capacity at each powerplant and the Project Use energy and capacity quantities also come from the PROSIM output using the same month and year used for the determination of energy generation.

The two types of hydrologic conditions, average and adverse, are used to form the basis of the modeling efforts. The average year is used as a representation of conditions that are illustrative of the levels of energy Sierra Nevada Region will be able to market. The Sierra Nevada Region will be able to market more energy approximately half of the time and will have less energy to market the remaining time. Thus, Sierra Nevada Region's long-term revenues from the sale of energy will average those represented by the average year.

For capacity to be firm over the long term, it needs to be available at the times it is required. Capacity value is measured based on adverse hydrologic conditions, since these tend to be representative of capacity available for the majority of the time. Given this need for availability under poor hydrologic conditions, capacity value to a customer (and, hence, its market value) is based upon its availability under adverse hydrologic conditions.

The capacity of a hydroelectric generator essentially is its ability to generate energy, given the "head" of water available in the associated reservoir. This capacity represents the *maximum rate* at which the generator can produce energy. The generator may be able to sustain this maximum capacity level (based on its head) for only a limited time period due to limited amounts of water available for release or regulating reservoir storage capacity. The period of time during which the level of maximum capacity is available may not be sufficient to offset the requirement for capacity during other periods. This then results in the acquisition of similar levels of capacity during periods of deficiency. To avoid the acquisition of redundant capacity, the output of the generator is reduced to a level less than its physical capability. Such reduction is based on achieving a sustainable output level, given the available energy, which does not require redundant capacity from elsewhere. This level of output is often referred to as firm load-carrying capacity. It is this firm load-carrying capacity that is generally referred to in this document as the capacity or capability of the CVP generation.

The maximum firm capacity credited to the CVP is based on adverse hydrologic conditions. Statistically, these conditions will be exceeded much of the time (up to 90 percent of the time). During most periods, there will be additional levels of energy available as well as greater rates of delivery (increased head at generators increase the generation capability) leading to increased load-carrying ability. This increased load-carrying ability (capacity) may be marketed on an as-available basis.

It is expected that the Sierra Nevada Region will market these increases in capacity (load-carrying ability) and energy based on market conditions. Table 4.2 demonstrates the additional load-carrying ability between adverse and average conditions. Table 4.2 also illustrates the difference in load-carrying ability under peaking conditions between adverse (90-percent exceedance), average (50-percent exceedance), and heavy runoff (10-percent exceedance)

Table 4.2 Estimated 2005 Load-Carrying Capacity (MW) Available from CVP Hydropower

	No-Action		**Peaking**			**Baseload**		**Preferred**	
	Average	**Adverse** [(a)]	**Heavy Runoff**[(b)]	**Average**	**Adverse**[(a)]	**Average**	**Adverse** [(a)]	**Average**	**Adverse** [(a)]
January	603.60	653.10	1,356.20	1,048.10	674.30	459.60	190.00	930.00	640.50
February	708.60	612.50	1,456.30	1,120.00	723.50	512.90	197.80	988.30	660.70
March	636.30	616.10	1,275.90	981.50	652.10	489.50	216.90	919.20	620.60
April	778.70	743.20	1,403.10	1,210.00	887.50	555.00	328.20	1,111.40	712.80
May	1,190.60	820.80	1,630.80	1,497.60	1,166.80	621.30	380.80	1,413.20	1,064.40
June	1,283.60	1,024.40	1,703.40	1,595.30	1,304.40	690.60	461.00	1,585.50	1,211.10

July	1,353.70	1,088.80	1,769.10	1,594.50	1,377.40	761.50	508.10	1,515.60	1,326.30
August	1,211.30	948.60	1,700.00	1,535.30	1,265.20	715.80	461.40	1,450.00	1,210.30
September	1,097.10	839.50	1,587.80	1,356.90	1,101.10	612.70	378.10	1,306.10	1,011.40
October	661.30	651.70	1,155.70	995.40	814.20	341.70	217.30	816.00	643.50
November	624.80	663.60	1,114.80	964.20	759.90	352.30	192.40	914.00	722.80
December	710.70	635.90	1,290.50	970.70	710.80	384.60	187.40	951.00	657.00

(a) 90-percent exceedance level.
(b) 10-percent exceedance level.

conditions. As hydrologic conditions vary, the capacity available for marketing will also vary; however, the dependable capacity (and thus the ability of the CVP to offset additional capacity construction) will remain as determined based on adverse conditions.

The cost of energy used in this analysis assumed a rate that is representative of a competitive market, slightly greater than its cost of production and transmission. The cost of power used herein was assumed to reflect a portion of the capacity costs associated with producing power. Such costs were based on the estimated market value of capacity, which varied seasonally and with on- and off-peak periods of the day.

4.2.1 Modeling the No-Action Alternative

Under the current mode of operating, Sierra Nevada Regions utility customers base their decision to purchase Sierra Nevada Region energy, in part, on the price of the resource. This price, in turn, is partially determined by the amount of non-CVP power purchases Sierra Nevada Region must acquire to serve its customers' needs. This type of cause and effect results in the need for an iterative modeling effort, since the price assumed initially determines the amount of resource purchases required. In addition, this type of situation requires a number of iterations to ultimately determine a price level reflective of the demand and purchase costs.

The no-action alternative was modeled in two steps. The first step was to create a case with the Sierra Nevada Region resources, represented as a single dispatchable resource, with a fixed amount of energy at a set price. The fixed monthly energy for this resource was set equal to Sierra Nevada Regions monthly energy allocation to its customers based on current contracts. The maximum rate of delivery (capacity) was equal to the approximate sum of Sierra Nevada Regions CRD (i.e., 1,450 MW) plus hourly Project

Use load. The price was set based on the melded cost of the CVP and the anticipated purchases.

The results of this run indicated how customers would integrate the Sierra Nevada Region energy with other available resources. The run essentially produced the hourly load requirements that Sierra Nevada Region could be expected to serve given the economic dispatch of the Sierra Nevada Region energy with other options available to the customers. A second run was then made modeling Sierra Nevada Region's purchases together with the CVP hydropower units. In this second run, the individual CVP units and Sierra Nevada Regions purchases were dispatched to meet the hourly load requirements determined in the initial run. This second iteration determined the timing and mix of CVP hydropower and purchases used to meet Sierra Nevada Region requirements that were determined in the first run.

Resource prices for the CVP hydropower and the no-action alternative are shown in Table 4.3. The resulting mix of resources (CVP hydropower and Sierra Nevada Region purchases) resulted in a cost for Sierra Nevada Region power, which was based on those specific purchases utilized by the model to meet the load rather than those assumed for the initial run. This cost was compared to that assumed in the initial run. Since a customer decision as to how much Sierra Nevada Region power is purchased is, in part, driven by the price, the price of energy in the initial run was then adjusted accordingly and rerun to determine how the new price for Sierra Nevada Region energy would affect the load which Sierra Nevada Region would be required to meet (i.e., how Sierra Nevada Region's load varied with price). Several iterations were made until the energy price resulting from the second run closely matched the variable cost of power assumed in the initial run. When this occurred, the results were indicative of the actual levels of Sierra Nevada Region power the customer would schedule and the actual purchase requirements of Sierra Nevada Region to support the CVP power. This process resulted in a net cost of Sierra Nevada Region power of $28.08 per MWh.

The no-action case was modeled assuming average and adverse hydrological conditions. Energy was priced based on Sierra Nevada Region costs. Included in the costs were transmission expenses and supplemental purchases necessary to meet monthly obligations as well as estimated project restoration charges applicable under the CVPIA.

4.2.2 Modeling the Peaking Alternative

To determine the effects of maximizing the peaking ability of the CVP, the energy available from the CVP hydropower resources was dispatched into the combined northern and central California preference load. This dispatch was carried out for both adverse and average hydrologic conditions within the constraints of the regulating reservoirs and other project

Table 4.3 CVP Hydropower and No-Action Alternative

Resource Price Assumptions

	$/MWh	Energy (GWh)[a]
CVP Hydropower	20.78	3,161
No-Action[b]	28.08	7,730

[a] Net of Project Use. [b] This is the aggregated costs including purchases.

constraints. Conformance to temperature requirements downstream of Keswick Reservoir has generally resulted in approximately 50 percent of the generation at Trinity, Carr, and Spring Creek powerplants being baseloaded.(1) This assumption was carried through in the modeling.

In this initial dispatch, no other customer resources were modeled to ensure that the CVP hydropower peaking capability was maximized relative to the load prior to the use of any other competing resources. This initial dispatch resulted in an hourly generation pattern for the CVP resources that essentially maximized their use in meeting forecasted peak loads. The resulting hourly pattern was then used in conjunction with the other resources available to the northern and central California preference customers in determining the final dispatch for the peaking alternative. In addition, the same dispatch of the CVP hydropower units was used in other alternatives, which combined the peaking ability of the project with various levels of potential Sierra Nevada Region firm purchases. The CVP energy was assumed to be priced at a rate based on the projected costs of the CVP. Note that this case assumed that Sierra Nevada Regions resources only consisted of the CVP resource and that the Sierra Nevada Region made no supplemental firm purchases to meet customer loads.(2) The alternative was modeled for both adverse and average hydrologic conditions. The capacity usable in meeting the peak customer load requirements (load-carrying ability) is tabulated in Table 4.2.

The impact of peaking operations on CVP capacity, usable in meeting load, is discussed in Section 4.2.7.

4.2.3 Modeling the Baseload Alternative

In this case, Sierra Nevada Regions hydropower resources were modeled to serve as baseloaded units (loaded at a constant level of generation). Since the units are loaded at a constant rate, the load served by the resource has no bearing on the operation of the CVP generation, provided it is large enough to absorb the generation. As in the peaking case, the northern and central California preference load was used in the modeling. Each of the CVP units was operated such that the monthly energy produced by the project was evenly distributed in all hours of the month. The energy was assumed to be priced at a rate based on the projected costs of the CVP hydropower resources. Sierra Nevada Region was assumed to make no energy or capacity purchases in this case.(3) Additional resources necessary to meet the load were provided by individual customers. The alternative was modeled for both adverse and average hydrologic conditions. Capacity values associated with this mode of operation of the CVP generation are tabulated in Table 4.2. The impact of baseload operations on CVP capacity, usable in meeting load, is discussed in Section 4.2.8.

4.2.4 Purchase Assumptions and Approaches Applicable to the Baseload and Peaking Alternatives

To assess the impacts associated with the potential of firming the hydropower system with thermal support, a series of alternatives was studied in which purchases were included. Two levels of purchases (up to 450 MW and 900 MW) were identified and modeled as firm purchases. Each of these resources was modeled as a baseload resource (up to an 85-percent capacity factor) and as a peaking resource (up to a 15-percent capacity factor). Cases were modeled that paired each purchase with the CVP operated in both the peaking and baseload modes. Resource prices for the various purchases were assumed to be market rates.

4.2.4.1 Purchases

In addition to the assumptions used to establish the cost of purchase power, it was also assumed that the Sierra Nevada Region would not be required to purchase any energy above its requirements.

4.2.4.2 Aggregated and Disaggregated Costs

The analyses of the purchase scenarios assume that the Sierra Nevada Region would supplement CVP hydropower with power purchased from the market. The Sierra Nevada Region's market costs for purchased power would be passed on to its customers, either through aggregated or disaggregated rates. In the draft 2004 EIS, both aggregated and disaggregated costs were analyzed. In the aggregated cases, all Sierra Nevada Region purchased power costs were assumed to be melded with CVP hydropower costs into one rate. In the disaggregated cases, separate costs for CVP hydropower and purchases were established. Since the costs assumed for Sierra Nevada Region purchases were generally greater than the cost associated with only CVP energy, the aggregated energy cost was greater than the CVP energy cost.

In the final 2004 EIS, industry restructuring is assumed to have changed the power market so that it operates with open access for both wholesale and retail customers. Because both Western and its customers would have equal access to the market, all purchases would be under similar terms and conditions. Under these market conditions, in the disaggregated case there would be no cost differences between a Sierra Nevada Region purchase and a customer's direct market purchase. Therefore, analysis of this case was eliminated from the final 2004 EIS. Instead, the no purchase cases represent the effects of disaggregating costs associated with any Sierra Nevada Region purchases. The modeling of alternatives with purchases in the final 2004 EIS assumes only aggregated costs.

4.2.5 Modeling the Renewables Alternative

Renewable resources could be acquired either by direct purchase or through allocations of Federal hydropower to utilities developing renewable resources. Either approach would result in similar effects to the physical environment. For purposes of PROSYM modeling, it was assumed that the Sierra Nevada Region made direct purchases of renewable resources.

Renewable resource purchases were made up of equal portions of capacity from four types of resources: wind, geothermal, solar photovoltaic, and biomass and priced at a level incorporating current and projected resource costs.[(4)]

Current resource cost estimates were based on installing and operating resources with the current level of technologic development. The projected resource cost assumed that future costs would decline as a result of improvements in the various underlying technologies. The current and projected costs were weighted to arrive at an estimate of the cost in 2005.

The weighting factors assumed that the resource mix would consist of 80 percent of renewable resources with characteristics similar to existing technologies and of 20 percent with new technology. Review of the WSCC 1993 resource expansion plan (WSCC 1993), which was prepared prior to restructuring, indicates a current installed capacity level for renewable resources, of the type assumed in this study, to be 6,719 MW, with approximately 1,400 MW of new additions planned. These data tend to indicate that the future renewable resource mix would consist of approximately 83 percent of resources with current technology levels and 17 percent of resources with advanced technologies. More recent information shows a declining percentage of new resources to about 5 percent (WSCC 1996; EIA 1996). However, the technology and costs of existing resources may be adjusted to compete with newer generation types. Further, the full extent of new resource development may depend on policies and regulations incorporated into State and Federal utility restructuring approaches. Therefore, for study purposes, the percentages above were used to establish renewable resource costs for 2005. The costs of a variety of renewable and emerging resources are shown in Appendix C.

Table 4.4 shows the cost and generation assumed for each of the renewable resources included in the renewables alternative. Using these data and the debt service and reserve assumptions, the cost of the renewable resources was calculated. The calculation was similar to that used for the generic thermal purchases. The fixed and variable costs for each of the renewable resources were calculated individually. The sum of the individual fixed cost represented the total fixed cost of the renewable resources. The sum of the individual variable cost represented the total variable cost of the renewable resources. Energy generated by the renewable resources was determined using a capacity factor of the four renewable resources.

A series of cases were first run to estimate the level of renewable resources combined with CVP hydropower that would approximate the market rate for energy. These cases were developed by adding renewable resources in 50-MW increments to a base case consisting of CVP hydropower resources serving peak loads to develop a curve to determine where the combined rate for Sierra Nevada Region energy equaled the estimated market rate for firm energy. This curve is shown in Figure 2.4 in Section 2.3.

Table 4.4. Assumptions for Renewable Resource Price Forecasts

Resources	Installed Plant Cost ($/kW)	Fixed O&M ($/kW-yr)	Total Fixed ($/kW-yr)	Variable O&M ($/MWh)	Capacity Factor	Annual Generation (GWh)
Wind	1,545	29.90	260.28	11.60	26.3%	28.8
Solar Photovoltaic	8,895	35.00	1,275.59	11.50	30.5%	33.4
Geothermal	4,344	112.00	727.10	18.54	92.0%	100.7
Biomass	4,378	124.05	743.79	14.05	80.0%	87.6
Combined Rate [(a)]		75.24	751.69	15.23	57.2%	
Total						250.5
(a) Combined = 25% meld of each resource based on capacity.						

The cost of power is shown in Table 4.4. Based on the results, it was estimated that the combination of 50 MW of renewable resources melded with the peaking CVP hydropower resource would be the maximum amount of renewables that could be melded with the CVP and still be competitive in the marketplace. The energy generated by these renewable resources totaled 250.5 GWh/yr.

4.2.6 Modeling the Preferred Alternative

A preferred alternative was developed in which no purchases were made by the Sierra Nevada Region (except to support off-peak Project Use load) and in which the CVP hydropower was dispatched based on economics and relative allocations to each customer group. This would mean that the CVP hydropower would be dispatched into the load curve intermingled with the customers' hydropower and other limited energy resources.

Modeling of the preferred alternative was carried out in two steps. The first step involved economically dispatching CVP hydropower facilities together with other generation to arrive at an overall hourly CVP hydropower dispatch. This approximated the optimum use of the CVP facilities relative to other available resources. In the second step, hourly CVP generation was allocated, based on CRDs, to the three customer groups and Project Use. This dispatch was used to identify how each customer group would utilize its share of the resource and the resultant power costs.

This scenario could be used to represent a case where Sierra Nevada Region makes market purchases for a customer and then sells them to the customer at market rates (i.e., disaggregated from the CVP rates). Since the cost to the customer of this purchased power is the same whether it comes from Sierra Nevada Region or the customer purchased it directly from the market, the total costs of this alternative remain unaffected by any assumed market purchased by the Sierra Nevada Region and resold at a disaggregated rate.

4.2.7 Modeling Allocation Options

To determine the effects of increasing or decreasing allocation to various customer groups, several alternatives were modeled in which the current allocation levels were either increased or reduced to zero. This exercise resulted in six different combinations of allocating 1,450 MW of Sierra Nevada Region capacity. To achieve comparability between the no-action scenario and the modeling of the different allocations, the various allocation cases were run assuming Sierra Nevada Region and the customer enjoyed the same access to the market in the allocation change cases as they did in the no-action case.

In the first allocation case (Allocation 1), it was assumed that all of Sierra Nevada Regions power was marketed to the utility customers. Therefore, the agriculture and other customers were assumed to be totally served by other entities.

In Allocation 2, the Sierra Nevada Region's power marketed to the agriculture and other customers was increased to meet their respective loads. The utility customers were only provided that power excess to the requirements of agriculture and other customers.

In Allocation 3, the allocation to the agriculture customers was increased to meet the full load, and the allocation to the utility and other customers was proportionally reduced to maintain the overall sales level.

In Allocation 4, the allocation to the agriculture customers was assumed to be zero, with the allocation to the utility and other customers being proportionally increased.

In Allocation 5, the allocation to other customers was assumed to meet their full load requirement, and the allocation to the utility and agriculture customers was proportionally reduced.

In Allocation 6, the allocation to the other customers was assumed to be zero, with the allocation to the utility and agriculture customers being proportionately increased.

4.2.8 Effects on Capacity and Energy

How the CVP is operated will affect its ability to produce energy during peak load periods. The project's ability to provide peaking energy is a function of its peaking capacity, which is shown in Table 4.2. As discussed in the introduction to Section 4.2, the "firm load-carrying" capability of the project is the maximum sustainable level of output that is useful in avoiding the acquisition or construction of additional resources. The maximum load-carrying capacity in an adverse year for each of the alternatives occurs in July as follows: 1,088.8 MW for the no-action alternative; 1,377.4 for peaking; 508.1 for baseload; and 1,326.3 for the preferred. The renewables alternative is based on peaking alternative operations. The greatest differences between the no-action and other alternatives occur in July, August, and May.

The maximum difference in CVP adverse year load-carrying capacity between the no-action alternative and the peaking scenario is 346 MW in May and 316.6 MW in August,[(5)] with the monthly average over the year being 178 MW. This difference is an increase in available load-carrying capacity over the no-action alternative. This indicates that by switching from the no-action mode of operating to a mode in which the CVP peaking generation is maximized, capacity additions may be delayed for some period of time. The duration of the delay will depend primarily on load growth. The environmental benefits resulting from this delay contribute to the selection of the peaking alternative as the environmentally preferred alternative.

The maximum difference in CVP load-carrying capacity, under adverse year conditions, between the no-action alternative and baseloaded scenarios is a 581-MW reduction in July, with the monthly average over the year being a 465-MW reduction. This indicates that by switching from the no-action mode of operating to a mode in which the CVP is operated as a baseload resource results in a need for additional capacity to be added to the region to accommodate the reduction in CVP capacity. The timing of the increase will depend on the rate of load growth. The preferred alternative results in a difference that ranges from a reduction of 30 MW in April to an increase of 262 MW in August. Because of the larger summertime demand and resource abundance in April, it is likely that the 30-MW springtime reduction would not need to be made up.

The total energy generated from hydropower and other resources does not change in any of the cases modeled since there is no change in the load being served. The energy production for each case is tabulated in Appendix I. This appendix illustrates the amounts of energy being produced by various resource groups. The largest change from case to case is within the combustion turbine group of resources owned by the utility customers. An analysis of resources that would be purchased by utility customers in response to the alternatives found that CCCTs provide the bulk of the energy. Very often this resource is incremental and therefore responds to changes in the amount or price of Sierra Nevada Region energy. The results of the allocation studies are presented in Section 4.9.2.

4.3 CVP Water Resources

This section describes potential effects on water temperature and pool fluctuations resulting from the alternatives. It should be noted with respect to these potential effects that power generation is subordinate to Interior's operation of the storage projects for in-stream flow fluctuation and temperature management and other project purposes, as defined in Federal legislation.

4.3.1 Water Temperature

Water temperature has been identified as a critical parameter in habitat suitability for many fish, including some species listed as threatened or endangered, such as winter-run chinook salmon in the Sacramento River. Reclamation is tasked with meeting seasonal water temperature criteria to benefit fish in downstream reaches through storage project releases. Water release temperatures are a function of seasonal and daily climatic conditions, withdrawal level from primary storage reservoirs, surface area of reservoirs, and flow rates within the reservoirs and rivers. Sierra Nevada Region's power generation will not change the seasonal operation of the main storage projects (Trinity, Shasta, Folsom, and New Melones). Also, flow rates below the regulating reservoirs are the same as in the no-action alternative for all alternatives. Therefore, assessment of impacts to water temperature is limited to changes in temperature that may occur within and downstream of the regulating reservoirs (Lewiston, Keswick, Lake Natoma, and Tulloch) as a result of differences in the two hydropower operating alternatives that set the boundaries for potential temperature effects (peaking[(6)] and baseload). The water operations in the preferred and no-action alternatives are very similar to the peaking alternative, so separate analyses were not conducted. The potential effects of all the alternatives fall within the boundaries analyzed. Thermal calculations were designed to detect any change in the temperature of releases from the regulating reservoirs. The approach to the analysis and resulting impacts are presented below.

4.3.1.1 Approach

Monthly water temperature estimates for each of the storage projects, consistent with Reclamation's operating policies for managing stream temperatures, were developed from PROSIM results. Hourly inflow volumes were estimated from PROSYM simulations consistent with the monthly flow volumes provided from PROSIM simulations. The limited control that the hydrosystem operation has over stream temperatures does not provide any guarantee that temperature criteria downstream from reservoirs will not be violated. Structural improvements have been made in several of the CVP storage projects to help manage downstream temperature effects. However, under certain climatic and water year conditions, it is not likely that the temperature criteria established to enhance conditions for fish will be met consistently despite project controls. The approach detailed below was taken to assess whether changes in hydropower generation patterns could result in any change in the likelihood of these violations occurring.

Two separate calculations were performed to assess what, if any, impact various hydropower alternatives could have on the temperature of water in the affected aquatic environment. The first calculation was a simple thermal analysis performed for each of the regulating reservoirs to provide a bound on the changes in stream temperature that might result from baseload and peaking alternatives. The second calculation was performed to estimate the impacts on temperature that might result from the unique condition where two inflows with different flow rates and temperatures combine in Keswick Reservoir.

The first set of calculations estimate the likely magnitude of any thermal impact due to hydrosystem operation. For simplicity, these calculations treated the regulating reservoirs as perfectly mixed tanks with volumes and surface areas varying in a manner consistent with the specific reservoir's stage-contents relationship (see Appendix J). The changes in temperature are primarily the result of the exchange of heat across the reservoir's surface. Heat exchange resulting from short-wave solar radiation, long-wave atmospheric radiation, long-wave back radiation, and evaporation heat loss was estimated on an hourly basis using the methods reported in Edinger et al. (1974). Heat exchange was estimated using extreme atmospheric conditions including clear sky to maximize solar radiation, 120^{o} F air temperature to maximize long-wave atmospheric radiation, and no wind to minimize evaporative cooling. Short-wave radiation was estimated for the month of September, since this is a critical month for stream temperature in the region. While the net energy flux per unit area is independent of both water year (average or critical) and hydrosystem alternative (no-action, baseload, peaking, and preferred), the total heat exchange does vary for water years and alternatives due to changes in the surface area. Energy transfer estimates for Keswick are shown in Table 4.5. These estimates neglect processes of evaporation, conduction, and reflected solar radiation, and changes in surface temperature. Not including these processes results in a higher net energy flux estimate.

Table 4.5. Keswick Reservoir Estimated Energy Input for September 15

Time of Day	**Short-Wave Solar (W/m^2)**	**Long-Wave Atmospheric (W/m^2)**	**Long-Wave Back Radiation (W/m^2)**
12:00 PM	0	278	-352
3:00 AM	0	278	-352
6:00 AM	233	278	-352
9:00 AM	920	307	-352
12:00 AM	1,199	338	-352
3:00 PM	904	368	-352
6:00 PM	209	338	-352
9:00 PM	0	307	-352

The change in the release temperature from a reservoir is proportional to the net energy flux, the surface area, and residence time. It is inversely proportional to the reservoir volume. The residence time is the average time it takes for water to pass through a reservoir. In storage reservoirs, residence times are defined in terms of months or years; however, in regulating reservoirs, the residence times are typically a few days. Lowering pool elevations reduces the surface area and the residence times. Therefore, over the long term, peaking operations with pool elevations often less than the full stable pool conditions associated with baseload operations would generally result in lower release temperatures. However, dynamic effects associated with peaking operations may result in temperatures being higher for short periods. In either case, the magnitude of the differences between temperature changes is very small.

The small magnitude of the impacts of hydrosystem operation on release temperatures is illustrated for the Keswick Reservoir. The magnitude of the Keswick pool fluctuations is greater than the other regulating reservoirs, as shown in Table 4.6, so the impact on temperature here will be the greatest. Using the heat fluxes estimated for extreme atmospheric conditions discussed above, the temperature increase during the resident time is 0.8^{o}F for the baseload case and 0.6^{o}F for the peaking alternative.

Figure 4.2 shows the greatest magnitude of thermal impact based on a thermal analysis of the regulating reservoirs. The calculated impact of different hydrosystem operating policies is less than 0.2^{o}F, which is less than the ability to reliably predict water temperatures in water bodies. For purposes of this analysis, a difference of 0.2^{o}F between alternatives is considered negligible.

Table 4.6. Annual and Hourly Range of Pool Fluctuations in Regulating Reservoirs (ft)

Regulating Reservoir	**Average**						**Adverse**					
	No-Action		**Peaking[a]**		**Baseload**		**No-Action**		**Peaking**		**Baseload**	
	Hr.[b]	**Ann.**	**Hr.**	**Ann.**	**Hr.**	**Ann.**	**Hr.**	**Ann.**	**Hr.**	**Ann.**	**Hr.**	**Ann.**
Lewiston[c]	0.5	3.0	0.6	3.7	0	0	0.5	3.9	0.5	3.9	0	0
Keswick	1.8	11	2.1	11	0	0	2.0	11	2.1	11	0	0
Natoma	0.9	4.5	0.9	4.5	0	0	1.1	4.5	1.2	4.5	0	0
Tulloch	0.5	2.5	0.5	2.5	0	0	0.5	2.5	0.5	2.5	0	0

(a) The preferred and renewables alternatives are very similar to the peaking alternative.

(b) Hr. = hourly, which is the greatest difference found in any two consecutive hours in the year; Ann. = annual, which is the greatest difference over the year between the single most maximum and minimum hours.

(c) Estimates for Lewiston unchanged from the draft 2004 EIS

Figure 4.2. Greatest Magnitude of Simple Thermal Impact Based on

Thermal Analysis of Regulating Reservoirs

The second set of calculations was performed as a related but separate analysis to examine the impact that hydropower operation will have on the Keswick Reservoir. Keswick Reservoir receives water from both Shasta Dam and from the diversion of water from the Trinity River Basin into the Sacramento River via the Clear Creek and Spring

Creek tunnels. Water diverted from the Trinity through the Spring Creek Tunnel joins the Sacramento River in Keswick Reservoir. Water from the two sources comes at different rates and different temperatures. Keswick mixes these inflows into a single stream that is released through the Keswick Powerplant.

These calculations examined the hourly changes in temperature that result from mixing the two inflows. Since the earlier analyses showed negligible changes in temperature due to surface heat flux, in this analysis the impact of heat exchange across the reservoir's surface was not included. To simplify the analysis, it was assumed that the two inflows mix instantly in a tank whose contents varies based on mass balance. Inflow temperatures were set at different values based on monthly temperature calculations performed with the PROSIM analysis. Figure 4.3 shows the temperature for adverse and average water years for the peaking and baseload alternatives, simulated for two weeks in September, which is a critical temperature period. The peaking alternative, while dynamic, shows no variations of greater than 0.4^{o}F from the baseload counterpart even under these extreme assumptions. The difference between the adverse

Figure 4.3. Estimated Benchmark Temperature Fluctuations at Keswick Reservoir

(No-action and preferred alternatives are similar to the peaking alternative.)

and average year reflects the temperature and relative fraction of water coming from the two sources for the different years.

4.3.1.2 Impacts

Since the releases from the regulating reservoirs are independent of hydropower operations, there is no impact to water temperature in the stream due to Sierra Nevada Region's power generation unless changes occur in the regulating reservoirs. In the extreme case scenario for Keswick Reservoir presented above, the maximum temperature difference within Keswick related to the peaking and baseload alternatives is a fraction of 1^{o}F. For the no-action, renewables, and preferred alternatives, the difference would be the same or less. It should be noted that the maximum difference calculated would occur infrequently and for short durations, further minimizing temperature effects.

The effects of the regulating reservoir water releases on downstream temperature are so small that, although they can be calculated, they could not be measured in the river. This finding is true for all of the alternatives. Neither fish, recreation, nor temperature criteria violation frequency will be impacted by temperature fluctuations resulting from Sierra Nevada Region's influence on the operation of the hydropower system.

4.3.2 Pool Fluctuation

Fluctuations in the elevation of regulating reservoir pools may impact the suitability of the reservoir environment for some purposes. However, it should be recognized that the regulating reservoirs were intentionally designed to contain the fluctuating releases from the main reservoirs and attenuate the fluctuations downstream. As such, other uses of the regulating reservoirs are secondary to their fluctuation control function. For many fish species, the aquatic environment of a regulating storage reservoir with fluctuating pool elevations has reduced spawning, rearing, and feeding success relative to a reservoir with a stable pool elevation. Also, recreation is generally less attractive at a fluctuating reservoir than at a stable reservoir due to aesthetic impacts, boating and access difficulties, and possible changes in the abundance of fish. Impacts to fisheries, terrestrial environment, and recreation are addressed in the following Sections 4.4, 4.5, and 4.6.

Fluctuations in large storage project reservoirs tend to be seasonal in nature. Operations are designed to reduce the volume of water stored in the projects in the winter and early spring in

time to provide adequate flood control capacity for the spring runoff, and to maintain sufficient storage in the summer and fall months to release water for downstream use. As described in Sections 3.2 and 3.3, Sierra Nevada Region's hydropower scheduling will not change the operation and fluctuation patterns of the large storage reservoirs. However, changes in hydropower generation from the no-action condition to peaking or baseload alternatives will change the fluctuation patterns in the regulating reservoirs below the main storage projects.

The baseload alternative would maintain the regulating reservoirs at stable pool elevations. The peaking alternative would result in the greatest pool elevation fluctuations, using the entire allowable range of pool elevations in the regulating reservoirs to confine the fluctuating conditions and maintain continuous power generation at the regulating dams. The renewables and preferred alternatives are based on hydropower operations similar to the peaking alternative and result in similar impacts. The following sections describe the approach and results of the analysis to assess the magnitude of pool fluctuations under the three alternatives.

As discussed in Section 3.4.2, the Sierra Nevada Region has assumed for the purposes of this 2004 EIS that Keswick Reservoir can fluctuate up to 11 ft with the removal of contaminated sediment in the Spring Creek arm of Keswick Reservoir. If this problem is not resolved by 2005, the Sierra Nevada Region will schedule powerplant operations within the then current normal operating level that would reduce the potential effects on water temperature and pool fluctuation.

4.3.2.1 Approach

The change in storage in a regulating reservoir can be estimated by a direct mass balance calculation. The change is equal to the inflow less the outflow. When inflow exceeds outflow, the storage in the reservoir increases. When outflow exceeds inflow, storage in the reservoir decreases. This approach can be applied for any period of time. In this analysis, the approach was applied for an hourly time step to emulate reservoir conditions resulting from hydropower generation across the range of alternative operations.

Hourly inflows and outflows were estimated for each alternative from the hourly power generation estimated in the PROSYM analysis based on the relationships between hydropower generation and releases. The analysis also estimated hourly flows for both an average water year and an adverse water year for the no-action, peaking, and baseload alternatives. (The renewables and preferred alternatives are based on hydropower operations similar to the peaking alternative and result in similar CVP operational effects.) Using these inflow and outflow estimates, initial storage contents were estimated to ensure that the maximum capacity of the regulating reservoirs were never exceeded. Once initial contents were defined, an hourly series of contents were developed for both average and adverse water years.

Contents are translated into pool elevations using stage-contents tables developed by Reclamation for each of the regulating reservoirs. Stage-contents curves for each of the regulating reservoirs are shown in Appendix J. Comparison of the changes in pool elevations over time under each of the alternatives for the two water year types provides the contrast between the impacts attributable to the alternatives relative to the no-action condition.

4.3.2.2 Impacts

The impact analysis demonstrated consistent results for all four regulating reservoirs. Details of the Keswick Reservoir analysis are presented as the case with greatest fluctuation. Hourly pool elevation fluctuations at Keswick Reservoir for the month of September in average and adverse years are shown in Figures 4.4 and 4.5. These figures reflect the daily and weekly variations in peaking operations for hydropower compiled from hourly time series data. Main storage reservoirs typically have elevation changes linked with seasonal cycles; whereas, regulating reservoirs have daily and weekly cycles with much smaller elevation changes, regardless of season.

Figures 4.4 and 4.5 show estimated water-level fluctuations in Keswick Reservoir for the no-action, peaking, and baseload alternatives. The baseload alternative results in very little pool fluctuation and is represented by a straight line across the figures. The peaking alternative results in fluctuations very similar to the no-action alternative. Each results in annual pool fluctuations of about 11 ft with no more than 2 ft of fluctuation within any hour (normal daily fluctuation is no more than 8 ft). Water year type demonstrated little effect on results of the analysis. Similar patterns with lesser magnitudes of change are demonstrated in the analysis of the other regulating reservoirs. The pattern and magnitude of fluctuations at the regulating reservoirs resulting from the various alternatives are all within the design parameters of the projects. Continuous, controlled releases through the regulating dams remove fluctuations from the rivers downstream.

4.4 Fisheries

Sierra Nevada Region's proposed alternatives have no effect on the CVP main storage reservoirs, and Sierra Nevada Region's limited discretion in scheduling the CVP hydrosystem confines any potential impacts to fisheries to the regulating reservoirs

(Lewiston, Keswick, Lake Natoma, Tulloch) and rivers downstream of these reservoirs. Because Sierra Nevada Region's proposed alternatives would not alter the quantity or timing of releases below the regulating dams, and since the only probable change to water quality (i.e., temperature) has been shown to be insignificant (Section 4.3.1), no differences in impacts between any of Sierra Nevada Region's alternatives would be found in the rivers downstream from the regulating reservoirs. Resident and anadromous fish species downstream of the regulating reservoirs would not be affected by any of the alternatives.

Within the regulating reservoirs, Sierra Nevada Region's decisions would affect the degree to which the pools fluctuate. The potential beneficial and adverse impacts from fluctuating versus stable pool will vary among fish species and their life stage. Different reservoir operations could result in improved opportunities for some species that compete within the aquatic ecosystem and reduced opportunities for others.

4.4.1 Approach

Resident fish may be sensitive to water-level fluctuations in the regulating reservoirs, primarily with regard to shallow-water habitat where the effects of water-level fluctuations are most evident. The level of impact depends on the magnitude and frequency of the water-level fluctuations. Resident species of fish that spawn in tributaries (e.g., rainbow trout, brown trout) or in open-water areas (e.g., carp) generally are less likely to be affected by fluctuating reservoir levels. Fish that use shallow-water habitat (e.g., smallmouth and largemouth bass,

Figure 4.4. Keswick Pool Elevation for September in an Average Year

Figure 4.5. Keswick Pool Elevation for September in an Adverse Year

crappie, sunfish, catfish and bullhead) for spawning, rearing, or feeding could be affected most by reservoir fluctuations. The populations of fish that are more tolerant of water-level fluctuations could increase in abundance and thus change the species composition within the reservoir.

The potential changes resulting from a constant water level, as described for the baseload alternative, are discussed in Section 4.5. Shallow-water habitats could become more stable year around. Additionally, solar warming of these areas could occur, particularly in the warm months of the year. Stable conditions could promote establishment of a littoral aquatic vegetated zone and improve primary production. Fish species whose life cycles depend on availability and stability of this type of habitat would likely benefit from stabilized pool levels. Fish species using tributary habitats for spawning or rearing could benefit from improved, consistent access to these areas. Open-water habitats and the species using these areas would not be affected, with one possible exception. Holding water elevation at a constant level could stabilize thermal stratification within a given reservoir. Stratification could alter the species composition of a reservoir by enhancing conditions for warmwater species in the upper thermal zone and displacing or reducing abundance of species adapted to colder conditions.

4.4.2 Impacts

The fish species in the four regulating reservoirs include both coldwater and warmwater species. Lewiston, Keswick, and Lake Natoma have populations dominated by coldwater species, while Tulloch also has species adapted to warmwater environments. The fish populations of these reservoirs would be limited by habitat conditions consistent with fluctuating levels for which the regulating reservoirs were designed. Water-level fluctuations in the reservoirs are similar between the no-action and peaking alternatives. The renewables and preferred alternatives are similar to the peaking and no-action alternatives. Therefore, daily water-level fluctuations under the peaking alternative would not likely create changes for resident fish species' composition or abundance in comparison to the no-action alternative. This conclusion is consistent for all four regulating reservoirs.

The baseload alternative would result in stable pool elevations. Stable pool elevations would tend to benefit species that prefer these conditions. Most of the species that could benefit from these conditions are warmwater species. However, the storage reservoirs upstream of Lewiston, Keswick, and Lake Natoma would still be managed for coldwater releases. Thus, any potential benefit would be limited by persistent coldwater conditions. Therefore, changes to fisheries' composition and abundance in these reservoirs under this alternative are not likely when compared to the no-action alternative.

The storage reservoir upstream of Tulloch Reservoir is not normally managed for coldwater releases. Tulloch stratifies into warm and coldwater pools at least part of the year. Pool fluctuations attributable to the no-action alternative are held within 2 ft of seasonal full pool. (In the summer, the water level is allowed to reach 510 ft above sea level. In the winter, water is maintained at about 498 to 501 ft above sea level. The lower winter water levels are not related to Sierra Nevada Region's operations.) Baseload operations would hold reservoir elevation at seasonal full pool. The 2-ft elevation change attributable to the no-action alternative relative to the large reservoir surface area means there should be no discernable change in species' composition or abundance within Tulloch Reservoir under the baseload alternative.

4.5 Terrestrial Environment

This section describes the potential impacts to terrestrial vegetation, wetlands, and wildlife due to changes in the pool fluctuation of the regulating reservoirs. The affected terrestrial environment (see Section 3.6) under the alternatives is limited to the zone of active pool fluctuation surrounding the four regulating reservoirs (Lewiston, Keswick, Lake Natoma, and Tulloch). Sierra Nevada Region's scheduling does not affect water levels in the storage reservoirs. The regulating reservoirs were designed to accept variable levels of water released from the storage reservoirs. In this way, water-level fluctuations are confined to the regulating reservoirs and do not extend to the rivers below them.

4.5.1 Approach

Within the pool fluctuation zone, vegetation is very sparse; however, small areas of riparian vegetation occur along the margins of the four regulating reservoirs. As described in Section 4.3.1, pool elevation fluctuations under the no-action alternative can span the entire design range for fluctuations at each of the regulating reservoirs. In the peaking alternative, the daily range of pool fluctuations would be nearly identical to the no-action alternative. The renewables and preferred alternatives are similar to the peaking alternative. However, maximizing baseload hydropower production, as proposed for the baseload alternative, would result in maintenance of the regulating reservoirs at full pool without daily fluctuations. Two potential impacts of changes in pool fluctuation under the proposed alternatives are hydrologic changes that affect soil moisture for riparian plant species and erosion and sedimentation of shoreline habitats for riparian plant species. These potential impacts would occur in the nearshore and water-fluctuation zones.

4.5.2 Impacts

The hydrologic changes associated with the proposed alternatives would not significantly impact riparian forest, riparian wetlands, or the associated wildlife habitats. Most riparian plants depend largely on saturation near the soil surface rather than groundwater (Smith et al. 1991). Although modification of seasonal or annual patterns of surface soil saturation can adversely affect riparian vegetation types (Stromberg and Patten 1992; Smith et al. 1991), there is no evidence to suggest that minor changes in the daily pool fluctuation would adversely affect riparian plant species. Unlike seasonal or annual changes that result in decreased availability of water in the soil, the proposed daily changes would be brief and would have no lasting effect on the availability of soil moisture. Furthermore, the proposed daily range of pool fluctuation would be similar to the conditions under which the riparian vegetation has developed.

Since the differences in maximum pool elevation between other alternatives and the no-action alternative are small and stay within normal operating levels, the terrestrial environment of the regulating reservoirs would not be adversely affected.

Fluctuating pool conditions disperse the potential for shoreline erosion over a wider area at the reservoir margins. Since conditions that maintain shoreline vegetation do not change under the no-action and peaking alternatives and the potential for shoreline erosion is not increased from existing conditions, no adverse impacts to riparian plant species are anticipated under these alternatives.

Stable pools can have the effect of concentrating the erosive forces of wind and wave action (including boat wakes) to a narrow band of shoreline. The stable pool conditions also allow aquatic vegetation to establish near the shoreline. Stable pool conditions as described for the baseload alternative are not likely to pose an adverse impact to riparian plant species because resulting development of emergent nearshore vegetation would function as a physical buffer against potential erosion.

Neither the baseload alternative nor peaking alternative would change growth and stability of riparian vegetation and habitat at the water's edge relative to the no-action alternative. No potential impacts to terrestrial wildlife and birds are anticipated. Forage opportunities, cover habitat, and predator-prey relations are not expected to change from current conditions.

4.6 Threatened and Endangered Species

This section describes the potential for impacts to threatened and endangered species due to changes in the pool fluctuation of the regulating reservoirs (Lewiston, Keswick, Lake Natoma, Tulloch).

4.6.1 Approach

The approach to assessing impacts to threatened and endangered species is directly related to the approaches described for Sections 4.4.1 and 4.5.1.

4.6.2 Impacts

Sierra Nevada Region's proposed alternatives will not alter the quantity or timing of releases below the regulating dams, and the only anticipated change in the water quality would be a slight change in temperature, which has been shown to be insignificant (see Section 4.3). Therefore, no additional impacts would occur in the rivers or designated critical habitat downstream from the regulating reservoirs as a result of any of the four proposed alternatives. Due to the fact that the dams at the regulating reservoirs are barriers to upstream migration, no endangered or threatened anadromous fish species exist upstream of these dams.

Within the regulating reservoirs, Sierra Nevada Region's proposed peaking alternatives would slightly impact the degree to which the pool fluctuates. However, no Federal or State listed threatened or endangered species are known to occur within these regulating reservoirs. In the vicinity of the regulating reservoirs bald eagles occur near Lewiston, Keswick, and Tulloch reservoirs, and northern spotted owls occur in the forest around Lewiston Reservoir. Also, the valley elderberry beetle occurs near Lake Natoma. However, these species and designated critical habitat are not likely to be affected by limited changes in regulating reservoir water elevations associated with the proposed alternatives compared to the no-action alternative. As described in Section 4.5.2, forage opportunities, cover habitat, and predator prey relations are not expected to change from current conditions. Plants or plant communities would not be impacted by the anticipated water-level fluctuations that will occur under the peaking operations. Pool levels will not fluctuate down for a long enough period to desiccate the wetted area associated with the fluctuation zone.

4.7 Recreation

This section describes the potential for impacts to recreation due to changes in the pool fluctuation of the regulating reservoirs (Lewiston, Keswick, Lake Natoma, Tulloch).

4.7.1 Approach

The approach to assessing impacts from recreation is directly related to the approaches described for Section 4.5.1.

4.7.2 Impacts

Water-level fluctuations are similar for the no-action, peaking, renewables, and preferred alternatives as described in Section 4.3.2. Thus, there would not likely be an increased recreation impact in moving to the peaking or similar alternatives.

Varying elevations in regulating reservoirs associated with the no-action, peaking, renewables, and preferred alternatives could impact recreation. Inattentive boaters may find their boats either stranded temporarily on the beach or drifting away from the shoreline as the pool fluctuates. Sport fishing could also be negatively impacted if pool fluctuations result in an aquatic habitat less suitable for resident sport fish species. Since these regulating reservoirs were designed to accommodate fluctuating pools and the alternatives are operating within the historical limits, there should be no additional impact associated with boat ramp access to regulating reservoirs in comparison to the no-action alternative.

The baseload alternative would result in very little water-level fluctuation. By providing a more stable pool, this alternative would tend to enhance recreation in the regulating reservoirs. The minor level of enhancement is not expected to change visitor usage.

Recreational resources downstream of the regulating reservoirs are not affected by any of the alternatives. Water-level fluctuations are confined to the regulating reservoirs, and the alternatives do not affect temperature fluctuations. Upstream recreational resources also are not affected by Sierra Nevada Region's actions.

4.8 Cultural Resources

4.8.1 Impacts Assessment and the Area of Potential Effects (APE)

For the purposes of cultural resources impact assessment, the analysis is focused on the potential for operations related to each marketing strategy to affect cultural resources in the area along each reservoir's margin (i.e., between the maximum high water mark of each pool and maximum drawdown of each pool). This zone consists of the area currently being affected by power marketing operations and is identical to the APE for the no-action alternative. Impacts could be expected to vary with marketing strategy to the extent that there are substantial operational variations with respect to speed, duration, and frequency of drawdown and fill relative to the no-action alternative.

Historic properties that could be affected by this undertaking could include archaeological and historic sites; historic buildings, structures, and districts; and areas which are of sacred or ceremonial significance to local Native American populations. An analysis of potential effects of the alternatives with respect to potential effects to historic properties and traditional cultural properties is provided below.

4.8.2 Potential Impacts Associated with Project Alternatives

4.8.2.1 No-Action Alternative

The no-action alternative describes the continuing operation and use of the reservoirs. This alternative consists of the current operational mode where the hydropower facilities are operated close to maximum peaking. Within the project APE as defined above, it is almost certain that effects of inundation, water-level fluctuation, wave-induced erosion, and artifact collection have taken place at all of the sites. The no-action alternative maintains a *status quo* condition; thus, no new impacts are introduced by the no-action alternative.

4.8.2.2 Peaking Alternative

The peaking alternative maximizes power generation during peak load periods within operating constraints. Pool size fluctuation is equivalent to that currently occurring under the no-action alternative. Drawdown and fill with a daily peak and trough are essentially identical with that under the no-action alternative, and minimum and maximum water lines would remain unchanged. The APE is the same for this alternative, and anticipated potential effects to cultural resources are the same.

4.8.2.3 Baseload Alternative

The baseload alternative seeks to maintain relatively constant power output within operating constraints. Pool fluctuation is minimized, and a "steady-state" effect occurs with a relatively unchanging pool height. The APE is considered equivalent to that identified in the alternatives described above. Potential effects related to reservoir fluctuation may be reduced under this alternative, but the effects of wave action might be focused on a narrower zone than under the no-action alternative.

4.8.2.4 Renewables Alternative

The renewables alternative seeks to maximize power production during peak power loads by using biomass, wind, solar photovoltaic, and geothermal facilities. No new potential effects are expected to accrue within the APE of the reservoirs with employment of this alternative. There would be the potential for new impacts to significant cultural resources as a result of new ground-disturbing activities that might be associated with development of alternative power sources. The locations and nature of these new land uses are not specified under this alternative. Separate cultural resource evaluations would be conducted for all of these locations once they are identified.

4.8.2.5 Preferred Alternative

Water operations are similar to the peaking alternative and result in similar effects on cultural resources.

4.8.3 Potential Impacts by Project Facility

The analysis for the cultural resources section of this 2004 EIS is based on published and unpublished reports and site records. Of the 96 identified archaeological sites and historic architectural properties surrounding the Lewiston, Keswick, Lake Natoma, and Tulloch reservoirs, only 21 are located within the APE of the alternatives proposed in this study. For this impact analysis, because many of the known sites in the reservoir vicinities are mapped on old and less accurate maps, those sites that appear to fall within 55 yards (50 m) of the mapped shoreline are assumed to fall within the project. Standing historic structures and features such as bridges (and in one case a historic district) that are within these same distances are included in this count; however, there are no project-related impacts that could accrue to these sites under any of the alternatives. Several sites were excluded from consideration because they have already been determined as not eligible to the NRHP and therefore do not qualify as historic properties. The remaining 75 sites identified in Appendix F are outside the APE and are not included in the following discussions. As no Native American consultation was undertaken in conjunction with this 2004 EIS, no traditional cultural properties or other similar resources have been identified; however, resources of this kind may be associated with any or all of the four reservoirs considered in this study.

4.8.3.1 Lewiston Reservoir

One archaeological site (TRI-19) is known to occur within the APE identified for Lewiston Reservoir. The site was recorded in 1952. The site record notes that much of the site had been destroyed by the erosive forces of the Trinity River and also notes that burials were weathering out of the bank above the river. This site may hold significance for Native Americans assuming the site is still extant. It is probable other sites occur within the APE. It is expected these sites could include evidences of both prehistoric and historic occupations (e.g., mining remains such as tailings, ditches, and flumes). There also could be materials associated with use of a historic road and ferry that crossed the Trinity River near Mooney Gulch. It is possible that limiting fluctuations could be beneficial to TRI-19. However, the site was reported as partly destroyed by erosion at the time it was recorded over 40 years ago.

4.8.3.2 Keswick Reservoir

One archaeological site containing a burial was said to be located at the 600-ft contour line along the Keswick Reservoir when it was recorded in 1952. Information on the site location and content has not been updated since it was recorded. This site has not been evaluated for listing in the National Register but may hold significance for Native Americans assuming the site is still extant. It is probable other sites occur within the APE. Based on known information, it is expected these sites could include rock art and bedrock mortars, but it is unlikely given the geographical situation that midden sites would be present. Mining remains such as flumes, ditches, tailings, and other historic debris associated with copper mining and smelting activities at Keswick Reservoir might also be expected.

At Keswick Reservoir, pool heights have been recorded at 586 ft (178.6 m). This is below the recorded elevation of 600 ft (182.9 m) at the one documented archaeological site. The alternatives with pool fluctuations are unlikely to introduce new impacts to this site. The baseload alternative, with its more stable pool, is less likely to impact these cultural resources. No new effects would be anticipated from the renewables alternative.

4.8.3.3 Lake Natoma

There are 21 known cultural resource sites within the APE of Lake Natoma, but only two historic archaeological sites and one historic bridge have been determined to be significant under the NHPA. Two prehistoric archaeological sites, one bridge, and one historic bridge site have been determined not eligible to the NRHP. For all 17 historic properties or potential historic properties that appear to be located within 55 yards (50 m) of the high water shore line of Lake Natoma, early records suggest that at least four have been inundated or destroyed. The presence of at least one site reported to contain historic or protohistoric Native American burials strongly suggests there would be Native American as well as archaeological concerns for this area. Other sites probably occur within the APE. It is expected that additional midden sites possibly containing burials could be present. Historic mining debris, primarily tailings works, cover virtually the entire lakeshore, and additional features which have not been recorded in detail are undoubtedly present. However, because many of these remains consist primarily of river cobbles excavated from the river bed, the potential impacts of rising and falling water are likely to be minor.

The alternatives are not likely to introduce new impacts to these known cultural resources. However, the pool fluctuations associated with the no-action and peaking alternatives may result in indirect impacts if inundated sites are exposed to recreationists. The baseload alternative, with its more stable pool, is less likely to impact these cultural resources. No new effects would be anticipated from the renewables alternative.

4.8.3.4 Tulloch Reservoir

Two historic archaeological sites, TUO-409H (a mining flume) and TUO-429H (mining features and tailings), appear to fall within the APE for Tulloch Reservoir. One prehistoric archaeological site is known to exist very near the proposed project, but it is situated on the downriver side of Tulloch Dam and will not be impacted by the alternatives considered in this study. An isolated prehistoric artifact recorded along the shore does not qualify for listing in the National Register and is therefore not considered in this impact assessment.

Other sites could occur within the APE. It is expected these sites could include prehistoric habitation sites, possibly including sites dating back as much as 9,000 years. Historic materials originating from the gold rush period would also be expected. These could include

tailings and mine works of various kinds, water conveyance systems, and habitation debris relating to the historic settlement around O'Byrne's Ferry.

The alternatives other than baseload propose pool fluctuations within the historic levels of 10 and 12 ft (3 and 3.6 m), respectively. These alternatives are not likely to introduce new impacts to the cultural resources situated around the shoreline, which include two sites located at a distance of 7.7 and 3.3 yards (7 and 3 m), respectively, from the river. The baseload alternative, with its more stable pool, is not likely to impact these cultural resources. No new effects would be anticipated from the renewables alternative.

4.8.4 Summary of Impacts

The alternatives with pool fluctuations are unlikely to result in impacts that have not already occurred through historic operations and use of the facilities. The pool levels proposed are within historic levels; new impacts to the cultural properties located within or near the APE are not expected to occur. The baseload alternative would likely reduce and/or minimize

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1. A separate analysis was conducted to determine the effects of removing this restriction. Results indicated that approximately 200 MW/month of additional annual peaking capacity could be available. To maintain hydropower operations within existing constraints, and because the difference was projected to have little effect on the overall study results, it was decided to model peaking operations with the 50-percent baseload operations at the above-mentioned CVP powerplants. This should not be interpreted to mean that this capacity does not have value.

2. To maximize peaking and the resultant environmental effects, these cases assumed that, where necessary, off-peak Project Use requirements were met by acquiring market energy.

3. (a) Except where necessary to meet Project Use load.

4. (a) A sensitivity test was run without biomass in the resource mix for purposes of analyzing air quality and non-CVP impacts to land use, water quality, and wastes.

5. The August amount is more meaningful because it occurs when loads are high relative to available capacity.

6. The renewables alternative incorporates the same hydropower operations as the peaking alternative and thus results in identical impacts.

impacts to cultural properties to the extent that it resulted in a reduction or moderation in sediment loss and bank erosion. However, offsite impacts associated with ground-disturbing activities at locations and facilities yet to be determined could result in new potential impacts to historic properties.

4.9 Socioeconomic Resources

The Sierra Nevada Region's customers affect their local economies. This interaction within a regional economy is diagramed in Figure 4.6. These customers spend money in the region where they are located in the form of procurements of labor and capital used to deliver electricity to end-users. End-users spend money to acquire the electricity necessary to operate their industrial plants, retail space, or other businesses. Governments spend tax revenue to acquire electricity from the Sierra Nevada Region or other sources, and households spend money for power in their homes. Not all of the money spent in a local economy stays in that

Figure 4.6. Financial Flows Within a Regional Economy

economy. Expenditures occur in other regions for goods and services that are not widely available in the originating region. These leakages that occur outside of a defined region of interest are not counted as part of the economic impact in the region of interest.

4.9.1 Approach

IMPLAN (IMpact analysis for PLANning) is a regional economic modeling system, originally developed by the U.S. Forest Service in cooperation with the Federal Emergency Management Agency. IMPLAN provides a framework for analyzing the economic impacts (changes in employment, output, income, etc.) from any number of economic influence scenarios. Examples include effects of public policy, new plant locations, tourism expenditures, plant closings, or major events.

Detailed economic effects can be measured for the nation, state, or group of states, or any single county or group of counties. Baseline economic data for all counties in the country are constantly updated and maintained by Minnesota IMPLAN Group, Inc. The heart of the IMPLAN system is the benchmark input-output table for the U.S. economy, maintained by the Bureau of Economic Analysis. IMPLAN can adapt that table to any region of the country using import and export information for that region. IMPLAN is an extremely flexible tool that allows locally collected or more recent economic data to override default values and permits a high level of customization of regional economic models.

The IMPLAN interindustry modeling system estimates the indirect and induced effects in the economy caused by the initial influence of the direct effects. This can be accomplished for any region (county, multi-county, state, multi-state) of the country. These "total effects" have been estimated here for regional output, employment, and labor income. Figure 4.7 depicts the economic impact modeling process. In addition, to adequately estimate potential economic impacts for 2005, several adjustments to regional economic models were necessary. Complete discussion of the input-output modeling approach is provided in Anderson et al. (1996). Results are reported in millions of 2005 dollars. Minor changes in the power cost analysis have caused the 2004 EIS economic impact results to vary slightly from those in Anderson et al. (1996)

The production cost analysis was used to estimate 2005 system-wide (northern and central California) power costs to Sierra Nevada Region's agriculture, utility, and other customers based on the provisions of each alternative. This information was adjusted for the economic impact analysis in two ways. First, the cost profile for each alternative was allocated to a specific economic region based on that region's share of capacity in each customer group marketed by Sierra Nevada Region as shown in Table 4.7. Appendix B lists Sierra Nevada

Figure 4.7. Economic Impact Modeling Process Used to Estimate 2005 Impacts

Table 4.7. Allocation of Capacity to Sierra Nevada Region's

Customer Groups and Economic Regions

Region	Agriculture Customers (MW)	Other Customers (MW)	Utility Customers (MW)	Total (MW)	Percent of Total
Kern County	33.0	0.2	0.0	33.2	2.3
Sacramento	2.6	34.1	430.0	466.7	32.2
San Francisco Bay Area	3.5	209.1	415.9	628.5	43.3
Shasta County	0.0	0.0	127.5	127.5	8.8
All Other Regions	39.9	70.3	84.6	194.8	13.4
Total	79	313.7	1,058.0	1,450.7	
Percent of Total	5.5	21.6	72.9		

Region customers by group and economic region. Once the system-wide power cost was allocated to the individual regions and customer groups, the expenditure profile of each customer group was used to allocate the cost effects to individual industries in the economy.

Results from the economic impact analysis of the alternatives include changes in output, employment, and labor income for the economic regions of Kern County, the San Francisco Bay Area, Sacramento, and Shasta County. In addition, these impacts are estimated for the

entire economy of northern and central California. It is important to note that each region is considered independently in the analysis. In actuality, the individual regional economies are linked by trade flows and the labor market. For example, potential employment changes in one region may affect employment in neighboring regions as shifts occur when jobs are created or lost. These interactions are not estimated in this 2004 EIS.

The economic impacts of making changes in power allocation levels were also estimated. As discussed in the presentation of alternatives (Section 4.2.7), allocations were either increased or decreased to simulate the effects of changing the allocations.

Regional economic impacts of making changes to the customer allocations depend on the Sierra Nevada Region capacity marketed to the customer groups residing in the affected region. For example, Shasta County has no customers in the other and agriculture groups. Therefore, changing the allocations to agriculture or other customers only impacts Shasta County through the resulting effects on the utility allocation. In Kern County, there are no utility customers, but more than 40 percent of Sierra Nevada Region's agriculture capacity is marketed there. Changing the utility customer allocations only affects Kern County through the resulting effects in the agriculture allocation. Increasing a particular customer group's allocation of Sierra Nevada Region power generally results in a lower cost of electricity for that customer group.

4.9.2 Power Costs

The results of the various PROSYM production cost cases provided information regarding the variable cost of power supplied to each customer group. To determine the socioeconomic effects of the various alternatives, it was necessary to estimate the total power costs resulting from operating under each case. This required that fixed costs such as debt service, reserve requirements, transmission costs, and other fixed costs associated with each of the alternatives be estimated and added to the operating costs. The estimate for the utility group of customers included costs such as distribution, administrative, and general, and any necessary capacity expansion/purchase costs. In the case of agriculture and other customers, primary and secondary distribution charges were estimated and added to the purchase power costs.

Estimates of all power costs are shown in Appendix K. Figure 4.8 summarizes total power costs for each of the alternatives and allocation cases. Figure 4.9 shows how CVP rates in the disaggregated cases would be similar within the peaking and baseload alternatives because any purchased power a customer needs is billed directly to that customer at the disaggregated purchased power rate.

The overall power cost for the preferred alternative would be the lowest of the alternatives for all customer groups. In the no-action alternative, the Sierra Nevada Region is assumed to deliver 7,731 GWh to its customers. This was priced at a melded rate of $28.1 per MWh based on CVP hydropower costs and market rates. In the preferred alternative, the Sierra Nevada Region is assumed to deliver 3,258 MWh to its customers. The cost of this energy does not include market purchases and is based on the Sierra Nevada Region's cost for CVP hydropower at $20.8 per MWh. The economic dispatch for the preferred alternative minimizes the overall system cost, given the specified customer group allocations.

4.9.3 Environmental Justice Impacts

Across the alternatives and the affected economic regions, economic impacts are minimal. The impacts are not disproportional across income or race groupings of the population because Sierra Nevada Region's power product prices are the same to all Sierra Nevada Region customers. In the case of agriculture customers, low-income and minority groups make up a larger proportion of the employment in that sector. Potential power cost impacts, which may result from Sierra Nevada Region's Power Marketing Program alternatives, could affect agricultural gross revenues but were found to be too small to affect production levels. Thus, employment levels are not affected, and the results do not disproportionally effect low-income or minority groups.

4.9.4 Regional Economic Impacts

The economy of northern and central California and the individual regional economies considered are large and relatively stable. Although the potential effects of Sierra Nevada Region's actions are quantifiable in terms of output, employment, and income, the economic impacts of Sierra Nevada Region's alternatives are not significant when viewed in the context of the larger economies where they could occur. In all cases, potential economic effects are a

small fraction of 1 percent of any of the economies presented in terms of output, employment, or income. The economic effects of the preferred alternative and all other alternatives are not significant; however, some indication of their positive or negative direction is possible.

Figure 4.8. Aggregated Power Costs for Alternatives and Allocation Cases

Figure 4.9. Example of Disaggregated Cases (aggregated renewables cases included for comparison)

The results of the economic impact analysis are driven by the effects of system power costs faced by each Sierra Nevada Region customer group under each alternative. The degree of economic effects caused by the actions of any one customer group depends on how strong the customer group's economic linkages are with the rest of the regional economy. The utility customer group is very tightly linked with most of the manufacturing industries and other industries that purchase electricity from Sierra Nevada Region utility customers. This means that actions that affect the utility customer group are very likely to be passed on to many sectors of the economy. On the other hand, the Federal, State, and local agencies that make up the other customer group are not goods-producing industries and are not strongly linked economically to the manufacturing industries of the region. Alternatives that affect this group directly are not felt in the regional economy to the same degree as effects on the utility group. The agriculture customer group falls in the middle of this comparison. The agriculture industry is a supplier industry to the food processing industry. It is more strongly linked to the other industries of the regional economy than the other customer group but less so than the utility customer group. In the overall effects of the alternatives, the effects of the utility customer group dominate the total economic impact in any given region studied.

The peaking alternative calls for maximizing the use of CVP hydropower resources during the times of highest system energy demand and supplementing the hydropower with varying levels of economy energy purchases. Average system power costs generally decrease under this alternative resulting in positive, although insignificant, socioeconomic effects. In the case where no purchases are made, power costs decrease substantially for the other and agriculture customer groups but increase slightly for the utility customer group. This cost increase along with the utility customer group's strong economic linkages results in slightly negative, although insignificant, socioeconomic effects for this case.

The alternative that maximizes CVP hydropower as a baseload resource results in slightly negative, yet insignificant, economic effects. System power costs increase under this alternative because relatively inexpensive Sierra Nevada Region hydropower resources currently are operated in a near-peaking mode, providing low-cost power at the highest demand times of the day. Changing to baseload operations would require higher-cost power resources to be used in the peaking mode. Any other alternatives considered are estimated to have neutral economic impacts across the regions considered.

The effects of moving from an average power cost of 5 cents per kWh to 6 cents per kWh under the baseload alternative for agriculture customers decreases average farm profits by up to 1.8 percent. All crops continue to be profitable to produce under a potential 1-cent increase in power costs, and the alternatives do not result in impacts on output, employment, or labor income, as further described in Section 4.9.4.1.

The effects of emphasizing the use of renewable resources (assuming technological improvements) in the generation mix have a negative economic impact compared to the same quantity of thermal purchases because the greater costs of the renewables increase the overall aggregated CVP costs to customers.

The preferred alternative results in positive economic impacts because system power costs decrease to all customer groups compared to the no-action alternative. These lower power costs result in positive economic impacts in all regions studied. The impacts are not significant when viewed in the context of the larger economies where they occur.

Generally positive, but insignificant, economic impacts result from increasing the Sierra Nevada Region power allocation to the utility customer group or reducing the allocation to the other customer group. Under these allocation alternatives, the utility customer group would get a greater share of Sierra Nevada Region power, which brings the cost of power down and benefits the economy.

Generally negative, but insignificant, economic impacts result from reducing the Sierra Nevada Region power allocation to the utility customer group. In this case, the utility customer group loses some access to Sierra Nevada Region hydropower and is forced to make up the difference using higher-cost power resources.

Figures 4.10 through 4.12 illustrate the effects of the respective alternatives on northern and central California's output, employment, and labor income compared to the no-action alternative. Figure 4.13 shows an example of how disaggregated cases would affect the socioeconomic outcomes based on the no purchase options within the peaking, baseload, and preferred alternatives.

All of these results reflect averaging across regions and customer groups and do not capture the effects on individual customers. Effects on individual Sierra Nevada Region customers who lose or gain allocations may be substantial to a particular customer but cannot be determined because specific allocations have not been made. Specific allocations will be made in a separate process under the APA.

The other regions show similar impact patterns. Figures for the other regions (similar to Figures 4.10, 4.11, and 4.12) are shown in Appendix L. In all regions, the economic impacts of the alternatives are not significant.

Figure 4.10. 2005 Impacts on Industrial Output by Alternative in the

Northern and Central California Economic Region

Figure 4.11. 2005 Employment Impacts by Alternative in the Northern and

Central California Economic Region

Figure 4.12. 2005 Regional Labor Income Impacts by Alternative in the

Northern and Central California Economic Region

Figure 4.13. Example of How Disaggregated Cases Would Affect Socioeconomic Outcomes

4.9.4.1 Kern County Region

In regions with a greater proportion of agriculture customers such as Kern County, the agriculture allocation is the most critical in terms of economic impacts. Agricultural irrigators are an important component in the analysis of potential economic impacts of changes in Sierra Nevada Region power costs posed by the 2004 EIS alternatives. The Kern County Region was selected to represent Sierra Nevada Region's agriculture customers in general, based on the share of Sierra Nevada Region agriculture capacity marketed there. Kern County and the Bakersfield metropolitan area were selected as an affected economic region because nearly one-third of Sierra Nevada Region's agriculture capacity is marketed to customers primarily to serve pumping load. The analysis focused on estimating the economic effects that changes in electric costs have on the cost of water used for irrigation. Thus, the analysis used in this section focuses on changes in agricultural production, and the impacts are presented in a different format.

This section discusses the potential impacts of power cost changes on irrigation costs and how these potential impacts affect the levels of crop production, land use, and profits. The sensitivity of these variables to changes in overall power costs are described on the basis of a linear programming (LP) model of irrigated farming in Kern County (Ulibarri et al. 1996). The model captures the potential impact of changes in overall power costs on the profitable use of land and water resources in crop production under various irrigation systems. Several key assumptions of the LP model are described below.

The LP model assumes Kern County farmers are impacted by overall power costs through the water price charged by their irrigation districts. In this way, the model relates the energy costs incurred by local irrigation districts to the costs of surface water supplied to farmers. Crop irrigation on the farm is then related to a variety of irrigation methods and the use of both surface water and groundwater resources. Based on these constructs, the model provides an understanding of the sensitivity of farm profits, crop production, and land use to changes in overall power costs, assuming farmers are profit-maximizers in general and operate in a competitive market environment.

Potential power costs confronting irrigation district customers in the Kern County portion of the Sierra Nevada Region range between 5 and 6 cents per kWh under the various 2004 EIS alternatives. In the draft 2004 EIS, these ranged from 5 to 10 cents per kWh; however, the assumptions implied by a restructured retail electricity market in California and a downward revision in the gas price forecast resulted in 2005 costs ranging between 5 and 6 cents per kWh. Therefore, a conservative sensitivity analysis considers the impact of paying between 5 and 10 cents per kWh. This power cost increment brackets all foreseeable power costs confronting irrigation district customers in the Kern County portion of the Sierra Nevada Region.

The impacts of the power cost escalations are calculated using two distinct water constraints: a maximum global water supply constraint that covers 11 crops and various minimum water use constraints covering selected field and vegetable crops (see Table 4.8). The maximum water supply constraint was set at 2.2 MAF: an approximation of average year growing conditions in the region of interest. Meanwhile, adverse-year growing conditions were recognized in the scenarios by imposing minimum water use constraints involving the production of selected field and vegetable crops observed during the 1991 and 1992 growing season; the most recent and severe drought years on record. Specifically, the scenarios assume that harvested levels of production of wheat, barley, alfalfa, cotton, sugar beets, and carrots would at least equal the levels observed in the 1991-1992 growing season.

The aforementioned water supply and crop production conditions are used in the analysis of power cost changes ranging from 5 cents per kWh up to 10 cents per kWh in 1-cent increments. As previously noted, this range brackets the potential power costs confronting irrigation district customers (i.e., 5 to 6 cents per kWh). Nevertheless, the impact of these potential cost escalations was estimated over the 5- to 10-cent range on the basis of 1-cent increments to provide a more conservative perspective of the potential impacts under the various 2004 EIS alternatives. A summary of these power cost impacts on crop profits in Kern County is reported in Table 4.8.

The analysis found no impacts on land use, crop production, and gross farm revenue. As noted above, the scenarios assume that harvested levels of production of wheat, barley, alfalfa, cotton, sugar beets, and carrots would at least equal the levels observed in the 1991-1992 growing season. Consequently, neither the land use nor the production levels deviate (in real terms) from their 1993 values as a result of the potential change in overall power costs. In a hypothetical case where rates to the agriculture group increase from 5 cents to 6 cents per kWh, farm profits are estimated to decrease 1.8 percent. None of the alternatives resulted in an impact this large.

Sierra Nevada Region's alternatives are not likely to result in direct changes in regional output, employment, or labor income. Although profits are impacted, the crops continue to be profitable to produce under the alternative economic structure. Farmers may seek to regain lost profits over time by taking steps to offset any potential change in power costs. Such offsets might include more efficient water delivery systems or mechanization that cuts labor costs. These potential responses were not accounted for in the economic analysis. The analysis also

Table 4.8. Impacts on Kern County Farm Profits by Crop Under Overall Power Costs(millions of 2005 dollars)

Crop	5/kWh	6/kWh	7/kWh	8/kWh	9/kWh	10/kWh
Citrus	79.26	78.88 -0.5%	78.52 -0.9%	7 8.15 -1.4%	77.70 -1.9%	77.41 -2.3%
Grapes	144.69	143.60 -0.8%	142.50 -1.5%	141.39 -2.3%	140.30 -3.0%	139.20 -3.8%
Cotton	91.17	87.61	84.05	80.48	76.94	73.37

		-3.9%	-7.8%	-11.7%	-15.6%	-19.5%
Alfalfa Hay	4.49	4.16 -7.4%	3.84 -14.4%	3.53 -21.5%	3.21 -28.5%	2.88 -35.9%
Wheat	-0.95	-1.04 -9.1%	-1.11 -16.7%	-1.20 -25.8%	-1.27 -33.3%	-1.35 -42.4%
Barley	-2.07	-2.13 -2.8%	-2.17 -4.9%	-2.23 -7.6%	-2.29 -10.4%	-2.33 -12.5%
Tomatoes	4.15	4.08 -1.7%	4.00 -3.5%	3.93 -5.2%	3.84 -7.3%	3.77 -9.0%
Sugar Beets	1.90	1.79 -6.1%	1.66 -12.9%	1.54 -18.9%	1.41 -25.8%	1.30 -31.8%
Almonds	46.83	45.33 -3.2%	43.86 -6.3%	42.38 -9.5%	40.90 -12.7%	39.41 -15.8%
Carrots	6.96	6.32 -9.1%	5.69 -18.2%	5.05 -27.3%	4.42 -36.4%	3.79 -45.5%
Pistachios	83.78	83.38 -0.5%	82.97 -1.0%	82.56 1.5%	82.18 -1.9%	81.73 -2.4%
Total Change	**460.20**	**451.97 -1.8%**	**443.82 -3.6%**	**435.59 -5.3%**	**427.44 -7.1%**	**419.18 -8.9%**

does not consider the effects of farm subsidy payments received by the farm sector to support the production of unprofitable crops.

4.10 Air Resources

Decisions made by the Sierra Nevada Region on how and when to supply power to its customers could influence the operation of other power suppliers within the WSCC. If the resources affected are thermal resources, this could in turn affect the amount, timing, and location of pollutant emissions to the air.

Operations of some thermal resources could be affected by Sierra Nevada Region's decisions on when to use its hydroelectric resources. In the no-action alternative, the majority of the hydroelectric resource is used to meet power demands during on-peak periods with a smaller portion used to help meet off-peak power demands. A departure from the no-action alternative would change the way hydroelectric resources are operated and could result in changing the operation of other power resources.

Pollutant emissions are also affected by Sierra Nevada Region's choices to acquire power from renewable resources to meld with low-cost hydroelectric power. The policy-driven decision to buy power from renewable resources, even if these resources are not the most cost-effective choice for the Sierra Nevada Region or its customers, may change the operation of thermal resources.

Because the Sierra Nevada Region and its customers are interconnected with the much larger WSCC, it is difficult to estimate how any decision by the Sierra Nevada Region will directly affect the operation of individual powerplants not controlled by the Sierra Nevada Region. If the Sierra Nevada Region changes its operation of hydropower resources, the resulting change in power supply will result in a change of power generation within the WSCC so as to continually meet power demand. Any change in power generation within the WSCC may involve small changes in a number of operating powerplants. These powerplants may be in the Sierra Nevada Region or they may be scattered throughout the area covered by the WSCC.

Additional information on air resource impacts is included in Appendix M.

4.10.1 Approach

Emission factors are used in conjunction with the PROSYM estimates of electricity generation to calculate annual and hourly quantities of air pollutants. Pounds of pollutant per unit of

generation, as represented in the emission factor, are multiplied by the quantity of generation from PROSYM.

To estimate air resource impacts, the focus is on the change in emissions of air pollutants that would result throughout the WSCC based on Sierra Nevada Region's marketing decisions. PROSYM provides output that characterizes the operation of individual classes of powerplants, as well as market sources that have power provided by a number of different resource types. Nearly one third of the energy required by Sierra Nevada Region's customers in PROSYM model simulations is obtained from market resources. These sources represent contracts with other regions, inter-area power and energy exchanges, and economy energy purchases. When characterizing market resources, it was determined which resource would be the incremental resource that would be adjusted as a result of Sierra Nevada Region's decision. These incremental resources are assumed to be subject to changes in operation based on load variations and market forces and are described in Section 3.10.

Renewable sources of energy represented in PROSYM may be obtained from wind, solar photovoltaic, geothermal, and biomass resources. Wind and solar photovoltaic resources are assumed to have no emissions of air pollutants. Geothermal resources emit hydrogen sulfide but are not sources of other criteria air pollutants. Criteria air pollutants are described in Appendix H. Biomass resources produce power using waste products that would normally be disposed of in landfills, incinerators, or left to decay in agricultural fields. For purposes of estimating air pollutant emissions, half of biomass power generation is assumed to come from the combustion of municipal solid waste and half from the combustion of agricultural wastes.

The emission factors used in this study were based on a number of sources. These included the EPAMP EIS (Western 1995a), a listing of emission factors for powerplants which supply electricity to California (Loyer 1994), EPA's compilation of emission factors for stationary sources (EPA 1995), and the BPA Resource Program EIS (Glantz et al. 1992). Emission factors used in this study are presented in Table 4.9.

Estimates are presented for three categories of power generation resource: natural gas-fired CTs, natural gas-fired CCCT, and a biomass resource that involves the combustion of equal amounts municipal solid waste and agricultural waste.

Emission factors for the biomass plants are the hardest to estimate for 2005. Biomass plants traditionally have high pollutant emission rates (municipal and agricultural wastes are not clean fuels). Results presented here are based on recent observations from existing biomass facilities. In 2005, it is assumed that existing and any new biomass facilities will have similar emissions characteristics. By 2005, air quality regulations might require the addition of new

Table 4.9. Powerplant Emissions Factors

Emissions	CT(lb/GWh)	CCCT(lb/GWh)	Biomass(lb/GWh)
NO_x	1,000	500	5,000
SO_2	10	10	1,000
CO	400	200	4,000
PM_{10}	50	50	1,000
VOC	40	40	1,000
CO_2 (tons/GWh)	500	450	1,500

emission control technologies that would significantly reduce emissions from biomass facilities; however, biomass facilities are expensive to operate at the current level of emission control requirements, and additional emissions controls would further increase the cost of power from these facilities. To keep biomass power from becoming prohibitively expensive, it is assumed that the current level of emission controls and projected 1995 emission factors for the study period remain unchanged.

Because of the uncertainty in estimating emissions from biomass-fueled powerplants and, as seen later in this section, the magnitude of the impacts resulting from these fuels, a special sensitivity case was created for the air quality and non-CVP impact analyses. This excludes biomass from the mix of renewable resources included in the renewables alternative. The renewables alternative without biomass includes wind, solar photovoltaic, and geothermal.

4.10.2 Air Quality Impacts

Air resource impacts are assessed by quantitatively estimating the difference in pollutant emissions between the alternatives. This is done for annual average emissions and for emissions as a function of month and time of day. Impacts are assessed for the following pollutants: NO_x, SO_2, PM_{10}, CO, and VOCs. In addition, annual emissions of CO_2 are also assessed. NO_x is a key pollutant because it is important in the formation of O_3. As discussed in Section 3.4, O_3 pollution represents a significant problem throughout California, especially the greater Sacramento area.

The differences in pollutant emissions between alternatives is relatively small when compared to the overall magnitude of regional pollutant emissions. In northern and central California, the emission of criteria pollutants from power generation is small compared to emissions from transportation and industrial sources. Differences between alternatives also tend to be a small percentage of the average level of emissions associated with each of the alternatives.

Differences in emissions between an average water year and an adverse water year, independent of the alternative being considered, are much greater than the differences between alternatives for any given year. Adverse years have significant reductions in hydroelectric capacity, and thermal resources are operated at greater capacities than in average water years. Differences between alternatives are generally the same in average and adverse water years, the base level of emissions common to all alternatives is simply much greater in adverse years.

The difference in air pollutant emissions between average and adverse water years for the no-action alternative is given in Figure 4.14, in which the zero-line represents emissions in the average year. This difference is greater than that found between the alternatives as illustrated by Figures 4.14 and 4.15.

In any given year, the no-action and preferred alternatives produce approximately the same quantity of annual pollutant emissions. The peaking alternative is slightly cleaner, as more hydroelectric resources are used to displace CT resources during on-peak periods and CCCTs replace hydroelectric resources during off-peak periods. The peaking alternative produces a net annual decrease in NO_x emissions that is about equivalent to the output of 15 MW of CT operating at a 15-percent capacity factor. The renewables without biomass power is the cleanest alternative. This alternative produces a net annual decrease in NO_x emissions from no-action levels that is about equivalent to operation of a 120-MW CT at a 15-percent capacity factor.

Emissions for the baseload alternative are greater than for the no-action alternative. The baseload alternative produces a net increase in No_x emissions over no-action levels that is about equivalent to the operation of a 50-MW CT with a 15-percent capacity factor. Emissions for the renewables alternative with biomass are greater than for any other alternative. This alternative produces a net increase in NO_x emissions over no-action levels that is about equivalent to the operation of a 230-MW CT with a 15-percent capacity factor.

An assessment of the difference between alternatives in the annual emissions of NO_x, SO_2, CO, PM_{10}, and VOCs is given in Figure 4.15. Emissions are shown in comparison to the zero line, which represents the emissions under the no-action alternative.

Figure 4.14. Increase in the No-Action Alternative Air Pollutant Emissions for an

Adverse Water Year Compared to an Average Year

Figure 4.15. Change in Pollutant Emissions from No-Action Alternative

Levels for an Average Water Year

Modeling results do not predict which powerplants within the WSCC will experience a change in operation as a result of departures from the no-action alternative. An emphasis on using hydroelectric resources to provide peaking power might reduce the operation of (and therefore emissions from) peaking thermal resources in areas of northern and central California with poor air quality. In addition, the increased operation of baseload resources could occur in areas with better air quality. As well as slightly reducing net emissions, the use of hydroelectric resources to provide more peaking power might also further decrease the Sierra Nevada Region area emissions by shifting some thermal resource operation to other regions. This is because peaking powerplants tend to be located closer to their loads.

In contrast, an emphasis on using hydroelectric resources to provide baseload power might increase the operation of (and therefore emissions from) local peaking resources. Although annual emissions for the baseload alternative might not be greater than for the no-action alternative, emissions may be shifted to northern and central California.

Renewable resources provide both baseload and peaking sources of power; the introduction of new renewable power sources could impact thermal powerplant operation both within and outside northern and central California. Biomass powerplants would have significant impacts on local air quality in the vicinity of these plants. It is not clear if a commitment by the Sierra Nevada Region to purchase 12.5 MW of power from new biomass power sources would result in new biomass resource being constructed.

While a significant regional impact is not foreseen to result from the adoption of any alternative, significant local air quality impacts can occur around new facilities (e.g., a new biomass-fired powerplant) or changes in the operation of existing facilities.

Differences between alternatives are not fully characterized by annual emissions; differences in pollutant emissions vary as a function of season and time of day. The peaking and renewables alternatives have less diurnal variation in emissions than do the baseload and no-action alternatives. This can be an important consideration for areas that have problems meeting air quality standards during summer afternoons when industrial, utility, and transportation emissions are at their peak. During summer afternoons, the difference in NO_x emissions between the baseload and peaking alternatives can reach 440 lb/h, which is equivalent to the operation of 440 MW of CT powerplants. During periods of poor air quality, any increase in the level of local emissions would make it more difficult for an area to meet air quality standards.

Figure 4.16 presents the hourly difference in NO_x emissions during July for each alternative. The zero line in the figure represents the no-action alternative's average daily July emission rate of NO_x. A point above zero indicates that for the given hour the alternative being considered has emissions greater than the no-action alternative's average emission for the day. In this way, the plot for the no-action alternative should have exactly as much area above the zero line as below. Other alternatives may have total daily emissions that may be greater or less than for the no-action alternative.

Although changes in air quality are expected to be exceedingly small for any given air basin as a result of Sierra Nevada Region's selection of a power marketing alternative, a number of small improvements in emissions from the utility, industrial, and transportation segments of the areas can have an additive and detectable positive effect. From an air quality standpoint, the peaking, preferred, and renewables without biomass alternatives are the most favorable. Additional information on annual and hourly effects is provided in Appendix M.

4.11 Water Consumption Associated with Non-CVP Powerplants

The primary impact of water consumption is wastewater production. This section describes estimates of wastewater production for each of the four alternatives. The impacts may occur at any of a number of powerplants if power purchases are made to offset changes in CVP operations or if renewable resources are developed. Total wastewater production is used as a

Figure 4.16. Hourly Difference in No_x Emissions During July for Each Alternative

composite measure of specific pollutants that make up the wastewater. For example, powerplants that produce large quantities of wastewater will require extensive sources of water for operations. This analysis does not identify specific pollutants that may be present in wastewater or treatment techniques that may be used to remove the pollutants. Pollutants and treatments are dependent on specific powerplant technologies, fuels, and locations. The estimates presented in this section do indicate which alternatives are more likely to contribute to water quality issues, such as those presented in Section 3.13.

4.11.1 Approach

The analytic approach uses estimates of annual electric generation from the PROSYM model. The PROSYM results are multiplied by an impact factor to arrive at an estimate of wastewater produced under each of the alternatives. The development of the impact factors is described in Appendix N. The impact factors used in the analysis are shown in Table 4.10.

Table 4.10. Impact Factors for Use in Wastewater Analysis

Impact Factors (gal/MWh)							
Pulv. Coal	Simple Cycle CT	CCCT	Geo-thermal	Solar Photovoltaic	Wind	Biomass: Agriculture Residue	Biomass: Municipal Solid Waste
65	6	66	2	0	0	650	650

4.11.2 Impacts

In comparison with the no-action alternative, all of the other alternatives would result in beneficial effects on wastewater production. In the renewables alternative, a portion of the generation comes from renewables resources rather than natural gas-fired CTs and CCCTs used in the other alternatives. In addition to the typical thermal resources, the renewables alternative without biomass excludes agricultural residue and municipal solid waste. Renewables without biomass would result in the greatest benefit. Renewables with biomass would produce the least benefit but would still result in a reduction in wastewater production in comparison to the no-action alternative. As can be seen in Table 4.10, biomass technologies use roughly 10 times as much water as either coal or CCCT generators. Estimates for wastewater production are shown in Figure 4.17.

Figure 4.17. Differences in Estimated Wastewater Production Among

Alternatives in Comparison with the No-Action Alternative

4.12 Waste Production Associated with Non-CVP Powerplants

This section describes predicted solid waste production in the form of ash, under the four alternatives. Ash wastes are indicative of the level of all wastes that would be produced under each of the alternatives. The impacts may occur at any of a number of powerplants if power purchases are made to affect changes in CVP operations or if renewable technologies are developed.

4.12.1 Approach

The analytic approach is described in the wastewater section of this report. The impact factors used in the analysis are shown in Table 4.11. The development of the impact factors is described in Appendix N. Specific powerplant technologies and fuels produce wastes that will likely vary from the impact factors described in the approach discussion because the factors are based on averages and calculations across many powerplants rather than a specific powerplant. Specific conditions at a particular powerplant will also determine the quantity of hazardous wastes produced. Combustion ash is the solid waste included in this analysis.

Table 4.11. Impact Factors for Ash Production

Impact Factors (lb/MWh)							
Pulv. Coal	Simple Cycle CT	CCCT	Sulfur Geothermal	Solar Photovoltaic	Wind	Biomass: Agriculture Residue	Biomass: Municipal Solid Waste
30	0	0	0	0	0	636	618

4.12.2 Solid Waste Impacts

Solid wastes generated under the peaking alternative, the baseload alternative, and the renewables alternative without biomass show no substantial difference from the no-action alternative. Estimates of waste production are shown in Figure 4.18. As with wastewater, the major differences between the various alternatives occurs with variation of the renewables alternative without biomass. In the other alternatives, the wastes produced result from coal plants operated as baseload resources, which would not change operation in response to the alternatives.

Solid wastes generated under the renewables with biomass alternative would be about twice the no-action alternative. These larger differences between the renewables with biomass and no-action alternatives are due to the presence of biomass, which produces about 20 times more solid waste than coal. However, this comparison is reversed when the positive effect of diverting solid waste from landfills is considered. For every pound of ash entering landfills from biomass generators, 5 lb of municipal solid waste has not entered a landfill (Andrews 1991). The net impact of the renewables alternative with biomass is a reduction in the annual waste stream of about 40,000 tons. To the extent that agricultural wastes are burned in a controlled powerplant rather than burned in the field, air emissions would be reduced.

4.13 Land Use Associated with Non-CVP Powerplants

This section describes predicted land-use impacts for the five alternatives. A land-use impact is a one-time, long-lasting impact that results from the siting of powerplants. This analysis looks only at land requirements and acres needed to build new powerplants. Impacts to land-use patterns, such as displaced uses and traffic flows, are dependent on specific locations and conditions. The Sierra Nevada Region is not planning to develop new powerplants, but its customers or others may in response to its marketing decisions.

Figure 4.18. Estimates of Solid Waste Production

4.13.1 Approach

The analytic approach uses estimates of load-carrying capacity additions from the PROSYM model (see Section 4.2.7). The model forecasts that the maximum difference in CVP load-carrying capacity under adverse year conditions between the no-action alternative and baseload scenario is a 581-MW reduction. This indicates that by switching from the present mode of operating to a mode in which the CVP is operated as a baseload resource results in a need for additional capacity to be added to the system to accommodate the reduction in CVP capacity. The timing of the increase will depend primarily on the rate of load growth. During the summer season when loads are highest, the maximum annual difference between the peaking and no-action alternatives is 317 MW and between the baseload and no-action alternatives is 581 MW for a total of 898 MW of load-carrying capacity.

The PROSYM results are, as with wastewater and solid waste, multiplied by an impact factor to arrive at an estimate of land-use impacts under each of the alternatives. However, unlike solid wastes and wastewater, the impacts are tied to capacity, rather than generation. The impact factors used in the analysis are shown in Table 4.12. The development of the impact factors is described in Appendix N.

Table 4.12. Impact Factors for Land-Use Analysis

Impact Factors (acres/MW)							
Pulv. Coal	Simple Cycle CT	CCCT	Geothermal	Solar Photovoltaic	Wind	Biomass: Agriculture Residue	Biomass: Municipal Solid Waste
1.41	.16	.16	1.8	3	5.9	.16	.16

4.13.2 Land-Use Impacts

Under the peaking alternative, the Sierra Nevada Region's August load-carrying capacity is 317 MW greater than it is under the no-action alternative. This increase in capacity could potentially offset the need for future powerplants, ultimately resulting in a slight reduction in the amount of land needed for electric generation. On an annual basis, the monthly load-carrying capacity under the preferred alternative ranges from an increase of 262 MW to a decrease of 30 MW. Because this decrease occurs in April, it is unlikely that new capacity would have to be built for this decrease due to availability of other capacity in the region at this time of year and low demand for electric power. Indeed, the 262 MW increase occurs in August, a peak load month, and could defer the need for future capacity construction. As the need for capacity increases, the need for land to build that capacity also increases, as shown in Table 4.12.

Land-use increases under the baseload alternative because the Sierra Nevada Region's load-carrying capacity is reduced by 581 MW. The impact from the baseload alternative is roughly the area required for a single CCCT plant.

The renewables alternative results in large increases in land use (see Figure 4.19). Geothermal, solar photovoltaic, and wind facilities have larger land-use requirements than any of the other generating technologies. Wind facilities use land at between 3.5 and 30 times the rate of nonrenewable technologies (Table 4.12). Based on PROSYM results, approximately 25 MW of CT and CCCT capacity is avoided.

The renewables alternative without biomass has greater land-use impacts than the renewables with biomass alternative. Since biomass plants have fewer conventional land-use requirements than the other renewable technologies, land-use impacts are reduced when biomass is included in the renewables alternative (Table 4.12). The analysis does not account for offsets in solid waste landfills resulting from the diversion of wastes from disposal to combustion.

Figure 4.19. Land-Use Impacts Relative to the No-Action Alternative

4.14 Irreversible and Irretrievable Commitments of Resources

The manner in which hydropower generating plants are operated is one of the fundamental differences across the alternatives. The PROSYM analyses show that, when operated to provide electricity at peak times (the peaking alternative), the hydropower system can offset up to 898 MW of electric generating capacity from other sources when compared to baseload operations (see Section 4.13.1). Conversely, if the baseload alternative is chosen, up to 898 MW of replacement electric generating capacity (the difference between peaking and baseload) will eventually need to be built to meet peak load requirements. The increase in replacement capacity needed from the difference between the baseload and no-action alternatives, which is similar to peaking, is 581 MW of load-carrying capacity.

In comparison with the no-action alternative, the preferred alternative results in a range of a gain of 262 MW to a loss of 30 MW. However, the loss comes in the spring when demand for electric power is low and other sources are available. Thus, the loss would likely not need to be made up. Building new capacity results in land-use impacts and use of the natural and financial resources needed to build the powerplant and connect it with the interconnected transmission grid.

The CVP hydropower system does not require additional facilities or modifications to change from baseload to peaking operations or vice versa. Thus, the lost load-carrying capacity from baseload operations would be retrievable for CVP operations if a decision to subsequently implement peaking operations was made. However, if the baseload alternative is implemented and replacement capacity is built, the replacement capacity is expected to remain in place. If this occurs, a potential shift from baseload back to peaking CVP operations would likely result in temporary surplus capacity in the region.

The renewables alternative results in land-use impacts. Renewables, such as solar photovoltaic and wind, may require up to about 30 times the land area per MW of capacity of the thermal resources such as CTs.

Changes in hourly powerplant operations outside the CVP could result from responses to the alternatives. These changes included shifts in the operation of CTs and CCCTs. These plant types are both likely to be fueled with natural gas. Thus, the alternatives will not result in a shift in fuel type. To the extent that CCCTs are more efficient than CTs, total fuel consumption may change slightly.

4.15 Unavoidable Adverse Impacts

Each of the alternatives results in unavoidable adverse impacts as described in the preceding sections of Chapter 4. The impact analyses found no impacts that the Sierra Nevada Region could mitigate. Air quality impact analyses are based on the assumption that air pollution control is at least as effective in the year 2005 as with today's technology. The analyses of water resources and related impacts on the CVP assume that the regulating reservoirs will be in place to control flows downstream of the main reservoirs.

The only potential major impact related to the Sierra Nevada Region's 2004 Plan would result from selection of the baseload alternative. Baseloading the CVP hydrogeneration facilities would cause a loss in load-carrying capacity. Any marketing plan that does not optimally use CVP hydrogeneration to match load shape (i.e., to provide peaking capacity) would result in less-than-optimal economic benefits and could result in economic impacts in the form of slightly reduced employment.

4.16 Relationship Between Short-Term Uses and Long-Term Productivity

The potential impacts of the alternatives are discussed earlier in this chapter. The alternatives do not result in impacts that would require a major amount of land to be taken out of production, or a loss of long-term productivity in the river systems, or similar impacts that would normally be described in this section of an EIS. Instead, the effects are more indirect and are primarily secondary effects related to responses of electric power end-users to changes in retail rates. Customers could elect to build new electric capacity in response to Sierra Nevada Region's 2004 Plan, especially if the baseload alternative were selected. Local long-term productivity could be adversely impacted if new capacity was constructed, but on a regional scale the impacts would be negligible. It also should be noted that the impacts identified are basically variations on existing effects from Sierra Nevada Region's current power marketing program.

No discernible adverse impacts would occur to the long-term productivity of the region as a result of implementing Sierra Nevada Region's 2004 Plan. Changes in power costs were not found to be large enough to affect land-use or crop production. Water releases due to power generation at main storage reservoirs, as varied across the entire range of possible generation options, were found not to affect the pool levels of the main storage reservoirs, but did have effects on the fluctuations in regulating reservoirs.

The long-term productivity of fish populations in the regulating reservoirs could be slightly improved under stable pool conditions associated with the baseload alternative, in comparison with the no-action alternative; however, the regulating reservoir's designed function is to fluctuate in order to provide steady flows in the rivers downstream, not maximize fish habitat and populations in the regulating reservoirs. River flows downstream from regulating reservoirs would be unaffected regardless of the pattern of power generation at upstream main dams, as flow restrictions imposed by Interior prevent power generation from affecting planned regulating reservoir releases.

Impacts to air and non-CVP water resources are tied to generation capacity required if Sierra Nevada Region's decisions on power marketing result in a loss of hydropower capacity. The long-term productivity effects of these new plants would be assessed in site-specific environmental documentation as required.

4.17 Direct and Indirect Effects

The direct effects discussed in this 2004 EIS are those related to possible changes in electric power generation at those CVP power generation facilities where the Sierra Nevada Region has some discretionary control over daily and hourly water releases. All other identified potential impacts would be indirect. The projected socioeconomic effects would stem from how the 2004 Plan affected the power costs of Sierra Nevada Region's customers and ultimately the retail rate to the end-user. Customers could react to changes in power costs and availability in a number of ways, which would greatly influence the nature of these indirect effects. Negligible indirect effects on air quality, non-CVP water quality, wastes, and land use may occur as Sierra Nevada Region customers respond to changes in CVP power generation and available capacity and energy.

4.18 Cumulative Effects

All of the impacts described in this 2004 EIS would be cumulative when considered in conjunction with other activities being undertaken in the region. The analyses in this 2004 EIS incorporate cumulative impacts to the extent that they can be identified, such as effects on the operation of other power resources in the areas where the Sierra Nevada Region could make power purchases. Sierra Nevada Region's power marketing decisions will not affect overall regional load or load growth. Meeting future load requirements will have environmental consequences. In large part, any cumulative impacts resulting from Sierra Nevada Region's power marketing activities have already been felt, as this power resource has been marketed to customers in the past, and the proposed action is to continue to market the hydropower resource, although perhaps in a different manner. Any potential effects related to existing transmission (such as changes in land use, aesthetics, or electromagnetic fields) will be unaffected by the 2004 Marketing Plan. For this reason, the impact analyses in this 2004 EIS describe the potential shift in impacts from region to region, customer group to customer group, or resource to resource, and not new or additional impacts on the environment.

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5.0 Environmental Consultation, Review, and Permit Requirements

This 2004 EIS was prepared pursuant to CEQ NEPA Regulations (40 CFR 1500-1508), which requires Federal agencies to assess the impacts that their actions may have on the environment and to integrate this assessment into agency planning and decision-making at the earliest possi ble time. In addition, this 2004 EIS was prepared in accordance with 10 CFR 1021, the NEPA regulations specifically applicable to DOE.

In addition to their responsibilities under NEPA, Federal agencies are required to carry out the provisions of other Federal environmental laws and Executive Orders. The Federal actions related to the alternatives in this 2004 EIS do not require any particular response with regard to other Federal laws.

Some impacts described in this 2004 EIS are based on a judgment about utilities' potential future actions and the working of the power market. In response to Sierra Nevada Region's marketing decisions, utilities may decide to change the way they acquire or operate resources. The Sierra Nevada Region is not proposing the construction or modification of any electric facilities at this time, nor does it expect to in the near future. Electric facilities that might be built would be proposed and constructed by individual utilities, utility-based associations, or others. For these projects, environmental analysis and documentation would be required to conform to applicable Federal and State laws and regulations. At the time of the decision to build or modify an electric facility, the developers would be responsible for preparing and complying with site-specific permits and documents as necessary.

In addition to the extensive public process described in Section 1.5, agency coordination acti vities initiated by the Sierra Nevada Region as part of the environmental review process for the 2004 Plan include the following:

- Because of its extensive involvement with CVP river and reservoir operations, Recla mation was requested and agreed to serve as a cooperating agency for the 2004 EIS.
- To provide expertise and input related to the protection of biological resources, includ ing sensitive species, the Service was invited to be a cooperating agency for the 2004 EIS but agreed instead to serve as a consulting agency.(1) Lists of sensitive species were solicited from both the Service and the CDFG, and both agencies along with the NMFS were on the distribution list to receive a review copy of the draft 2004 EIS.
- The preparation of the affected environment text and analyses of potential impacts to cultural resources were coordinated with the California State Office of Historic Preser vation, which was also on the distribution list to receive a review copy of the draft 2004 EIS.

- Other agencies with relevant expertise that were on the distribution list to receive a review copy of the draft 2004 EIS include the U.S. Army Corps of Engineers (for wetlands and navigable waters); the California Air Resources Board (for air quality); the California Water Resources Control Board (for water quality and water tempera ture); the California Energy Commission (for energy, land use, and socioeconomic issues); and the California Department of Toxic Substances Control (for waste generation and hazardous materials management).

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(1)Letter from Dale A. Pierce (the Acting Field Supervisor for the Fish and Wildlife Service) to Jerry Toenyes (the Deputy Area Manager of Western's Sacramento Area Office), March 16, 1994.

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7.0 List of Preparers

Name	Area of Interest	Experience
Western Area Power Administration		
Gary L. Burton	Natural Resources (Fisheries, Wild life, and Endan gered Species)	Mr. Burton holds a B.S. in fisheries/microbiology from Colorado State University. He has worked as a Federal Fishery Biologist for 16 years, including 4 years with Western.
P. Nannette Engelbrite	Electrical Engineer	Ms. Engelbrite holds a B.S. in electrical engineering with a concentration in power engineering. Her area of interest is CVPIA coordination. She has 12 years of power engineering experience with Reclamation and Western.
Phil House	Power Resource Planning	Mr. House is a Hydraulic Engineer. He holds a B.S. in civil engineering from Missouri School of Mines and Metallurgy. He has worked for Western for 14 years in the area of power resource planning.
Zola Jackson	Marketing and Rates	Ms. Jackson holds a B.S. in business administration

		majoring in accounting from the University of Neva da. She has been with Western for 12 years, working in the areas of power marketing, power contracting, and power rates.
LaVerne Kyriss	Communications and Public Involvement	Ms. Kyriss holds a B.A. in psychology and an M.A. in communications. She has over 20 years of com munications, public involvement, and editing experi ence, including 8 years with Western.
Loreen R. McMahon	Public Involvement and Environmental Planning	Ms. McMahon holds a Master's degree in Public Policy and Administration with an environmental policy emphasis and a B.A. in political science. She has worked within the government for over 15 years and has over 10 years experience in public relations.
William J. Melton	NEPA Compliance Officer	Mr. Melton holds an M.S. in agriculture and a B.S. in agronomy from Texas A&M University. He has over 23 years experience in NEPA and has served as the Sierra Nevada Region's Environmental Manager for 4 years.
Earl Nelson	Environmental Planning and Prin cipal Reviewer	Mr. Nelson holds a B.A. in communication and pub lic policy from the University of California, Berke ley. He has over 23 years experience in environmen tal impact assessment, report preparation, environ mental review programs, land use planning, and project management.
Jerry Toenyes	Project Manager	Mr. Toenyes holds a B.S. in agricultural economics from Montana State University. He has been em ployed by Western for over 16 years and has approxi mately 25 years of experience related to the Central Valley Project.
Mark J. Wieringa	Environmental Planning and Principal Reviewer	Mr. Wieringa holds a B.S. in forestry and an M.A. in geography. He is an Environmental Protection Spe cialist and has worked for Western for 12 years. He was an environmental consultant for 5 years.
Pacific Northwest National Laboratory (PNNL)		
David Anderson	Socioeconomics	Mr. Anderson holds an M.S. in forest economics and a B.S. in forest resources. He has conducted socio economic studies at PNNL for 4 years and worked in forestry and land management for 4 years.
Michael C. Baechler	Project Manager	Mr. Baechler holds an M.P.A. from Harvard Univer sity and a B.A. from the Honors College of the Uni versity of Oregon. He has conducted NEPA assess ments for 13 years, 12 of which have been at PNNL. Mr. Baechler has worked in environmental manage ment for 18 years.

Gordon Bilyard	Air Quality	Dr. Bilyard holds a Ph.D. in biological oceanog raphy, an M.S. in marine zoology, and a B.A. in zoology. Prior to joining PNNL, he provided techni cal assistance to the EPA on marine and estuarine pollution. Since joining PNNL in 1989, he has worked in the areas of environmental policy analysis, environmental regulatory analysis, and ecological risk assessment.
Susan Blanton	Fisheries Ecology	Ms. Blanton received a B.S. in zoology at Miami University in 1992. During her 2 years with PNNL, she has provided technical assistance for diverse hydropower and fisheries-related projects.
Alan Brothers	Uncertainty Analysis	Dr. Brothers holds a Ph.D. in cognitive psychology from the University of California and a B.A. in mathematics. He has been doing research in the area of applied and theoretical decision analysis for 12 years and has been with PNNL for 4 years.
Jeff Dagle	Power Systems	Mr. Dagle received B.S. and M.S. degrees in electri cal engineering from Washington State University in 1989 and 1994, respectively. He has been involved in power system analysis, simulation and control while at PNNL for 7 years, where he currently serves as a Senior Research Engineer. Other areas of spe cialty include energy storage applications, advanced technology deployment, and facility power distribu tion systems.
Gariann Gelston	Air Quality	Ms. Gelston holds a B.S. in applied mathematics and has 2 years experience in multi-environmental media risk analysis.
Theresa Gilbride	Technical Editing	Ms. Gilbride has 10 years of technical editing and writing experience for the U.S. Department of Ener gy and other federal and state agencies. She holds a B.S. in editorial journalism from the University of Washington.
Cliff Glantz	Air Pollution Meteorology	Mr. Glantz holds an M.S. in atmospheric sciences from the University of Washington and a B.S. in physics and atmospheric sciences from the State Uni versity of New York at Albany. He has been with PNNL for 14 years and does research in the fields of air pollution meteorology, pollutant dispersion model ing, and environmental risk assessment and manage ment.
Gordon Haber	Database Manage ment	Mr. Haber has a B.S. in behavioral biology from the University of Minnesota and a B.S. in computer sci ence from Portland State University. He has con

		sulted in data management and numerical analysis since 1980 and has worked on three environmental impact statements.
Marye Hefty	Technical Editing	Ms. Hefty has 10 years of technical editing, writing, and teaching experience. She holds a B.S. in biology and an M.S. in English.
Allen Lee	Uncertainty Analysis	Dr. Lee has a Ph.D. in policy analysis, an M.S. in aerospace engineering, and a B.S. in engineering. He has conducted and managed numerous energy and environmental studies. He has applied decision analysis, uncertainty analysis, and conjoint analysis in environmental impact studies.
Rosemary Mazaika	Wildlife Biology	Ms. Mazaika holds an M.S. in wildlife ecology from the University of Arizona and a B.S. in ecology from Unity College. She is a Wildlife Biologist at the U.S. Army Corps of Engineers, Portland District, and was previously employed at PNNL for 3.5 years. She has 7 years experience in natural resource planning and management.
Duane Neitzel	Fisheries and Terrestrial Ecology	Mr. Neitzel holds an M.S. in biological sciences from Washington State University. He has been at PNNL for 24 years, conducting research in aquatic sciences, mostly related to the biology of salmon and other freshwater fishes.
Derek Schrock	Renewable Resources	Mr. Schrock holds both an M.S. and a B.S. in mech anical engineering. Mr. Schrock was a PNNL re search scientist and has an extensive background in consulting to electric utilities in both demand and supply-side projects. He is currently employed at AGA Research.
Mary Ann Thornburgh	Document Preparation	Ms. Thornburgh has over 25 years of secretarial and administrative experience. She has been with PNNL for 4 years
Lance Vail	Hydrology	Mr. Vail holds an M.S. in civil engineering from Montana State University. He has been at PNNL for the past 15 years conducting research in surface and subsurface hydrologic processes.
Mona Wright	Cultural Resources	Ms. Wright holds an M.A. in anthropology from Washington State University. She has been at PNNL for the past 4 years involved in cultural resource management.
R.W. Beck, Inc.		
Willie G.	Mechanical Engineer	Mr. Manuel has a B.S. in mechanical engineering

Manuel		and an M.B.A in finance. He has 5.5 years experience performing financial and technical feasibility analysis of capital projects. Mr. Manuel has been with R.W. Beck, Inc., since March 1995. His main responsibili ties are providing financial analysis and production cost modeling to the firm's clients.
Kenneth J. Mellor	Utility Restructur ing Analyses	Mr. Mellor holds a B.S. in electrical engineering from the University of California, Berkeley. He has extensive experience in electrical utility management and has worked in several states and countries on preparation for utility restructuring and retail compe tition. He works with utility managers on strategic planning, financing, organization, and other competi tive issues.
Peter J. Robertshaw	Supervising Engineer	Mr. Robertshaw holds a B.A.Sc. in civil engineering from the University of Waterloo, Ontario, Canada. He has been involved in computer modeling of com plex systems for over 12 years. He has been with R.W. Beck, Inc., for over 8 years, applying his tech nical skills in a wide variety of engineering applica tions in the field of electric utility studies.
Paul G. Scheuerman	Utility and Power System Analysis	Mr. Scheuerman holds a B.S. in electrical engineer ing from Washington University, St. Louis. He has been involved with power system and related utility planning issues for over 30 years and has directed numerous studies involving the analysis of power sys tem issues. He has worked with R.W. Beck, Inc., for over 15 years, with much of this time devoted to providing assistance to clients in northern and central California related to utility issues.
Woodward-Clyde		
Brian Hatoff	Cultural Resources	Dr. Hatoff holds an M.A. and a Ph.D. in anthropol ogy and has more than 22 years of experience devel oping and implementing cultural resources and pale ontology programs. As the first District Archaeol ogist in Nevada, his principal role was to facilitate the CRM process to expedite land-use applications while ensuring compliance with applicable laws and regula tions. Since joining Woodward-Clyde, Dr. Hatoff has co-managed several large cultural resource/Sec tion 106 components of major NEPA-level projects.
Steve Leach	Terrestrial Biology	Mr. Leach has an M.S. in physical geography and is

		a terrestrial biologist who assesses potential impacts to rare plants, plant communities, and wetlands throughout California and Nevada. His experience includes research and baseline environmental studies related to the vegetation, rare plants, and wetland resources of California and the Great Basin.
Patricia Mosley	Wildlife Biology	Ms. Mosley holds a B.S. in wildlife biology and has over 9 years experience conducting surveys and bio logical assessments for threatened and endangered species in California and Nevada. Currently, Ms. Mosley is working on an international assignment that involves assessing potential impacts to avian species as a result of offshore oil development in the south western Caspian Sea region of the former Soviet Union.
Jennifer O'Connell	Biology	Ms. O'Connell holds a B.S. in biology. Since joining Woodward-Clyde, she has been involved with a vari ety of projects including assessing impacts to plants and wildlife for proposed transmission line rights-of- way, studies for constructing natural gas pipeline facilities, and siting studies for private companies.
Sally Salzman Morgan	Cultural Resources	Ms. Morgan holds an M.A. in anthropology. Since 1975, she has provided archaeological and cultural resource management services to private firms and civic and Federal agencies as a private archaeological contractor, as a Federal archaeologist, and as an envi ronmental consultant. At Woodward-Clyde, she re cently served as Cultural Resources Task Leader for preparing an extensive Notice of Intention for San Diego Gas and Electric and participated in designing a National Historic Preservation Act 106 compliance program for the Tasman Light Rail project.

National Systems & Research Information, Inc.

John D. Anderson	Power Marketing and Resource Planning	Mr. Anderson holds a B.S. in electrical engineering from Southern University in Baton Rouge, LA. He has worked for Reclamation, Western, and several of Western's contractors for over 30 years in areas deal ing with power resource planning and other power marketing issues.

Bureau of Reclamation

John Johannis	Reclamation Representative	Mr. Johannis holds a B.S. in civil engineering. He is a hydraulic engineer with over 15 years experience in water operations, power planning, and project man agement.

8.0 List of Recipients

The Sierra Nevada Region has maintained a project mailing list made up of approximately 430 individuals and organizations who have received bulletins, notices, and other correspondence related to the 2004 EIS. Volume 1 of the draft 2004 EIS (the Summary) was mailed to the full mailing list. The recipients listed below received a complete copy of the three-volume draft 2004 EIS, which included the environmental analysis volume and the appendices volume. Others interested in the draft 2004 EIS obtained copies from the Sierra Nevada Region.

The final 2004 EIS will be mailed to the U.S. Environmental Protection Agency (EPA) and individuals and organizations who contact the Sierra Nevada Region to request a copy.

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Windwalker

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Reference Desk

Westlands Water District

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9.0 Acronym

2004 EIS
    2004 Power Marketing Program Final Environmental Impact Statement
2004 Plan
    2004 Power Marketing Plan
AB
    Assembly Bill
acre-ft

acre-foot, acre-feet
AIRFA
American Indian Religious Freedom Act
APA
Administrative Procedure Act
APE
area of potential effects
AQMP
Air Quality Management Plan
BACT
best available control technology
CAAQS
California Ambient Air Quality Standards
CARB
California Air Resources Board
CCAA
California Clean Air Act
CCCT
combined-cycle combustion turbine
CDFG
California Department of Fish and Game
CDOF
California Department of Finance
CEC
California Energy Commission
CEQA
California Environmental Quality Act
cfs
cubic feet per second
CO
carbon monoxide
CO_2
carbon dioxide
COA
Coordinated Operation Agreement
COTP
California-Oregon Transmission Project
CPUC
California Public Utilities Commission
CRD
contract rate of delivery
CRHR
California Register of Historic Resource
CRS
Components Relationships Study
CT

combustion turbine
CVP
Central Valley Project
CVPIA
Central Valley Project Improvement Act
DOE
U.S. Department of Energy
DSM
demand-side management
EIR
environmental impact report
EIS
Environmental Impact Statement
EPA
U.S. Environmental Protection Agency
EPAMP
Energy Planning and Management Program
EPAct
Energy Policy Act of 1992
ESU
Evolutionarily Significant Unit
FERC
Federal Energy Regulatory Commission
GWh
gigawatt-hour
Interior
U.S. Department of the Interior
IRP
integrated resource plan
ISO
Independent System Operator
kV
kilovolt
kW
kilowatt
kWh
kilowatt-hour
LAER
lowest achievable emission rate
LP
linear programming
m
meter
MAF
million acre-feet
MW

megawatt
NAAQS
National Ambient Air Quality Standards
NAGPRA
Native American Graves Protection and Repatriation Act
NCPA
Northern California Power Agency
NEPA
National Environmental Policy Act
NERC
North American Electric Reliability Council
NHPA
National Historic Preservation Act
NMFS
National Marine Fisheries Service
NO_2
nitrogen dioxide
NO_x
oxides of nitrogen
NOPR
Notice of Proposed Rulemaking (FERC's proposal for open transmission access)
NRHP
National Register of Historic Places
O_3
ozone
O&M
operations and maintenance
Pacific Intertie
Pacific Northwest - Pacific Southwest Intertie
PEIS
programmatic environmental impact statement
PG&E
Pacific Gas & Electric Company
PM10
particulate matter less than 10 microns in diameter
PMI
Power Marketing Initiative
Reclamation
Bureau of Reclamation
ROD
Record of Decision
the Service
U.S. Fish and Wildlife Service
Sierra Nevada
Western's Sierra Nevada Customer Service Region
SMUD

Sacramento Municipal Utility District

SO_2

sulfur dioxide

SPPC

Sierra Pacific Power Company

SWP

State Water Project

SWRCB

State Water Resources Control Board

TAF

thousand acre-feet

TCD

temperature control device

Western

Western Area Power Administration

WSCC

Western Systems Coordinating Council

10.0 Glossary

Acre-foot

The volume of water that will cover an area of 1 acre to a depth of 1 foot (326,000 gallons, 0.5 second foot days, 1,233.5 cubic meters).

Active Storage

Storage in a reservoir that is normally used for water development and flood control. Storage above the minimum power pool and below the top of the flood control storage.

Adjustment Provisions

Sales contract provisions for changes in hydrologic resources.

Administrator

The Administrator of the Western Area Power Administration

Aggregated Costs

Costs for Sierra Nevada Region hydropower and power purchases are combined into a single cost, as opposed to disaggregated costs where these two costs would be treated individually.

Agriculture Customer

A customer that purchases all or a portion of its power supply from the Sierra Nevada Region for its pumping requirements for irrigation. This customer is not authorized to distribute power for other retail purposes.

Alternative Financing Arrangements

Customer-assisted financing.

Anadromous Fish

Fish, such as salmon or steelhead, that hatch in fresh water, migrate to and mature in the sea, and return to fresh water as adults to spawn.

Baseload

--Within the alternatives, this refers to operating the hydropower system to maximize baseload energy production. Baseload powerplants have high capacity factors meaning they operate much of the time.

Btu (British thermal unit)

The amount of heat energy necessary to raise the temperature of 1 pound of water 1^{o} Fahrenheit (3,413 Btus are equal to 1 kilowatt-hour).

Bundled Services

Products and services offered as a package.

California-Oregon Transmission Project

A jointly owned 500-kV transmission line connecting Northern California and the Pacific Northwest.

Capability

The maximum load that a generator, turbine, transmission circuit, apparatus, station, or system can supply under specified conditions for a given time interval, without exceeding approved limits of temperature and stress.

Capacity

The load for which a generator, turbine, transformer, transmission circuit, apparatus, station, or system is rated. Capacity is also used synonymously with capability.

Capacity Factor

The ratio of the average load on the generating plant for the period of time considered to be the capacity rating of the plant. Unless otherwise identified, capacity factor is computed on an annual basis.

Capacity Reserve

The sale of firm capacity that normally has no energy sale associated with it. The intent is to provide a capacity resource for use by a customer to meet its requirements for systems reserves.

Carryover Storage

Reservoir storage carried over to the following water year; storage on September 30.

cfs

cubic feet per second.

Combined-Cycle Combustion Turbine (CCCT)

The combination of a gas turbine and a steam turbine in an electric generation plant. The waste heat from the gas turbine provides the heat energy for the steam turbine.

Conservation

A reduction in electric power consumption as a result of increases in the efficiency of energy use, production, or distribution.

Content

An amount of water stored in a reservoir.

Contingent Power

Power that is sold based on the availability of generation and on hydrol ogical conditions. This product is marketed on a long-term basis with the actual capacity and energy sold during a period based on the level of power available during that period. It may include a provision for the Sierra Nevada Region to purchase additional power to supplement such power.

Cost of Debt

The amount paid to the holders of debt (bonds and other securities) for use of their money. Generally expressed as an annual percentage.

Cost of Equity

Earnings expected by a shareholder on an investment in a company. Generally expressed as an annual percentage.

Cost Allocation

How costs are allocated across products and services.

Contract Rate of Delivery

The amount of an allocation by Western under contract between a customer and Western. Also the maximum rate of delivery of power for each type of sale.

Customer

Any entity or entities purchasing firm capacity, with or without energy, from the Sierra Nevada Region under a long-term service contract. Customers may include parent-type entities and their distribution or user members.

Debt

Investment funds raised through the sale of securities having fixed rates of interest.

Debt/Equity Ratio

The ratio of debt financing to equity financing used for capital investment.

Delivery Conditions/Transmission

--A contractual requirement that certain facilities and conditions be in place to accept Sierra Nevada Region power.

Demand

The rate at which energy is used at a given instant or averaged over a designated period of time.

Demand Forecast

An estimate of the level of energy that is likely to be needed at some time in the future.

Demand-Side Management

Programs and technologies implemented with end users to manage loads or avoid purchasing capacity or energy.

Dependable Capacity

The capacity that is available from an electric system or plant under adverse hydrological conditions.

Disaggregated Costs

Costs for Sierra Nevada Region hydropower and power purchases are treated individually as separate costs, as opposed to aggregated costs where these two costs would be combined.

Discharge

The volume of water released from a dam or powerhouse at a given time, usually expressed as cubic feet per second.

Discount Rate

The rate used in a formula to convert future costs or benefits to their present value.

Dispatch

The operating control of an integrated electric system involving operations such as:

- The assignment of load to specific generating station(s) and other sources of supply to effect the most reliable and economical supply as the total of area loads rises or falls.
- The coordination of operations with maintenance of high voltage lines, substations, and equipment.
- The operation of principal tie lines and switching.
- The scheduling of energy transactions with connecting electric utilities.

Diversity

The difference among individual electric loads resulting from the fact that the maximum demands of customers do not all occur at the same time.

Draft

Release of water from a storage reservoir.

Drawdown

The distance that the water surface of a reservoir is lowered from a given elevation as water is released from the reservoir. Also refers to the act of lowering reservoir levels.

Economy/Nonfirm Energy

Energy sold on an as-available basis. This energy can be interrupted without notice by either buyer or seller, with the buyer paying only for energy that is actually delivered. This product was included as a class of service.

Effects

As used in NEPA documentation, the terms effects and impacts are synonymous. Effects can be ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

Elevation

Height in feet above sea level.

Eligibility Criteria

Conditions that must be met to qualify for a Sierra Nevada Region allocation.

End Use

A term referring to the final use of energy. In general, it can be used in the same way as the term "energy demand." In more detailed use it often refers to a specific energy service (for example, space heating) or type of energy-consuming equipment (for example, a washing machine or electric motor).

Energy

That which does or is capable of doing work. It is measured in terms of the work it is capable of doing; electric energy is usually measured in kilowatt-hours.

Energy Management

Programs to encourage customer energy planning, such as the provisions of EPAMP. The study team determined that this component would not be varied across 2004 EIS alternatives and that the EPAMP EIS could be referenced rather than conducting a separate analysis of potential impacts.

Exchange Capacity and Energy

The capacity and/or energy made available during a specified period with the energy returned in another period. This component refers to a means by which capacity and energy are sold and is classified with all classes of firm capacity. This product was included in the six classes of products and services.

Firm Capacity with Energy

This type of product consists of capacity that is available to a customer at the times it is required. The amount of energy that accompanies such capacity during the period of the sale is generally limited in some fashion. The most common limits set an upper or maximum energy allocation. That is, the resource may not be used to provide more energy than associated with an established capacity factor.

Firm Capacity with Energy - Baseload

A class of service generally available with a capacity factor of approximately 70 percent to 100 percent.

Firm Capacity with Energy - Intermediate

A class of service generally available with a capacity factor of approximately 25 percent to 70 percent.

Firm Capacity with Energy - Load Factor Power (x/y)

A way of packaging energy sales. The energy associated with the capacity is based upon the customer's load factor and is deemed to be delivered based upon the ratio of the customer's contract rate of delivery to its total demand. This component was subsumed by the six classes of products and services.

Firm Capacity with Energy - Peaking

A class of service used to meet load requirements during times of the highest system demand with a capacity factor of approximately 1 percent to 25 percent.

Firm Capacity with Zero Energy

A class of service that incorporates only exchange energy.

First Preference Customer

A qualified preference customer within a county of origin as specified under the Trinity River Division Act of 1955 and the New Melones Act of the Flood Control Act of 1962.

Flow

The volume of water passing a given point per unit of time. Same as streamflow.

Forebay

The portion of the reservoir at a hydropower project that is immediately upstream of a dam or powerhouse.

Fuel Cycle

Environmental, social, and economic effects that may result from the use of powerplants and fuels over their entire life cycles, including the following stages: mining, transportation, generation, and disposal.

Geothermal

Useful energy derived from the natural heat of the earth as manifested by hot rocks, hot water, hot brines, or steam.

G&AC

Guidelines and Acceptance Criteria. These are the criteria that Sierra Nevada Region's customers comply with under the existing Conservation and Renewable Energy Program. They were published in 50 FR 33892 (August 21, 1985).

Generation

The act or process of producing electricity from other forms of energy.

Gigawatt (GW)

The electrical unit of power that equals 1 billion watts.

Gigawatt-hour (GWh)

One gigawatt of power applied for 1 hour.

Heat Rate

The amount of input (fuel) energy required by a power plant to produce 1 kilowatt-hour of electrical output. Expressed as Btu/kWh.

Heating Degree Days

A measure of the amount of heat needed in a building over a fixed period of time, usually a year. Heating degree days per day are calculated by subtracting from a fixed temperature the average temperature over the day. Historically, the fixed temperature has been set at 65· Fahrenheit, the outdoor temperature below which heat was typically needed. As an example, a day with an average temperature of 45· Fahrenheit would have 20 heating degree days, assuming a base of 65· Fahrenheit.

Hydropower Operations

The hydropower operations within Sierra Nevada Region's discretion that may be changed to accommodate the 2004 power marketing program.

Hydroelectric Power

The generation of electricity using falling water to turn turbo-electric generators.

IMPLAN

(Impact Analysis for PLANning) A regional economic modeling system, origi nally developed by the U.S. Forest Service in cooperation with the Federal Energy Manage ment Agency.

Inflow

Water that flows into a reservoir or forebay during a specified period.

Integrated Resource Planning

According to the Energy Policy Act of 1992, a planning process for new energy resources that evaluates the full range of alternatives, including new generating capacity, power purchases, energy conservation and efficiency, cogeneration and district heating and cooling applications, and renewable energy resources, in order to provide adequate and reliable service to a utility's electric customers at the lowest system cost. The process shall take into account necessary features for system operation, such as diversity, reliability, dispatchability, and other factors of risk; shall take into account the ability to verify energy savings achieved through energy conservation and efficiency and the projected durability of such savings measured over time; and shall treat demand and supply resources on a consistent and integrated basis.

Interested Parties

Those groups or individuals that are interested, for whatever reason, in the project and its progress. Interested parties include but are not limited to private individuals, public agencies, organizations, customers, and potential customers.

Interim Water Supply

The difference between the contracted firm yield and total contractor demand.

Intermittent Water Supply

Supply beyond the firm yield supply; that supply used in com bination through a conjunctive use program to expand the total supply of water; contracted on an annual, short-term, or long-term basis. Intermittent supply depends on the type of water year, total amount of water, and the quantity of water delivered each year to firm contractors.

Investor-Owned Utility

A utility that is organized under State law as a corporation to pro vide electric power service and earn a profit for its stockholders.

Irrigation District

An irrigation district performs only an irrigation function. If other elec trical functions are performed, such as residential service or other utility responsibilities, the district may be considered a utility. The term irrigation districts may include agricultural types of districts, such as electrical districts, water delivery districts, and water conservation districts.

Kilowatt (kW)

The electrical unit of power that equals 1,000 watts.

Kilowatt-Hour (kWh)

A basic unit of electrical energy that equals 1 kilowatt of power applied for 1 hour.

Key Component Groups

Components that make up the alternatives in the 2004 EIS.

Load

The amount of electric power required at a given point on a system.

Load Forecast

An estimate of the level of energy that must be generated to meet a need. This differs from a demand forecast in that transmission and distribution losses from the generator to the customer are included.

Maintenance Power

The capacity and energy support for those periods when customer resources are unavailable due to maintenance. This would typically be a short-term product. The energy provided may be sold or returned to the Sierra Nevada Region. This product is classified with all classes of firm capacity. The customer's need would depend on what type of powerplant is being supported.

Marginal Cost

The cost of producing the last unit of energy (the long-run incremental cost of production).

Marketable Resources

The amount of electric power from the Sierra Nevada Region available to market.

Marketing Area

A geographic area in which Western's regional offices have the responsi bility for selling power from Federal electric generators. The Sierra Nevada Region's mar keting area extends over most of northern and central California and most of Nevada.

Megawatt (MW)

The electrical unit of power that equals 1 million watts or 1 thousand kilowatts.

Member Based Association

An organization of member utilities organized to serve supply, distribution, or service needs. These organizations are sometimes referred to as parent-type entities.

Mill

A tenth of a cent. The cost of electricity is often given in mills per kilowatt-hour.

Municipal Solid Waste (MSW)

Refuse offering the potential for energy recovery. Techni cally, residential, commercial, and institutional discards.

Nominal Dollars

Dollars that include the effects of inflation. These are dollars that, at the time they are spent, have no adjustments made for the amount of inflation that has affected their value over time.

Nonattainment

An area shown by monitored data or modeling to exceed National Ambient Air Quality Standards for a particular air pollutant.

Nonfirm

A nonfirm product or service that is marketed on a short-term basis without a guaranteed delivery.

Nonpower Services/Technical Assistance

Technical services provided by Sierra Nevada Region to help customers use its services more efficiently, or services that do not include power to be part of the service, for example, scheduling services. Transmission services are likely to be the only nonpower services assessed in the 2004 EIS. Other services would be assessed as they are identified and developed.

Nonspinning Reserve

The portion of the operating reserves capable of being connected to the system and loaded within 10 minutes. This product is included in firm capacity with zero energy.

Northern California Purchases

Potential purchases of capacity and/or energy from Northern California.

Northwest Purchases

Potential purchases of capacity and/or energy from the Pacific North west. These purchases may include existing contracts or may be from different producers.

Other Customer Group

For purposes of the 2004 EIS, a group of the Sierra Nevada Region's customers made up of local, state, and Federal Government agencies.

Outflow

The water that is released from a project in a specified period.

Pacific Intertie

(Pacific Northwest - Pacific Southwest Intertie) One of the Sierra Nevada Region's transmission assets connecting northern California to the Pacific Northwest.

Packaging of Unbundled Services

The process of combining individual products and ser vices into packages that the Sierra Nevada Region could sell in a way that would best meet customers' needs. This issue will be primarily addressed in the 2004 Plan. The environ mental analysis assumes that resources will determine the availability of products and services.

Peaking

--Within the alternatives, this refers to operating the hydrosystem to maximize peak ing energy production. Peaking resources have small capacity factors, which means they operate for brief periods when demand for electricity is greatest.

Peak Capacity

The maximum capacity of a system to meet loads.

Peak Demand

The highest demand for power during a stated period of time.

Power Marketing Plan

A formal blueprint describing how Sierra Nevada Region sells its power.

Power Marketing Program

A range of possible activities that could be included in a power marketing plan.

Preference Customer

An entity eligible to receive a power allocation pursuant to Section 9 of the Reclamation Project Act of 1939 which requires the Sierra Nevada Region to give pref erence when selling power to nonprofit organizations financed through the Rural Electrifica tion Act of 1936, municipalities, and public agencies.

Present Value

The worth of future returns or costs in terms of their current value. To obtain a present value, an interest rate is used to discount these future returns and costs.

Production Costs

The cost of producing electricity.

Project Use

Power that is used to move CVP water to the water users. Project Use must be satisfied before any power can be marketed by the Sierra Nevada Region to its preference power customers.

Project Water

Water that is available for sale from the various units of the CVP that is marketed to CVP water customers by Reclamation.

PROSIM
(Project Simulation Model) Reclamation's computer model for simulating operation of the CVP system.

PROSYM
(Production Cost Simulation Model) This commercially available computer model estimates power production costs and generation dispatch.

Public Involvement Plan
Methodology used by the agency to encourage public participation.

Public Utility Commissions
State agencies whose purpose is to regulate, among others, investor-owned utilities operating in the State with a protected monopoly to supply power in assigned service territories.

Ramping Service
This product provides operational backup to a generating utility during times when that utility finds it necessary to meet a schedule change that is greater than the rate at which it is able to load its own generation. Any net energy supplied under such a service is generally returned to the Sierra Nevada Region during a like time period. This would typi cally be provided on a short-term firm basis.

Rate
The monetary charge or the formula for computing such a charge for any electric service or products.

Rate Design
How rates are developed for products sold.

Rate Schedule
A document identified as a "rate schedule," "schedule of rates," "schedule rate," or "tariff," which designates the rate or rates applicable to a class of service specified therein and may contain other terms and conditions relating to the service.

Real Dollars
Dollars that do not include the effects of inflation. They represent constant purchasing power.

Reliability
The ability of the power system to provide customers uninterrupted electric service. Includes generation, transmission, and distribution reliability.

Regulating Reservoirs
Reservoirs created by regulation dams designed to mitigate water level fluctuations from upstream dams.

Regulating Service
The capacity and energy used to match loads and resources.

Renewable Resource
A resource that uses solar photovoltaic, wind, water (hydroelectric), geothermal, biomass or similar sources of energy.

Reserve Capacity
Generating capacity available to meet unanticipated demands for power or to generate power in the event of outages in normal generating capacity. This includes delays in operations of new scheduled generation. Forced outage

reserves apply to those reserves intended to replace power lost by accident or breakdown of equipment. Load growth reserves are those reserves intended for use as a cushion to meet unanticipated load growth.

Reserves

See Capacity Reserves, Spinning Reserves, and Nonspinning Reserves.

Resident Fish

Fish species that reside in fresh water throughout their lives.

Rule Curves

Water levels, represented graphically as curves, that guide reservoir operations.

Scheduling Customer

A wholesale utility customer of the Sierra Nevada Region that is capable of scheduling its power transactions; for example, those power purchases required by the utility to match load and resources in addition to any internal generation that the utility may have scheduled on an hour-by-hour basis.

Scoping

An early, open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action.

Seasonal Power

The amount of firm power that may be marketed during a specific period of time and is variable due to the seasonal characteristics of a resource or load.

Selected Generation Technology Firming

The capacity and energy support needed for selected generation technologies. This product would need to fit the needs of the technology being firmed. It would probably not be feasible to firm technologies to a level requiring firm capacity with a high capacity factor.

Simple-Cycle Combustion Turbine (SCCT)

A combustion turbine is similar to a jet engine. Large volumes of air are forced to high pressures in a compressor. Natural gas is injected and combustion occurs. The resulting high-temperature, high-pressure exhaust gases are expanded in a turbine which produces electricity.

Siting Agencies

State agencies with the authority for issuing permits to locate generating plants of defined types and sizes to utilities at specific locations.

Siting and Licensing

The process of preparing a powerplant and associated services, such as transmission lines, for construction and operation. Steps include locating a site, developing the design, conducting a feasibility study, preliminary engineering, meeting applicable regula tory requirements, and obtaining the necessary licenses and permits for construction of the facilities.

Solar Photovoltaic

Direct conversion of sunlight to electric energy through the effects of solar radiation on semi-conductor materials.

Spill

Water passed over a spillway or regulating outlets and not going through turbines to produce electricity.

Spinning Reserve

The portion of the operating reserves synchronized to the system, auto matically responding to fluctuations in system frequency, and capable of assuming load up to its cited magnitude within 10 minutes. This product was classified with firm capacity with zero energy.

Station Service

Power that is being used by the powerplants at any particular time to main tain and operate powerplant equipment.

Standard Provisions

One of the initial components, it refers to standard contract terms and conditions included in Sierra Nevada Region transactions.

Storage Reservoirs

Reservoirs primarily used for storage of water. This is in contrast to regulating reservoirs.

Surplus Power

Capacity and/or energy available above and beyond the contracted rate of delivery. This product may be firm or interruptible and sold only when available.

TAF

Thousand acre-feet.

Termination Provisions

Procedures for terminating contracts.

Thermal Resource

A facility that produces electricity by using a heat engine to power an electric generator. The heat may be supplied by burning coal, oil, natural gas, biomass or other fuel, by nuclear fission, or by solar or geothermal sources.

Transmission Services

These services may include firm and nonfirm transmission, as well as transmission by a third party. Firm and nonfirm transmission services occur when capacity and energy are received into a system at points of interconnection with other systems and transmitted and delivered to points of delivery from a system. The CVP system may include transmission facilities owned by the Sierra Nevada Region or facilities that the Sierra Nevada Region has an entitlement or contractual right to use. Third party transmission means the Sierra Nevada Region uses transmission facilities other than its own to provide delivery of CVP power to its customers.

Unbundled Services

Products and services that are marketed individually.

Useable Storage

Water occupying active storage capacity of a reservoir.

Utility Customer

A customer that the Sierra Nevada Region serves that currently has a franchise to be the power supplier to the retail customers within a defined service area.

Water Rights

Permits or licenses issued after application to the State Water Resources Control Board are submitted.

Withdrawal Provisions

One of the initial components, it refers to the right to withdraw firm power under certain conditions related to contractual penalties and terms. This component was dropped from further study in the CRS because its effects are inconsequential. The requirement is addressed in the 2004 EIS and likely will be included in the 2004 Plan.

Yield

A measure of the availability of water to meet authorized purposes sometimes defined in terms of the ability to meet project needs within specific time periods.