Chapter 4
Affected Environment and Environmental Consequences

4.0 Introduction

This introduction lists the resources that could be affected by the implementation of any Restoration Project action alternative (Five-Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal) and discusses environmental baseline, affected environment, environmental consequences, and an environmental protection strategy. Following this introduction are resource-specific sections that describe the affected environment and environmental consequences associated with each resource.

Resources

The following resources could be affected by the implementation of any Restoration Project action alternatives. The affected environment and environmental consequences for each of the resources listed below are discussed in the sections that follow this introduction.

- fish
- botanical, wetland, and wildlife resources
- hydrology
- water quality
- groundwater
- land use
- geology and soils
- aesthetics and visual resources
- transportation
- noise
- air quality

- public health and safety
- public services and utilities
- recreation
- cultural resources
- power generation and economics
- socioeconomics
- environmental justice
- Indian trust assets

Environmental Baseline

Section 15125 of the State CEQA Guidelines (Title 14, California Code of Regulations, Section 21000 *et seq*.) states that "the environmental setting will *normally* constitute the baseline physical conditions by which a lead agency determines whether an impact is significant" (emphasis added). The environmental setting is further defined in this section as the physical environmental conditions in the vicinity of the project as they exist at the time the notice of preparation is published.

NEPA requires that the EIS present, for the alternatives, the environmental consequences and their significance (40 CFR 1506.16). *Significantly* is defined to require the federal agency to consider the "context and intensity" of the action (40 CFR 1508.27); however NEPA has no direct guidance regarding the baseline for determining the significance of an impact when preparing an EIS. According to CEQ's Memorandum "Forty Most Asked Questions Concerning CEQ's NEPA Regulations," question 3 states that the analysis No Action Alternative "provides a benchmark, enabling decision makers to compare the magnitude of environmental effects of the action alternatives." Therefore, some NEPA practitioners interpret this language to allow the No Action Alternative to be use as a baseline for determining the significance of the impacts within an EIS.

For the majority of environmental impacts in this EIS/EIR (those unrelated to flow), the lead agencies have chosen to use the current environmental setting as the baseline for determining the significance of environmental impacts. Except for those resources affected by flows, the current environmental setting (described in this document as the *affected environment*) is equivalent to the No Action Alternative.

For flow-related resources, the current conditions include the Interim Flow Agreement between Reclamation and PG&E. This agreement is, as its title suggests, a temporary flow condition that does not accurately reflect the conditions along Battle Creek; it is not included in the No Action Alternative. Use of the term *normally* in CEQA's definition of *environmental setting* is intended to convey that the environmental setting is not required to be the baseline for analysis of the significance of resource impacts when circumstances dictate the use of another baseline. Therefore, for the purpose of analyzing flow-related resource impacts, the Interim Flow Agreement is not included in the environmental baseline.

Affected Environment

In the sections that follow this introduction, affected environment is described for each resource. *Affected environment* includes the environmental setting and the regulatory setting, as appropriate. Within the regulatory setting, applicable laws, regulations, permits, and policies associated with the resource are identified.

Environmental Consequences

Environmental consequences are presented after the affected environment discussion for each resource. Impacts, as well as respective mitigation, compensation, or restoration, are discussed. In conducting the impact analyses, the action alternatives (Five Dam Removal [Proposed Action], No Dam Removal, Six Dam Removal, and Three Dam Removal) are compared with the No Action Alternative.

The significance of an impact relies on significance thresholds generally referenced in section 15065 and Appendix G of the State CEQA Guidelines and on professional judgment and knowledge of the context within which the impact would occur. As applicable, significant, less-than-significant, and beneficial impacts and cumulative impacts are identified for each resource being evaluated. Mitigation measures are recommended for all significant adverse impacts. Compensation or restoration measures are recommended for all other impacts.

NEPA requires a federal agency to prepare an EIS for major federal actions that significantly affect the quality of the human environment. *Significantly* as used in NEPA, requires the federal agency to consider both the context and intensity of the action and its effects. Although the CEQ NEPA regulations [40 CFR 1508.27] direct federal lead agencies to consider certain factors when determining context and intensity, there are no specific significance criteria spelled out as there are in CEQA. Determination of significance is left to the discretion of the federal lead agency. Because the CEQA guidance on thresholds of significance is more explicit than the NEPA guidance and the CEQA guidance is consistent with NEPA's concepts of *context* and *intensity*, this analysis of the Restoration Project will rely on the thresholds identified above.

For any Restoration Project action alternative, resources could be directly and indirectly affected during construction and future operation and maintenance activities. Construction- and operation-related impacts could result in temporary, short-term, or long-term disturbance of the resources.

Information included in the following sections—"Impact Terminology," "Impact Assessment Areas," "Impact Assumptions," and "Impact Mechanisms"—was used in environmental consequences impact analyses.

Impact Terminology

Types of environmental impacts are described below.

- A significant impact would cause a substantial adverse change in the environment. Mitigation is required for all significant impacts.
- A less-than-significant impact would cause an adverse, but not a substantial adverse, change in the environment. Compensation/restoration is planned for all less-than-significant impacts.
- A beneficial impact would cause a change in the environment for the better.

Impact Assessment Areas

The following areas associated with the Restoration Project action alternatives were included in environmental consequences impact analyses:

- dam removal sites and their work zones (including temporary cofferdams);
- fish ladder installation sites and their work zones;
- stream reaches with flow changes;
- proposed improved or new access roads;
- proposed improved, new, or to be removed hydroelectric project appurtenant facilities and their work zones;
- proposed improved or new trails; and
- proposed staging areas, stockpile areas, disposal areas, borrow material sites, parking areas, and construction administration sites (e.g., trailers, etc.).

Impact Assumptions

The following assumptions were made regarding Restoration Project action alternatives and were considered in environmental consequences impact analyses.

- For sites not accessible by existing or temporary access roads, construction equipment would be brought into the dam sites by helicopter; however, helicopters could be used at any site. Light equipment and tools would be hand-carried down existing access trails rather than along new means of access.

- Existing access roads would not be widened, including during re-grading and graveling activities (e.g., at the Wildcat Diversion Dam maintenance road).
- New temporary access roads may be constructed to remove pipelines at Wildcat Diversion Dam and the Soap Creek Feeder.
- If material from a dam removal were placed in the creek, it would be done in a manner that would not hinder flows. It is assumed that the natural streamflow would distribute the material throughout the downstream river system.
- All material-stockpiling areas and staging areas would be located either within the work zones in nonsensitive areas or at designated disturbed sites outside the work zones. All materials would be disposed of at the nearest approved commercial disposal site unless otherwise indicated.
- Removing portions of common and widespread habitat types, such as annual grassland, would not lead to substantial local decreases in those habitat types.
- Removing portions of uncommon and biologically unique habitats, such as riparian woodland, could lead to a localized decrease in those habitat types and could result in the direct loss of special-status species or their habitats.

Impact Mechanisms

The following activities, associated with Restoration Project action alternatives, were considered in environmental consequences impact analyses:

- excavation and vegetation removal;
- dewatering of waters of the United States;
- changing flows;
- alteration of instream flows as they relate to effects on aquatic organisms (other than fish) and riparian vegetation;
- temporary stockpiling and sidecasting of soil, construction materials, and/or other construction wastes;
- redistributing of diversion dam materials;
- construction of temporary and permanent access roads;
- soil compaction, dust, and water runoff from the construction site;
- equipment access through stream channels;
- construction-related noise from equipment and helicopters;
- construction of improvements to existing trails for construction access;
- site preparation for temporary water bypass structure;
- development of waste disposal areas to contain material from tunnel excavation and access road construction;

- decommissioning of open water diversion tunnels and conveyance canals; and
- impacts from growth inducement.

Cumulative Impact Analysis

Legal Requirements

State CEQA Guidelines and NEPA regulations require that the cumulative impacts of a proposed project be addressed in an EIR/EIS when the cumulative impacts are expected to be significant (40 CFR 1508.25[a][2], CEQA Guidelines Section 15130[a]). Cumulative impacts are impacts on the environment that result from the incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7, CEQA Guidelines Section 15355[b]). Such impacts can result from individually minor but collectively significant actions taking place over time.

Section 15130 of the State CEQA Guidelines states that the discussion of cumulative impacts need not provide as much detail as the discussion of effects attributable to the project alone. The level of detail should be guided by what is practical and reasonable.

Methodology

According to the State CEQA Guidelines (Section 15130), an adequate discussion of cumulative impacts should contain the following elements:

- an analysis of related future projects or planned development that would affect resources in the project area similar to those affected by the proposed project,
- a summary of the expected environmental effects to be produced by those projects with specific reference to additional information and the sources of the information, and
- a reasonable analysis of the cumulative impacts of the relevant projects and an examination of reasonable options for mitigating or avoiding the significant cumulative effects of a proposed project.

To identify the related projects, the State CEQA Guidelines (15130[b]) recommend either:

- the list approach, which entails listing past, present, and reasonably anticipated future projects producing related or cumulative impacts, including those projects outside the control of the agency; or

- the projection approach, which uses a summary of projections contained in an adopted general plan or related planning document designed to evaluate regional or areawide conditions.

The CEQA guidance for assessing cumulative impacts was used in this EIR/EIS. The cumulative impact assessment requirements under CEQA provide specific guidance and are consistent with and more stringent than those under NEPA. Therefore, this assessment focuses on meeting the requirements of CEQA as discussed in the State CEQA Guidelines.

Environmental Protection Strategy

Mitigation Strategies

Mitigation measures are methods and techniques that can be implemented to reduce the amount of adverse environmental impacts during and after construction. The following measures, identified in 40 CFR 1508.20 and in CEQA Guidelines Section 15370, were used in developing mitigation strategies for the Restoration Project action alternatives. These measures, listed in the order in which they would be applied, lay out a strategy to protect the environment.

1. Avoid the impact by not taking a certain action or parts of the action.
2. Minimize impacts by limiting the degree or magnitude of the action and its implementation.
3. Rectify the impact by repairing, rehabilitating, or restoring the affected environment.
4. Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action.
5. Compensate for the impact by replacing or providing substitute resources or environments.

General Environmental Protection Measures

As part of the environmental protection strategy, the following general environmental protection measures, based on the mitigation strategies described above, will be used before and during construction of any Restoration Project action alternative, where applicable. These measures are consistent with broader measures adopted in the CALFED record of decision (ROD) (CALFED 2000c). In addition to these general environmental protection measures, each resource section may discuss specific environmental protection measures, as well as mitigation for significant adverse impacts and compensation or restoration for all other impacts.

Develop and Implement a Worker Environmental Education Program

Construction contractor and subcontractor personnel will be required to participate in and comply with a government-provided environmental education program. This program will include, but is not limited to (1) awareness regarding federal, state and local environmental laws and regulations and permits, as well as the penalties for noncompliance with environmental requirements and conditions; (2) threatened and endangered species and special-status species, as well as their habitats; (3) cultural resource sites; and (4) environmental protection measures, mitigation, compensation, and restoration. A member of the contractor's management staff shall participate in the training sessions to discuss the contractor's environmental protection plans. Upon completion of each training session, each employee will be required to sign a statement indicating that he/she has received the training.

Obtain and Implement the Conditions of the Environmental Permits

All permit conditions included in the state and federal permits obtained for the project will be followed. Reclamation will obtain the required state and federal permits and comply with the conditions of those permits. Where appropriate, the permit conditions will be incorporated into the project engineering plans and specifications.

Develop an Environmental Compliance Monitoring Program

Reclamation will develop an environmental compliance monitoring program to ensure that the mitigation measures identified in this EIS/EIR are implemented in an appropriate and timely manner. As part of this construction monitoring program, Reclamation will retain qualified biologists, environmental resource specialists, and archeologists to monitor construction activities near environmentally sensitive areas, including areas that support threatened, endangered, and special-status species; migratory bird nesting; woody riparian vegetation; wetlands and perennial drainage crossings; and cultural sites.

Construction monitors will be hired and trained prior to construction and will be responsible for daily preconstruction surveys, staking resources, on-site monitoring, clearing equipment and vehicle staging areas, documentation of violations and compliance, coordination with construction inspectors, and postconstruction documentation. Resource monitors will be responsible for patrolling work zones and working with construction inspectors to ensure that barrier fencing, stakes, and required setback buffers are maintained.

The roles and responsibilities of the resource monitors and other individuals on the project, compliance documentation, and other elements of the environmental compliance monitoring program will be clearly outlined in the Implementation Plan (described below).

Designate Work Zones

Reclamation will ensure that construction equipment and associated activities will be confined to the designated work zone in areas that support sensitive resources. Construction equipment will be confined to a designated work zone (including access roads) at each project site. Prior to construction, the work zone will be clearly staked and flagged. During the environmental training program, construction personnel will be informed about the importance of avoiding ground-disturbing activities outside the designated work area. During construction, the construction monitors and resource monitors will ensure that construction equipment and associated activities avoid any disturbance of sensitive resources outside the designated work zones. Construction personnel will avoid all marked environmentally sensitive locations and cultural resources locations within and outside of the contractor use area limits. Environmental monitors will conduct surveys as appropriate for threatened and endangered species and special-status species. The following measures will also be employed:

- Use and storage of construction equipment, including helicopters, will be confined to within the designated contractor use area limits.
- Existing roads and access points will be used to the extent possible to minimize disturbance to wildlife and their habitats.
- Excavating, filling, and other earth-moving within the contractor use areas will be done gradually to allow wildlife to escape in advance of machinery and moving soils.
- Riparian vegetation or wetlands temporarily affected by loss or reduction of water supplies as a result of construction activities will be provided with replacement water supplies.
- Staging areas, borrow material sites, parking locations, stockpile areas, and storage areas will be located outside of environmentally sensitive locations and will be clearly marked and monitored.

Anadromous Fish Spawning Exclusion

Exclusionary materials will be placed on the stream bottom to prevent spawning by chinook salmon and steelhead prior to initiation of construction activities. The exclusionary materials will be installed in areas where heavy equipment may be operated within the stream channel or in the vicinity of potential blasting. Exclusionary materials, such as fencing, will be placed over gravels that potentially support spawning by chinook salmon and steelhead. The need for exclusionary materials at construction locations will be determined by a qualified fish biologist prior to any construction activity.

Implement Environmental Timeframes

All activities will be completed in a timely manner to minimize their duration and resulting impacts. In addition, all activities will occur during the times of the year that are least detrimental to the environment. Instream work will be conducted during periods of low streamflow, as explained in Section 4.1, "Fish." In addition, construction activities that could adversely affect nesting birds and their habitat will be limited to the nonbreeding period, and construction activities that could adversely affect bat colonies and their habitat will be limited to the non-hibernation, non-maternity colony period (August–October). Each are explained in Section 4.2, "Botanical, Wetland, and Wildlife Resources."

Develop an Implementation Plan

As part of the environmental protection strategy, a postconstruction mitigation, compensation, restoration, and reporting plan, referred to in this document as an Implementation Plan, will be developed through coordination with the state and federal agencies responsible for the Restoration Project. This plan will provide detailed information on how each mitigation measure will be implemented and monitored during the preconstruction, construction, and postconstruction periods. The implementation plan will contain the following documents:

- storm water pollution prevention plan (SWPPP) (including specific erosion control and site reclamation measures),
- spill contingency plan,
- riparian restoration plan,
- wetland restoration plan,
- oak planting plan,
- noxious weed eradication plan, and
- environmental compliance monitoring program.

4.1 Fish

This section presents information on fishes and other aquatic resources that occur or have the potential to occur within the geographical area encompassed by the Restoration Project and in the connected upper Sacramento River (i.e., Keswick Dam to Red Bluff). The recognition of the decline in salmon and steelhead populations in the Sacramento Valley and its tributaries has led to several legislative mandates to restore the fishery. The most relevant state planning process that initiated restoration on Battle Creek was the California Resources Agency's Upper Sacramento River Fisheries and Riparian Management Plan (1989), which involved public agencies, local government/communities, and stakeholders. Much of this state plan was later embodied in the CVPIA, which also includes the AFRP. The Restoration Project is part of a larger basinwide effort described in the CALFED Program Ecosystem Restoration Program Plan (ERPP) (CALFED 2000b). A focus of the ERPP is salmon and steelhead populations, the primary focus for the habitat improvements proposed for the Restoration Project.

Detailed biological data provided the background for this section (DFG 1966; Thomas R. Payne and Associates 1994, 1998a, 1998b, 1998c, 1998d; and Kier Associates 1999a). Information on the occurrence and life history of special-status fish in the Restoration Project area and the upper Sacramento River basin was obtained from the ERPP, Volumes I and II (CALFED 2000a, 2000b). The habitat analyses conducted by Thomas R. Payne and Associates (1998a) considered three resident fish. Flow/habitat relationships were developed for rainbow trout in the entire creek and for smallmouth bass in the mainstem.

Affected Environment

Regional Setting

The Restoration Project is located in the Battle Creek watershed in the Cascade Range Foothill physiographic region (Hickman 1993). The Cascade region's geology is derived from the volcanic formations created by Mount Lassen and its predecessor volcanoes. The volcanic formations produce a type of hydrology that is unusual for the Central Valley, characterized by abundant cold, spring-fed flows and relatively high dry-season base flows. The climate of Battle Creek is Mediterranean in the low-elevation, Sacramento Valley portions of the Restoration Project. Summers are hot and dry, with most of the precipitation falling as rain during the late fall, winter, and early spring months.

Restoration of Battle Creek will restore coldwater anadromous fish habitat unique to the Cascade region in Northern California. The construction of Shasta and Keswick Dams in the 1940s permanently blocked the access of chinook salmon and steelhead to 187 miles of unique Cascade region spawning and rearing habitat (Skinner 1958). Battle Creek (a tributary to the upper Sacramento River located approximately 28 river miles below Keswick Dam) has been identified as one of the only watersheds of significant size remaining in the Cascade region that has habitat types similar to the habitat types in which the now scarce salmon runs evolved (USFWS 1995b). Prior to the hydroelectric development in Battle Creek watershed more than a century ago, prime habitat for chinook salmon and steelhead extended from the confluence with the Sacramento River upstream to natural barrier waterfalls. The Restoration Project is designed to restore and reopen these habitats in the watershed. Although the Restoration Project will likely benefit all runs of salmon and steelhead, species that are specifically dependent on the Cascade region's unique habitat features, such as the winter-run chinook salmon, are a priority target species for the Restoration Project.

Species Occurrence and Status

Seventeen resident and anadromous fish species are known to occur in Battle Creek (Table 4.1-1).

Table 4.1-1. Fish Species in Battle Creek

Species	Scientific Name
Chinook salmon—N	(*Oncorhynchus tshawytscha*)
Steelhead trout—N	(*Oncorhynchus mykiss*)
Pacific lamprey—N	(*Lampetra tridentata*)
River lamprey—N	(*Lampetra ayresi*)
Rainbow trout—N	(*Oncorhynchus mykiss*)
Sacramento pikeminnow—N	(*Ptychocheilus grandis*)
Sacramento sucker—N	(*Catostomus occidentalis*)
California roach—N	(*Hesperoleucus symmetricus*)
Riffle sculpin—N	(*Cottus gulosus*)
Speckled dace—N	(*Rhinichthys osculus*)
Hardhead—N	(*Mylopharodon conocephalus*)
Three-spine stickleback—N	(*Gasterosteus aculeatus*)
Tule perch—N	(*Hysterocarpus traski*)
Brown trout—I	(*Salmo trutta*)
Smallmouth bass—I	(*Micropterus dolomieui*)
Green sunfish—I	(*Lepomis cyanellus*)
Golden shiner—I	(*Notemigonus crysoleucas*)

Species	Scientific Name
Notes : N = Native I = Nonnative Sources: Kier Associates 1999a, Thomas R. Payne and Associates 1998c, Moyle 2002	

Chinook salmon from the upper Sacramento River are important components of the commercial and sport fish along the Pacific Coast and an important sport fish in the Sacramento–San Joaquin River Delta (Delta) and Sacramento River. Steelhead are an important sport fish in the Sacramento River and its tributaries. Chinook salmon and steelhead are anadromous, spending the majority of their lives in the Pacific Ocean and migrating to freshwater rivers and streams to spawn. Prior to migration to the Pacific Ocean, juvenile fish rear in stream habitat anywhere from several weeks to several months. Steelhead remain in fresh water longer than chinook salmon. Pacific lamprey are similarly anadromous, but reside for several years in freshwater habitat.

The distribution and abundance of resident fish in Battle Creek were examined in detail in 1989 (Thomas R. Payne and Associates 1998c). Unlike anadromous species, the resident species in Battle Creek spend their entire lives in fresh water. Resident species include natives as well as nonnative. The assemblage of resident native fish that evolved in streams like Battle Creek transitions from warmwater species that occupy warmer, low-velocity reaches of the lower to mid-elevations to coldwater species that use colder, higher-velocity reaches of the mid- to high elevations (Moyle and Cech 1988). Warmwater species such as bass, sunfish, and native cyprinids (minnows) typically prefer slow-moving, low-velocity stream reaches in the low elevations of Battle Creek. Recreationally important coldwater resident species, such as brown and rainbow trout, generally prefer colder water and higher velocity than warmwater fish; however, their occurrences overlap to varying degrees. The upper portions of Battle Creek and the Hydroelectric Project's canal system are both acknowledged to support a sport fishery for rainbow and brown trout (Kier Associates 1999a).

Special-Status Fish Species

Special-status fish species present in the Sacramento River and its tributaries include chinook salmon and steelhead (Table 4.1-2). These species receive additional protection from the CESA and ESA based on scientific findings for their particular Evolutionarily Significant Units (ESUs).

Table 4.1-2. Special-Status Fish Species in Battle Creek

Species	Evolutionarily Significant Unit (ESU)	State Listing	Critical Habitat Designation	Federal Listing
Chinook salmon	Sacramento River winter-run	Endangered	Yes	Endangered
Chinook salmon	Central Valley spring-run	Threatened	Under development	Threatened
Chinook salmon	Central Valley fall-/late fall–run	None	Not applicable	Candidate/not warranted
Steelhead	Central Valley	None	Under development	Threatened
River lamprey	N/A	Species of Concern	Not applicable	Species of Concern

Winter-Run Chinook Salmon

Abundance of returning adult winter-run chinook salmon in the Sacramento River declined from approximately 120,000 adults in the late 1960s to a few hundred in the early 1990s. Since the early 1990s, winter-run chinook salmon abundance appears to be increasing (USFWS 2001a). Between 1987 and 1999, an average of 1,273 spawners returned each year to this basin. Juvenile production indices for naturally spawning winter chinook salmon averaged more than 1.9 million from 1995 through 1999, ranging between 384,146 and 4,628,597 annually (USFWS 2001a). Since the late 1990s, winter-run chinook salmon populations have increased. The likely explanation for these trends is a combination of factors, including improved freshwater and marine habitat conditions, changes in hatchery production, restricted commercial harvest, and changes to the operations of water development facilities in the Sacramento River, its tributaries, and its estuary.

Winter-run chinook salmon are unique to the Central Valley (Healey 1991). They originally occurred in the Sacramento River upstream of Shasta Dam and in Battle Creek (Yoshiyama et al. 1998). Currently, winter-run chinook salmon spawn and rear primarily in the Sacramento River. Historical reports of naturally produced winter-run chinook salmon in Battle Creek include observations of juvenile outmigrants in the early 1900s (Rutter 1902, 1903), runs in the late 1940s and early 1950s (USFWS 1987), uncounted runs in the late 1950s and early 1960s, and 24 adults observed in the South Fork of Battle Creek in 1965 (DFG 1965).

Monitoring conducted during a part of the migration period for winter-run and spring-run chinook salmon estimated that 0 to 4 of the observed adults were late fall–run chinook salmon, 0 to a few were winter-run, and approximately 100 were spring-run(USFWS 2002c). These observations were made after the hatchery program for winter-run chinook salmon was moved from Coleman National Fish Hatchery on Battle Creek to Livingston Stone National Fish Hatchery on the Sacramento River. Juvenile downstream migrant trap data indicated winter-run and spring-run juveniles were produced in Battle Creek (CAMP 2001). The number of winter-run chinook salmon in Battle Creek is unknown, but if they do occur, they are scarce.

The Sacramento River winter-run chinook salmon was state-listed as endangered on September 22, 1989 (CNDDB 2001) and federally listed as endangered on January 4, 1994 (59 FR 440). Designated critical habitat includes the Sacramento River from Keswick Dam downstream to the Sacramento–San Joaquin Estuary (58 FR 33212; June 16, 1993). Battle Creek is not included as critical habitat for winter-run chinook salmon; however, Battle Creek is the only stream in the Central Valley in which the recovery plan recommended an effort be made to establish a self-sustaining population of this ESU (NOAA Fisheries 1997b).

Spring-Run Chinook Salmon

Sacramento River spring-run chinook salmon population sizes have varied significantly since the 1950s, declining to less than 1,000 adults since 1991. Counts for this run at Red Bluff Diversion Dam, however, are not particularly reliable (DFG 1999). Estimated spawner escapement for the Sacramento River basin averaged 11,155 between 1987 and 1999 (USFWS 2001a). Yearly estimates range from 3,000 to more than 31,000 adults within this period.

Beginning with a short period in the 1940s, only sporadic counts of spring-run chinook salmon are available for Battle Creek. During this period, incomplete counts of 1,000 or more fish indicated that a relatively large population was present in Battle Creek (DFG 1998). Population estimates from recent years indicate a remnant of the original population, perhaps ranging between 50 and 100 (USFWS 2001a).

The Central Valley spring-run chinook salmon was state-listed as threatened on February 5, 1999 (CNDDB 2001) and federally listed as threatened on September 16, 1999 (64 FR 50394). NOAA Fisheries has withdrawn the critical habitat designation for spring-run chinook salmon.

USFWS administered a monitoring program for adult chinook salmon, rainbow trout, and steelhead in Battle Creek from March through October 2001 (USFWS 2002c). A total of seven reaches were sampled on a monthly basis: four reaches on mainstem Battle Creek; two reaches on North Fork Battle Creek (from the confluence to Eagle Canyon Diversion Dam); and one reach on the South Fork (from the confluence to Coleman Dam). From July through September, approximately 68 % of the chinook salmon observed in holding locations were observed in the South Fork reach. No chinook salmon were observed holding in the North Fork, and the remaining 32% were observed holding in the mainstem of Battle Creek (USFWS 2002c). It is not possible to determine whether the spring-run chinook salmon observed in the South Fork were natal to the South Fork or were falsely attracted to the South Fork during power system outages, when large amounts of predominantly North Fork power water were discharged to the lower South Fork for substantial periods of time while North Fork flow was low. USFWS monitoring revealed that 75% of chinook redds in their analysis area were located in the North and South Forks of Battle Creek (USFWS 2002c). The majority of the redds in the South Fork were located close to the Coleman Diversion Dam, where the fish ladder is impassable (USFWS 2002c). Redds were observed in the North Fork between Wildcat and Eagle Canyon Diversion Dams (near River Mile [RM] 3).

Fall-/Late Fall–Run Chinook Salmon

Fall-run chinook salmon constitute the largest population of spawning chinook salmon in both the Sacramento River and Battle Creek. Most fish in Battle Creek are thought to be derived from production at the Coleman National Fish Hatchery (USFWS 2001a). In the Sacramento River, abundance of adult fall-run chinook salmon has varied from approximately 50,000 to more than 100,000 adults; abundance in Battle Creek fluctuated from less than 10,000 to more than 100,000.

Late fall–run chinook salmon compose the second largest population of chinook salmon in the upper Sacramento River and Battle Creek. Run size estimates for late fall–run chinook salmon in the Sacramento River have steadily declined from approximately 35,000 adults in the late 1960s to approximately 7,000 to 10,000 adults in the early 1990s. Return of late fall–run chinook salmon to Coleman National Fish Hatchery increased from 323 to 7,075 over the period from 1995 to 1999. The majority of the Battle Creek population of this run is thought to be derived from Coleman National Fish Hatchery Production (USFWS 2001a).

Following a status review of the Central Valley fall-/late fall–run chinook salmon ESU, NOAA Fisheries determined that listing this ESU as threatened or endangered was not warranted. The ESU is designated as a candidate for listing under the ESA because of concerns over specific risk factors (NOAA Fisheries 1999). Long-term population trends appear generally stable or increasing; however, it is unclear whether natural populations are self-sustaining because hatchery and natural fall chinook salmon are not distinguishable and not all hatchery chinook salmon are marked (64 FR 50394; September 16, 1999).

Steelhead

Populations of steelhead in the Sacramento River basin have declined precipitously in the last 40 years. From 1953 through 1958 the population passing Red Bluff Diversion Dam averaged approximately 20,000 adults (Hallock et al. 1961). In recent years, based on comparison with adults returning to the Coleman National Fish Hatchery, most of the adults counted at Red Bluff Diversion Dam originated from the hatchery.

All naturally spawned adult steelhead are allowed to pass the barrier at Coleman National Fish Hatchery and migrate into the Battle Creek watershed. The returning adults during the winter of 2001–2002, however, represented the first year in which all returning hatchery steelhead had been marked to distinguish them from naturally occurring steelhead. Although estimates are generally unavailable, the size of naturally spawned steelhead populations in Battle Creek is fewer than 100–300 adults returning in a given year USFWS 2002c)

Central Valley steelhead was federally listed as threatened on May 19, 1998 (63 FR 13347); the steelhead is not state-listed. The final rule designating federal critical habitat for this species has been withdrawn.

Other Aquatic Organisms

In addition to fish, the aquatic community in Battle Creek includes many other organisms. The shallow, fast-flowing areas of the stream provide habitat for algae, crustaceans, and aquatic insects that make up part of the food web for fish in Battle Creek. Aquatic insects serve as a major food supply for resident fish and juvenile anadromous fish. Upon emergence from Battle Creek as adults, the aquatic insects contribute to the food supply of wildlife (e.g., flycatchers, bats, etc.).

Battle Creek and its tributaries also support amphibians. The early life stages of the amphibians spend their entire time in the water. Amphibians are discussed in more detail in Section 4.2.

The riparian communities in the Restoration Project area provide important habitat for stream-dependent wildlife. Terrestrial insects that inhabit riparian habitat contribute to the food supply for fish and amphibians. Shade provided by tall trees and shrubs reduces solar heating of the stream. Trees that fall into the stream, along with the roots that help hold the bank together, provide cover for fish. Leaves that accumulate on the streambanks and in the stream provide shelter as well as nutrients and food for aquatic and terrestrial species. Riparian communities and other stream-dependent species are discussed in more detail in Section 4.2.

Selected Species Life Histories

Chinook Salmon

The upper Sacramento River and its tributaries, including Battle Creek, provide essential habitat for adult holding, spawning, egg incubation, and juvenile rearing (Figure 4.1-1). Chinook salmon spend the largest proportion of their lives in the Pacific Ocean (generally 3 years, but ranging from 1 to 5 years). While reaching sexual maturity, adults migrate to the Sacramento River and its tributaries. Chinook salmon home to the stream where they hatched, although some adults stray and spawn in streams other than their streams of origin. Spawning requires cool water temperature, access to holding and resting pools, clean gravel for building nests, or redds, where eggs are deposited and fertilized, and suitable water velocity and depth.

As indicated previously, four runs of chinook salmon occur in the upper Sacramento River and Battle Creek: fall, late fall, winter, and spring. Identification of the runs is based on the time of year the adults leave the Pacific

Ocean and enter fresh water. Fall- and late fall–run chinook salmon spawn upon arrival at spawning grounds. One or more life stages of chinook salmon are found in the upper Sacramento River throughout the year. Limited studies indicate that chinook salmon in Battle Creek exhibit a life history pattern similar to that derived from the studies made at Red Bluff Diversion Dam (CAMP 2001). The actual timing of runs throughout the upper Sacramento River and its tributaries varies slightly from year to year as a function of weather, streamflow, and water temperature (Vogel and Marine 1991).

Spring-run chinook salmon migrate upstream in the spring and over-summer or hold in cool river and stream reaches where cover is provided by deep water or boulders. Adults spawn in August through October (Figure 4.1-1). The species is dependent on cold reservoir releases and cold spring-fed or high-elevation streams for holding and spawning habitat.

Winter-run chinook salmon migrate upstream in winter and hold in cool reaches during the spring and early summer (Figure 4.1-1). Adults spawn in the summer and are dependent on cool reservoir releases or streams dominated by cold spring water.

Steelhead

Steelhead occur in the upper Sacramento River and its tributaries, which provide the main habitat for holding, spawning, egg incubation, and fry and juvenile rearing. The number of steelhead that actually spawn in the Sacramento River is small. Spawning occurs primarily in cool reaches of tributaries.

The majority of adult steelhead migrate into the upper Sacramento River from July through March and spawn in the upper Sacramento River and its tributaries, such as Battle Creek, from December through April and possibly May in most years (Hallock et al. 1961, DFG 1996a, Kier Associates 1999a) (Figure 4.1-1). Steelhead home to the stream where they were hatched; although a portion of the population can be expected to stray and spawn in other streams.

Unlike chinook salmon, steelhead typically rear in the upper Sacramento River watershed for at least 2 years before migrating to the Pacific Ocean. Also unlike chinook salmon, steelhead may spawn more than once, returning to the Pacific Ocean between spawning runs. The proportion of the population that spawns more than once is small.

Other Anadromous Species

Pacific lamprey adults migrate to Battle Creek and the upper Sacramento River from July to October (Thomas R. Payne and Associates 1998c and as documented by U.S. Fish and Wildlife Service monitoring programs). Lampreys are eel-like in appearance. In the ocean, adults are parasitic, feeding off larger fish species including salmonids. Adults excavate a nest in gravel substrate where fertilized eggs are deposited. Following incubation, larval lamprey distribute in slow water where abundant organic material provides a source of food and cover. After 5 to 7 years of freshwater residence, lamprey begin their migration to the Pacific Ocean and, as they transform into the adult stage, develop a sucker-like mouth with numerous rasping teeth that are used to bore into the sides of host fish (Hart 1988).

Resident Species

Central Valley rivers include many other native and nonnative species (Table 4.1-1). In general, native species, such as Sacramento pikeminnow, hardhead, Sacramento sucker, and California roach, spawn early in the spring. Most native fishes do not guard the eggs or young. Native fishes are adapted to rear in areas that provide abundant cover and abundant prey (Moyle 2002).

With some exceptions, nonnative species, such as green sunfish and smallmouth bass, spawn later in the spring and in the summer. Nonnative species are more successful in disturbed environments than native species. In general, they are adapted to warm, slow-moving and nutrient-rich waters (Moyle 2002). An exception is the nonnative brown trout that spawns in the fall and has habitat requirements similar to rainbow trout, the nonanadromous form of steelhead.

Factors Affecting Abundance

Information relating abundance with environmental conditions is most available for chinook salmon and steelhead; therefore, the following section focuses on factors that have affected the abundance of chinook salmon and steelhead, especially within the Battle Creek Watershed. Although not specifically referenced, many of the factors discussed for chinook salmon and steelhead also have affected the abundance of other species, including resident fish species.

The decline of salmon and steelhead in the Sacramento River and its tributaries is attributed to a number of factors that have acted upon the populations in a cumulative fashion over decades. These factors include reduced key habitat quantity, reduced migration habitat, warm water temperature, increased contaminants, entrainment in diversions, increased predation, reduced food, hatchery effects, and harvest.

Key Habitat Quantity

The primary factor affecting spawning and rearing habitat area in Battle Creek is streamflow. Habitat quality is also significantly affected by temperature as influenced by diversion of cold spring water accretions away from adjacent stream sections and reduced flows in the stream below dams. Diversion for power generation have substantially reduced streamflow in all the reaches of Battle Creek downstream of Keswick Diversion Dam and South Diversion Dam. Although minimum flows are maintained, reduced streamflow has substantially reduced spawning and rearing habitat area available to chinook salmon, steelhead, and other fish species.

Limited information is available for flow-habitat relationships on Soap, Ripley, and Baldwin Creeks. However, the FERC license–required minimum flow of 0 cfs would not provide sufficient water to sustain fish. Occurrence of fish in the reaches below the existing diversion dams is limited under the No Action Alternative.

Spawning habitat area may limit the production of juveniles and subsequent adult abundance of some species. Spawning habitat area for fall-/late fall–run chinook salmon, which compose more than 90% of the chinook salmon returning to the Central Valley streams, has been identified as limiting their population abundance. Spawning habitat area has not been identified as a limiting factor for the less-abundant winter-run and spring-run chinook salmon (NOAA Fisheries 1997b; USFWS 1996), although habitat may be limiting in some streams (e.g., Battle Creek), especially during years of high adult abundance.

Spawning habitat area is defined by a number of factors, such as gravel size and quality and water depth and velocity. Although maximum usable gravel size depends on fish size, a number of studies have determined that chinook salmon require gravel ranging from approximately 0.3 cm (0.1 inch) to 15 cm (5.9 inches) in diameter (Raleigh et al. 1986). Steelhead prefer substrate no larger than 10 cm (3.9 inches) (Reiser and Bjornn 1979). Salmonids spawn in water depths that range from a few inches to several feet. A minimum depth of 0.8 foot for chinook salmon and steelhead spawning has been widely used in the literature and is within the range observed in some Central Valley rivers (DFG 1991). Velocity that supports spawning ranges from 0.8 foot per second to 3.8 feet per second (USFWS 1994).

Rearing habitat area may limit the production of juveniles and subsequent adult abundance of some species. Rearing habitat for salmonids is defined by environmental conditions such as water temperature, dissolved oxygen, turbidity, substrate, water velocity, water depth, and cover (Jackson 1992; Reiser and Bjornn 1979; Healey 1993).

Rearing area varies with flow. High flow increases the area available to juvenile chinook salmon because they extensively use submerged terrestrial vegetation on the channel edge and the floodplain. Deeper inundation provides more overhead cover and protection from avian and terrestrial predators than shallow water (Everest and Chapman 1972). In broad, low-gradient rivers, change in flow can greatly increase or decrease the lateral area available to juvenile chinook salmon, particularly in riffles and shallow glides (Jackson 1992).

Battle Creek is a high-gradient, headwater stream with an elevation change in excess of 5,000 ft over 50 miles. The creek flows through remote, deep-shaded canyons and riparian corridors with little development near its banks. Battle Creek flow consists of rainfall and snowmelt from the western slope of the Cascade Mountain Range, complemented by the year-round flow of natural springs.

Substrate size ranges from sand to boulder with predominantly gravel and cobble throughout the system. The total estimated area of spawning gravel is 57,000 square feet in the mainstem above Coleman Powerhouse; 81,000 square feet in the North Fork up to the barrier waterfall; and 28,000 in the South Fork up to Panther Creek (Thomas R. Payne and Associates 1994). Concentration and types of gravel deposits are directly correlated to stream gradient. Mobility studies imply that gravel in Battle Creek moves with enough frequency to keep it clean of fine sediment and loose enough to support spawning.

The Battle Creek channel is characterized by alternating pools and riffles. The channel form, along with boulders, ledges, and turbulence, provides key elements of rearing habitat for fish species.

Water Temperature

Fish species have different responses to water temperature conditions depending on their physiological adaptations. Salmonids in general have evolved under conditions in which water temperatures are fairly cool. In addition to species-specific thresholds, different life stages have different water temperature requirements. Eggs and larval fish are the most sensitive to changes in water temperature.

Unsuitable water temperatures for adult salmonids such as chinook salmon and steelhead during upstream migration lead to delayed migration and potential lower reproduction. Elevated summer water temperature in holding areas of Battle Creek causes mortality of spring-run chinook salmon (USFWS 1996). Warm water temperature and low dissolved oxygen also result in an increase of egg and fry mortality. USFWS (1996) cited elevated water temperatures as limiting factors for fall- and late fall–run chinook salmon in Battle Creek.

Juvenile salmonid survival, growth, and vulnerability to disease are affected by water temperature. In addition, water temperature affects prey species abundance and predator occurrence and activity. Juvenile salmonids alter their behavior depending on water temperature, including movement to take advantage of local water temperature refugia (e.g., movement into stratified pools, shaded habitat, and subsurface flow) and to improve feeding efficiency (e.g., movement into riffles).

Water temperature in Central Valley rivers frequently exceeds the tolerance of chinook salmon and steelhead life stages. Based on a literature review, conditions supporting adult chinook salmon migration are reported to deteriorate as temperature warms between 54ºF and 70ºF (Hallock 1970 as cited in McCullough 1999). For chinook salmon eggs and larvae, survival during incubation is assumed to decline with warming temperature between 54ºF and 63ºF (Myrick and Cech 2001; Seymour 1956). For juvenile chinook salmon, survival is assumed to decline as temperature warms from 64ºF to 75ºF (Myrick and Cech 2001; Rich 1997). Relative to rearing, chinook salmon require cooler temperatures to complete the parr-smolt transformation and to maximize their saltwater survival. Successful smolt transformation is assumed to deteriorate at temperatures ranging from 63ºF to 73ºF (Marine 1997; Baker et al. 1995).

For steelhead, successful adult migration and holding are assumed to deteriorate as water temperature warms between 52ºF and 70ºF. Adult steelhead appear to be much more sensitive to thermal extremes than are juveniles (McCullough 1999). Conditions supporting steelhead spawning and incubation are assumed to deteriorate as temperature warms between 52ºF and 59ºF (Myrick and Cech 2001). Juvenile rearing success is assumed to deteriorate at water temperatures ranging from 63ºF to 77ºF (Raleigh et al. 1984; Myrick and Cech 2001). Relative to rearing, smolt transformation requires cooler temperatures, and successful transformation occurs at temperatures ranging from 42.8ºF to 50ºF. Juvenile steelhead have, however, been captured at Chipps Island in June and July at water temperatures exceeding 68ºF (Nobriega and Cadrett 2001). Juvenile chinook salmon have also been observed to migrate at water temperatures warmer than expected based on laboratory experimental results (Baker et al. 1995).

Warm water temperature can limit the amount of habitat available and cause mortality of chinook salmon, steelhead, and other fish species in the Battle Creek system. Water temperature is determined primarily by weather, channel form and dimension, shade, and flow. Diversion of flow, including spring water accretions, from Battle Creek substantially warms water temperature, especially from March through October. Flow diversion and subsequent warming substantially reduce the habitat area that can support migration, holding, spawning, and rearing of chinook salmon and steelhead in Battle Creek (Kier Associates 1999a). Transbasin water diversions from the North Fork of Battle Creek to the South Fork tend to warm North Fork Battle Creek and cool South Fork Battle Creek. Additional information on water temperature is provided in Section 4.4, "Water Quality."

Migration Habitat

Migration habitat is the specific conditions that support migration of individuals to habitat required for activities essential to survival, growth, and reproduction. Migration habitat is supported by streamflows that provide suitable water velocities and depths.

Absolute barriers mark the terminus of the Restoration Project on North Fork and South Fork Battle Creek at all times. In the steep, high-elevation stream reaches there are natural features in the channel such as boulders and logs that can impede passage depending on vertical drop, flow depth, and flow velocity. Seven diversion dams block passage of chinook salmon, steelhead, and other fish species; a fish barrier at Coleman National Fish Hatchery blocks passage six months of the year.

Passage conditions that support migration of chinook salmon, steelhead, and other fish species in Battle Creek also have been affected by the reduction in streamflow attributable to diversions for power production. Streamflow affects passage conditions, both flows within the range that can be controlled by the Hydroelectric Project and the high, uncontrolled flows that spill. Natural events, such as floods, can alter physical characteristics of the channel, including depth of pools from which the fish jump, height that must be jumped, water velocity, slope of the streambed, and the length of the slope, all factors affecting passage. An on-site survey identified transitory barriers in 18 locations on North Fork Battle Creek and five locations on South Fork Battle Creek (Table 4.1-3). Passage of all or some adult chinook salmon and steelhead could be impaired under streamflow conditions in the range controlled by the hydroelectric diversions. Based on the conditions observed at the time of the survey, a general estimate was made of the streamflow allowing passage through the entire reach for all adult salmon and steelhead. On North Fork Battle Creek, obstacles required greater amounts of streamflow for unimpaired passage than on South Fork Battle Creek. In one extreme case on North Fork Battle Creek (river mile 5.14), an especially steep transitory barrier was modified by DFG in 1997 (Warner pers. comm.) to provide numerous ascent routes at more gradual slopes (Kier Associates 1999a).

The North Battle Creek Feeder, Eagle Canyon, Wildcat, Coleman, Inskip, and South Diversion Dams potentially block approximately 55 miles of upstream habitat. The fish ladders at Eagle Canyon, Wildcat, and Coleman Diversion Dams are considered ineffective under most flow conditions (DWR 1997 and 1998). The fish ladder effective flow range for each diversion dam is between 2 and 7 cfs. The ladder at the South Diversion Dam has an effective flow range between 3 and 35 cfs. The ladders proved impossible to maintain during high flows. During average or wet water years, fish ladders at North Battle Creek Feeder, Eagle Canyon, Wildcat, Inskip, and Coleman Diversion Dams could be ineffective for 3 to 8 months because flow exceeds the maximum effective capacity of the ladders by a factor of 10 or more. Fish ladders at Eagle Canyon and Coleman Diversion Dams were intentionally closed to fish passage under the 1998 Interim Agreement.

In addition to the barriers discussed above, Coleman National Fish Hatchery operates a barrier weir along with a fish ladder 5.5 miles upstream of Battle Creek's confluence with the Sacramento River (USFWS 2001a). When the fish ladder is closed, the barrier weir extends across the full width of Battle Creek and obstructs passage of adult steelhead and chinook salmon to Battle Creek above the hatchery. The barrier is not completely effective and some adult chinook salmon and steelhead pass the barrier, especially at flow in excess of 350 cfs. The number of adult chinook salmon passing over the barrier weir has been substantial (several thousand fish). The barrier weir is being redesigned to improve the ability to block upstream migration under all flow conditions. A fish ladder at the barrier weir is operated to manage and monitor passage of adult chinook salmon into Battle Creek upstream of the weir. The objectives of management currently are to:

- minimize the potential for hybridization between co-occurring, naturally-reproducing runs of chinook salmon in Battle Creek upstream of the barrier weir;
- minimize the risk of infectious hematopoietic necrosis (IHN) virus being shed into the Coleman National Fish Hatchery water supply; and
- monitor passage of salmonids.

Contaminants

In the Sacramento River, industrial and municipal discharge and agricultural runoff introduce contaminants. Organophosphate insecticides, such as carbofuran, chlorpyrifos, and diazinon, are present throughout the Central Valley and are dispersed in agricultural and urban runoff. Contaminants enter rivers in winter runoff and enter the estuary in concentrations that can be toxic to invertebrates (CALFED 2000a). Because they accumulate in living organisms, they may become toxic to fish species, especially those life stages that remain in the system year-round and spend considerable time during the early stages of development, such as chinook salmon and steelhead.

Water samples were collected at eight sites in the Battle Creek watershed and analyzed for metal, total suspended solids (TSS), and oil and grease. The results revealed that each of these parameters was within the EPA's recommended levels for aquatic life. Contaminant levels in Battle Creek are relatively low and adverse effects are not currently documented.

Entrainment

All fish species are entrained to varying degrees by diversions throughout the Sacramento River system. Fish entrainment and subsequent mortality are a function of the size of the diversion, the location of the diversion, the behavior of the fish, and other factors, such as fish screens, presence of predatory species, and water temperature. Low approach velocities and fish screens are assumed to minimize stress and protect fish from entrainment.

Given that most of the flow is diverted from Battle Creek for power production and that fish screens are absent from all of the diversions, most downstream migrant fish, including steelhead and chinook salmon, would be entrained. Survival of passage through the power turbines would likely be minimal and entrained fish would be lost from the population. Diversion volume is discussed in detail in Section 4.3, "Hydrology."

Predation and Pathogens

Native and nonnative species may cause substantial predation mortality on salmonids and other species. Nonnative fish predators in Battle Creek include brown trout, smallmouth bass, green sunfish, and other species (Table 4.1-1). Although the contribution to mortality is uncertain, predation mortality may reduce survival of juvenile chinook salmon and steelhead and other species, especially where the stream or river channel has been altered from natural conditions (DWR 1995). The existing diversion dams in the Restoration Project area may create environmental conditions that increase the probability that predator species will capture juvenile chinook salmon, steelhead, and other species during downstream movement. Water turbulence in the vicinity of the dams and other structures may disorient migrating juvenile chinook salmon and steelhead, increasing their vulnerability to predators. In addition, changes in flow velocity and depth affect the quality of habitat and potentially increase vulnerability of fish species to predation by other fish species and by birds and mammals.

Steelhead and chinook salmon that are present in Battle Creek carry pathogens, including IHN. Currently the potential for occurrence of fish pathogens associated with anadromous fishes is likely low because the abundance of chinook salmon and steelhead is relatively low. Rainbow trout (i.e., the resident form of steelhead) are susceptible to pathogens carried by stocked trout, chinook salmon, and steelhead. Rainbow trout are relatively abundant in the reaches of Battle Creek upstream of the diversion dams and in the canals conveying flow diverted from Battle Creek. Existing flows and fish ladder design and operation, including the operation of the fish barrier at Coleman National Fish Hatchery, control the migration and abundance of anadromous fish in Battle Creek and in reaches upstream of the diversion dams. Although data on the incidence of pathogens in wild populations of rainbow trout are not available, the low abundance of chinook salmon and steelhead in upstream reaches may minimize the incidence of pathogens upstream of diversion dams and in the canals conveying diversions.

Aquaculture facilities amplify pathogens and stress fish because of confined conditions, combining to create a higher level of disease in aquaculture settings than in wild populations in a stream. Rainbow trout (or other salmonid species) raised in the aquaculture facilities at Mount Lassen Trout Farms (MLTF) are potentially exposed to pathogens carried by chinook salmon and steelhead that spawn and rear upstream of the diversions for Eagle and Inskip Canals. The canal water seeps into the spring-fed water supplies servicing MLTF Jeffcoat and Willows Springs facilities, potentially carrying pathogens. The possibility of pathogens entering the aquaculture facilities increases with increasing abundance of chinook salmon and steelhead within the stream reaches upstream of the canal diversions.

Food

Food availability and type affect survival of fish species. Flow affects stream surface area and production of food. A primary factor affecting food production in Battle Creek is streamflow. Diversion for power generation has substantially reduced streamflow in all the reaches of Battle Creek downstream of Keswick Diversion Dam and South Diversion Dam. Although minimum flows are maintained, reduced streamflow has substantially reduced stream area. In addition, diversions entrain food organisms, exporting nutrients from segments of Battle Creek.

The density of adult salmon carcasses has been shown to increase nutrient input to stream systems and contribute to increased growth rates of juvenile salmonids (Wipfli et al. 2002). The historical reduction of chinook salmon populations also may have reduced food availability and productivity of Battle Creek.

Hatchery

The primary objective of the Coleman National Fish Hatchery is to serve as mitigation for the habitat lost when the upper Sacramento River and its tributaries were blocked by the construction of Shasta Dam in the 1940s. Coleman National Fish Hatchery propagates three salmonid stocks: fall-run chinook salmon, late fall–run chinook salmon, and steelhead trout (USFWS 2001a). The fall- and late fall–run chinook salmon and steelhead hatchery programs are considered to be integrated with naturally spawning fall chinook salmon in the upper Sacramento River and Battle Creek (USFWS 2001a). Risks that hatchery operations and augmentation may pose to natural populations of steelhead and chinook salmon include: introduction, spread, or amplification of fish pathogens; deleterious genetic effects of hatchery fish on natural stocks; impedance of migrating fish at the hatchery barrier weir and water intake structures; and exceeding the carrying capacity of riverine, estuarine, and marine habitat.

Harvest

Sport and commercial fishing affects the abundance of adult chinook salmon and steelhead (sport fishing only) returning to the Sacramento River system, including Battle Creek. Ocean survival may be reduced by 35%–85% (Pacific Fishery Management Council 2001). Ocean and river regulations have been implemented to minimize effects of sport and commercial fishing, especially on winter-run chinook salmon and steelhead. Sport fishing in Battle Creek may have local effects on anadromous and resident fish species that are currently unknown; however, Battle Creek is closed to the legal harvest of naturally produced anadromous fish.

Regulatory Setting

The regulations, laws, permits, and policies relevant to aquatic biological resources in stream reaches influenced by the operation of the Hydroelectric Project diversions and canals include:

- Federal Power Act;
- Fish and Wildlife Coordination Act (16 USC 661-667e);
- ESA administered by NOAA Fisheries for anadromous fish and USFWS for nonanadromous species (16 USC 1531 *et seq*);
- California Fish and Game Code, in particular sections relating to dams and diversions (Section 5900 *et seq*.), streambeds (1600 *et seq.*), and CESA administered by DFG (Sections 2080 and 2081 *et seq*) and sport fishing regulations;
- Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267);
- Clean Water Act Section 401 (clean water certification) and 402 (NPDES permitting) administered by SWRCB and the RWQCB through the Regional Water Quality Control Board, Central Valley Region (CVRWQCB) Basin Plan
- Clean Water Act Section 404 administered by the Corps for dredge-and-fill activities; and
- California Water Code Section 1707 regarding dedication of water to instream environmental purposes administered by SWRCB.

Environmental Consequences

This section identifies and describes potential beneficial and adverse effects on fish species that could result from implementation of the Restoration Project. The analysis is based on the best available information relevant to the proposed changes in the operation of the Hydroelectric Project and modification of its facilities. Feasible mitigation measures are provided for each significant adverse impact to reduce it to a less-than-significant level. Monitoring is also identified for mitigation measures as appropriate.

Assessment species are selected based on listing under the ESA, listing in environmental management plans (e.g., local environmental plans and state resource agency plans), and ecological, economic, or social importance. Information relating changes in environmental conditions to effects on species survival and abundance is most available for chinook salmon and steelhead. Therefore the following assessment provides the greatest detail for factors that may affect chinook salmon and steelhead within the Battle Creek watershed. In addition, the Restoration Project focuses on reestablishing and enhancing the production of winter- and spring-run chinook salmon and steelhead that use habitat in the project area for adult migration, adult holding, spawning, egg incubation, juvenile rearing, and juvenile migration. There is a recognized need to stabilize and increase the populations of these three species in the upper Sacramento River basin, including Battle Creek. When appropriate, discussions include a qualitative and general assessment of the effects on other fish species, including resident fish species.

Summary

The flow and channel dimensions of Battle Creek were modified in the late nineteenth century by development of hydroelectric facilities that included construction of multiple dams and diversions (Reynolds et al. 1980). The primary purpose of the Restoration Project is to reestablish steelhead and winter- and spring-run chinook salmon populations in Battle Creek. Consequently, most of the project impacts on fish and fish habitat are beneficial. The Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal Alternatives would restore habitat that could serve to reestablish steelhead and chinook salmon populations, substantially increasing the population abundance of steelhead and winter- and spring-run chinook salmon relative to the No Action Alternative.

Significant adverse impacts on fish and fish habitat in Battle Creek may occur during construction of project elements, including the removal of dams under the Five Dam Removal, Six Dam Removal, and Three Dam Removal Alternatives. The following significant adverse impacts could occur:

- short-term mortality and lowered growth rates and reproductive success of fish and other aquatic species in Battle Creek as a result of accidental spill of petroleum products and other construction-related materials;
- short-term mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species as a result of increased fine sediment to Battle Creek from construction activities; and
- short-term mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species as a result of removing Eagle Canyon, South, and Coleman Diversion Dams, which would temporarily release stored fine sediment to the stream channel

The adverse impacts would be reduced to less-than-significant levels through development and implementation of toxic materials control and spill response plans, a vegetation protection plan, erosion and sediment control plans, and worker environmental education programs. Work in and near the stream channel, including removal of dams, would be conducted during the dry season to minimize the mobilization of fine sediment (i.e., July–October).

Beneficial impacts would occur through substantially increasing the population abundance of steelhead, spring-run chinook salmon, winter-run chinook salmon, and other species that historically were part of the aquatic community in Battle Creek. There are different levels of performance and certainty for the beneficial impacts derived from each of the four action alternatives, but in general the different levels include:

- increased capacity for spawning and rearing habitat for steelhead and chinook salmon as a result of increased minimum instream flows for various reaches and tributaries;
- increased production of fry and juvenile life stages for steelhead and chinook salmon as a result of cooler water temperatures for various reaches and tributaries;
- increased survival of juvenile fish as a result of decreased flow fluctuations associated with power system operations, resulting from installation of tailrace connectors and flow ramping operations;
- increased survival of adults and increased spawning success as a result of higher instream flows that would improve conditions that facilitate passage of chinook salmon and steelhead over natural barriers;
- increased survival of adults and increased spawning success as a result of removing diversion dams, depending on the alternative, and constructing more effective fish ladders on remaining dams to facilitate passage of chinook salmon and steelhead;
- increased spawning success and fry production as a result of ceasing discharge of North Fork Battle Creek water to South Fork Battle Creek (resulting in reduced straying caused by abnormal olfactory cues and cooler temperatures of mixed water) to facilitate the return of adult chinook salmon and steelhead to natal spawning habitat in North Fork Battle Creek (depending on alternative);
- increased survival of juvenile steelhead and chinook salmon during downstream movement and migration as a result of eliminating some diversions and constructing fish screens on the remaining diversions on Battle Creek; and
- increased food production for fish as a result of increased minimum instream flows.

Detailed analysis and results are presented in the following sections.

Methods

Existing literature and discussions with fish biologists knowledgeable about the project area provided information used to evaluate the environmental consequences of the Proposed Action on fishes and their habitats.

The assessment addresses construction-related impacts and long-term impacts. Construction-related impacts are those effects that occur during or shortly after construction activities, including potential spill of contaminants and input of fine sediment, direct injury to individual organisms, temporary impedance of movement (i.e., migration habitat), and temporary disturbance of the channel bottom and bank. Construction-related impacts are generally of relatively short duration and affect a restricted area, although effects may continue over many years and extend into downstream areas. Long-term impacts include changes to key habitat quantity (as estimated by the Instream Flow Incremental Methodology [IFIM]), this includes a habitat quality component), migration habitat, water temperature, entrainment in diversions, predation, and food. Long-term impacts are associated with permanent and ongoing (e.g., hydropower operations) changes in environmental conditions. The project is not expected to substantially influence existing and ongoing harvest and hatchery effects, factors that currently affect the abundance of steelhead and chinook salmon that was discussed in the affected environment section.

A variety of predictive models on physical and biological parameters have been linked together to provide a relative assessment of fish production indices for each alternative. Many of the inputs to the models require assumptions based on observations taken at many times and places. These observations are broadly simplified in models to examine conditions and fish survival and productivity indices. If the assumptions and inputs to the models are sufficiently representative of actual conditions, and the model is applied equally to all alternatives, the model output is usable for discerning differences among alternatives to meet the needs for NEPA and CEQA. It should be noted that the models contain varying degrees of accuracy and should not be construed as predictive. A key premise of this impact assessment is that the tools applied support the comparison of alternatives based on the available physical and biological information. The water temperature survival indices, flow-habitat relationships, and other elements should not be considered as specific management recommendations or targets for the management of flow, water temperature, or other environmental conditions in Battle Creek or elsewhere in Central Valley rivers.

Key Habitat Quantity

Methods for evaluating key habitat quantity rely on minimum flow requirements for each of the alternatives (for details, see Section 4.3, “Hydrology”). Streamflow directly influences the availability and function of important habitat elements, including water velocity, depth, wetted area, and cover. Flow-habitat relationships for Battle Creek are based on the IFIM and Physical Habitat Simulation (PHABSIM) system (Milhous et al. 1984, Thomas R. Payne and Associates 1998a). Flow-habitat relationships are applied to minimum flow requirements for each alternative to estimate available spawning and rearing habitat area for chinook salmon and steelhead (Appendix F).

The estimated spawning habitat area is used to calculate a fry capacity index—the potential capacity to produce chinook salmon fry and steelhead fry. Fry are young fish that have recently emerged from a redd (a nest constructed by the female fish). The calculation takes into consideration redd size, the number of eggs produced by each female, and an estimated base survival rate.

The estimated rearing habitat area is used to calculate a juvenile capacity index—the potential capacity to produce juvenile chinook salmon and steelhead. Juveniles are young fish that have finished rearing in Battle Creek and are ready to begin downstream migration. The calculation takes into consideration the habitat need of an individual fish. The potential production of juvenile fish cannot exceed the potential number of fry produced (i.e., fry capacity index) or the juvenile capacity index.

Water Temperature

As water temperature increases toward the extremes of the tolerance range of a fish, biological responses, such as impaired growth and risk of disease and predation, are more likely to occur (Myrick and Cech 2001; Sullivan et al. 2000). Acceptable water temperatures identified in the available literature for chinook salmon and steelhead life stages fall within a relatively broad range (See the discussion above, Factors That Affect Abundance of Fish Species—Water Temperature). Conclusive studies of the thermal requirements completed for chinook salmon and steelhead in Central Valley streams are limited (Myrick and Cech 2001), but for the purposes of this impact assessment, survival indices are based on experimental tolerance studies reported in the literature.

Monthly average water temperature was simulated for the minimum flow requirements in each reach of Battle Creek for each alternative (for details, see Section 4.4, "Water Quality"). Temperature survival suitability indices were calculated for chinook salmon and steelhead life stages, including incubation and rearing (Appendix F). The survival indices applied in this assessment support the comparison of alternatives and should not be considered specific management recommendations or targets for water temperature management in Central Valley rivers.

The water temperature assessment builds on the assessment of Key Habitat Quantity discussed above. Temperature-survival relationships are applied to simulated water temperature for each alternative to estimate survival through incubation and rearing. The potential effects of water temperature are presented as production indices for fry and juveniles (Appendix F).

Migration Habitat

Migration habitat includes the specific conditions that support migration of individuals to spawning and rearing habitat, in particular the upstream migration of adult chinook salmon and steelhead. Methods for evaluation of migration habitat are qualitative. Minimum required flows under each alternative are used to assess the potential for impedance of migration. Delay and multiple attempts at passing the dams or natural barriers may reduce the survival of adults because of injury and exhaustion. After failed attempts at passing a dam, adults may spawn downstream of the dams where survival of eggs may be reduced by warmer water temperature.

The effective flow range for fish ladders is used to determine the potential for passage impedance at all dams (Table 4.1-4). For natural barriers (Table 4.1-3), Thomas R. Payne and Associates (1998b) determined flows that would allow fish passage at all low-flow barriers. Flow less than the minimum passage flow are assumed to impede upstream migration. Although the minimum passage flows are based on field observation of potential barriers (Thomas R. Payne and Associates 1998b), the actual impedance of migration is uncertain, and adult steelhead and chinook salmon undoubtedly would pass many of the barriers at lower flows or take advantage of peaks in runoff.

In addition to flow barriers, mixing of North Fork Battle Creek flow with South Fork Battle Creek flow potentially results in false attraction of adult chinook salmon and steelhead from their natal reaches in North Fork Battle Creek. Water temperature in North Fork Battle Creek is cooler than temperature in South Fork Battle Creek. Water temperatures required for spawning and rearing of steelhead and chinook salmon are more likely to be adverse in South Fork Battle Creek, especially from April through October. Reproductive failure of adults that stray to South Fork Battle Creek may reduce the overall year class production for Battle Creek as a whole, depending on the level of habitat saturation in North Fork Battle Creek.

The mechanisms that allow salmonids to home properly generally stem from their ability to recognize the olfactory characteristics of their home stream (Hasler and Scholz 1983). Juvenile salmonids remember, or "imprint on," the smell of organic compounds that are uniquely characteristic of a given stream or stream reach. When returning to fresh water to spawn, adult salmonids use these odors to locate and return to the stream reach where they were hatched and reared. Homing may be influenced by such factors as flow, water temperature, presence of other salmon, and habitat quality (Pascual and Quinn 1994; Quinn 1984, 1997). For instance, the homing precision of salmon increases with the relative magnitude of streamflow present in the home stream (Hindar 1992).

Evaluation of the potential for false attraction is qualitative. The proportion of the flow in South Fork Battle Creek that comprises flow discharged from North Fork Battle Creek is assumed to indicate the potential for false attraction. False attraction is assumed to increase at higher proportions of North Fork Battle Creek flow.

Entrainment in Diversions

Diversions entrain fish encountering the intake. Fish diverted into the hydropower canals are assumed to suffer total mortality and not contribute to annual production for the species populations in the stream. For reaches upstream of a diversion point, the proportion of production entrained is assumed equal to the proportion of streamflow diverted. Simulated flows and diversions under each alternative (for details, see Section 4.3, "Hydrology") are used to assess the potential entrainment. Fish screens that function at design and performance criteria are expected to avoid most losses of juvenile chinook salmon and steelhead attributable to entrainment and impingement.

Predation, Pathogens, and Food

Analysis of potential effects on predation and pathogens is qualitative. Dams and the associated fish ladders and other facilities are assumed to increase predation above natural levels, potentially increasing the abundance of predators and disorienting prey. Increased abundance of chinook salmon and steelhead is assumed to increase the occurrence of salmonid pathogens in Battle Creek.

Analysis of food effects is similarly qualitative. Prey abundance affects growth rate and the survival of individual fish. Prey abundance may increase with increased stream surface area. The minimum required flows under each alternative (for details, see Section 4.3, "Hydrology") are used to estimate stream surface area and assess relative differences in prey-species production.

Impact Significance Criteria

Impacts are considered significant when project actions potentially reduce the abundance and distribution of the assessed fish species (CEQA State Guidelines Section 15065 and Appendix G). Impacts may occur through:

- change in conditions affecting the movement of any resident or migratory fish species and other aquatic species,
- long- or short-term change in habitat quality or quantity,
- effects on rare or endangered species or habitat of the species, and
- effects on fish communities or species protected by applicable environmental plans and goals.

Significant impacts occur when changes in environmental conditions change the abundance, geographic range, or seasonal timing of any species life stage.

Impact Assessment

Table 4.1-5 summarizes the facility and instream flow modifications proposed for the No Action, Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal Alternatives. Impacts associated with each alternative are described in the following sections.

Table 4.1-5. Summary of Facility and Instream Flow Modifications for the No Action and the Proposed Salmon and Steelhead Restoration Alternatives

	Alternative				
Component	NA	5D[1]	ND	6D	3D
Remove Eagle Canyon Diversion Dam and appurtenant facilities				T	T
Remove Wildcat Diversion Dam and appurtenant facilities		T		T	T
Remove South Diversion Dam and appurtenant facilities		T		T	
Remove Soap Creek Diversion Dam and appurtenant facilities		T		T	
Increase releases at all Battle Creek dams not removed to levels per MOU		T		T	
Increase releases at all Battle Creek dams not removed to levels per AFRP			T		T
Remove Lower Ripley Creek Diversion Dam and facilities		T		T	
Remove Coleman Diversion Dam and appurtenant facilities		T		T	T
Provide water below dam sites on Soap and Lower Ripley Creeks		T			
Reoperate and gage Asbury Dam		T		T	T
Provide water below Asbury Diversion Dam		T		T	T
Redirect cold water from spring complexes from canals to adjacent creek reaches		T		T	T[2]
Maintain and replace, as needed all fish ladders on dams	T	T	T	T	T
Construct North Battle Creek Feeder Diversion Dam fish screen and fish ladder		T	T	T	T
Construct Eagle Canyon Diversion Dam fish screen and fish ladder		T	T		
Construct Wildcat Diversion Dam fish screen and fish ladder			T		
Construct South Diversion Dam fish screen and fish ladder			T		T
Construct Inskip Diversion Dam fish screen and fish ladder		T	T	T	T
Construct Coleman Diversion Dam fish screen and fish ladder			T		
Screen and ladder designs meet failsafe definition in MOU		T	T	T	T
Construct tailrace connector between South Powerhouse and Inskip Canal		T		T	
Construct channel to separate South Powerhouse tailrace waters from the stream					T
Construct tailrace connector between Inskip Powerhouse and Coleman Canal		T		T	T
Construct Inskip Powerhouse bypass facility		T		T	
Provide ramping rate during operations reducing flows below dams		T	T	T	T

Component	Alternative				
	NA	5D[1]	ND	6D	3D

Notes:
[1] The Five Dam Removal Alternative is the Proposed Action as developed in the MOU.
[2] Includes only springs at Eagle Canyon.
NA = No Action Alternative
5D = Five Dam Removal Alternative
ND = No Dam Removal Alternative
6D = Six Dam Removal Alternative
3D = Three Dam Removal Alternative.

No Action Alternative

Under the No Action Alternative, the facilities and operations (Table 4.1-5) are assumed to abide by the conditions of the current FERC license. As part of the FERC license, fish ladders would be maintained and operated in accordance with all applicable and relevant regulations, and the existing minimum flows would continue to be provided.

The No Action Alternative does not meet the underlying purpose of and need for the Restoration Project. Without the Restoration Project, it is expected that Battle Creek would continue to support relatively low numbers of anadromous salmonids as observed in the past. The steelhead and chinook salmon produced in Battle Creek would not be expected to contribute to the population and recovery goals for the upper Sacramento River basin as a whole.

Construction-Related Effects

Construction of new facilities and removal of existing facilities are not proposed under the No Action Alternative, and fish species would not be affected.

Long-Term and Ongoing Effects

Long-term and ongoing effects fall into five categories: key habitat quantity, water temperature, migration habitat, entrainment in diversions, and predation, pathogens, and food.

Key Habitat Quantity and Predicted Fish Capacity Indices. Based on flow-habitat relationships, the minimum flow required under the No Action Alternative (i.e., FERC license-required minimum flows) potentially supports spawning habitat area with a capacity index of approximately 760,000 fry, depending on the species (see the Methods section for more information on the model output for fry capacity indices and its limitations). Figures 4.1-2 through 4.1-5 show the capacity indices for each reach of North Fork and South Fork Battle Creek under all alternatives. Habitat areas used to calculate capacity are discussed in Appendix F

Minimum flow requirements under the No Action Alternative support rearing habitat with a capacity index of approximately 360,000 juveniles, depending on the species, as shown on Figures 4.1-6 through 4.1-9. The capacity index for fry exceeds the capacity index for juveniles, indicating that surplus fry could be produced in years when the abundance of adults is sufficient to use all available spawning habitat. A surplus of fry, however, assumes that other environmental conditions would not substantially reduce fry production (i.e., see the assessment of water temperature effects described below).

The number of fry and juveniles indicated in Figures 4.1-2 through 4.1-9 reflects the assumption that adult steelhead can access all reaches and that chinook salmon can access all reaches except Keswick. An assessment of access to the reaches is provided in a following section (Migration Habitat). Late fall–run chinook salmon may be limited primarily to reaches downstream of Wildcat and Coleman Diversion Dams; therefore, the capacity indices may be overestimated. Including the capacity represented by the mainstem, Coleman, and Wildcat reaches might be a better estimate of expected capacity indices. Although some fall-run chinook salmon spawn in Battle Creek upstream of Coleman National Fish Hatchery, capacity indices are not simulated because current management objectives include blocking fall-run chinook salmon at the hatchery weir. Capacity indices of fall-run chinook salmon would likely be similar in magnitude and pattern to the indices represented by late fall–run chinook salmon (Figures 4.1-6 and 4.1-9).

Limited information is available for flow-habitat relationships on Soap, Ripley, and Baldwin Creeks. However, the FERC license–required minimum flow of 0 cfs would not provide sufficient water to support fish. Occurrence of fish in the reaches below the diversion dams on these streams is limited under the No Action Alternative.

Water Temperature. The water temperature assessment uses the capacity to produce fry and juvenile life stages identified in the assessment of key habitat quantity (see above). The potential effects of water temperature under the No Action Alternative are presented for fry and juveniles for the minimum flow requirements under each alternative (Figures 4.1-2 through 4.1-5 and Figures 4.1-6 through 4.1-9). Water temperatures that potentially occur in Battle Creek reduce the capacity indices of fry and juveniles.

Estimated survival for steelhead fry is relatively high, as indicated by 78% survival attributable to water temperature conditions during the incubation period (Table 4.1-6). Water temperature effects on spring- and winter-run chinook salmon are substantially more severe, with as little as 20% survival for spring-run fry and 5% survival for winter-run fry. The increased severity is attributable to the timing of spawning for spring- and winter-run chinook salmon that coincides with warmer water temperatures.

Estimated survival for juvenile steelhead is lower than the survival estimated for fry because juvenile steelhead rear through the warm summer months (Table 4.1-6). Approximately 44% of the steelhead fry production are estimated to survive as a result of water temperature conditions during the juvenile rearing period. Water temperature effects on juvenile spring-run chinook salmon are less than effects described for juvenile steelhead because rearing occurs in cooler months.

Expected survival attributable to water temperature effects could be substantially less than indicated. Two factors could result in warmer water temperatures and lower survival of fry and juveniles.

- Digger Creek inflow may have biased the water temperature data used for calibration of the water temperature model. The model may predict cooler water temperature and higher survival than would actually occur, resulting in overstatement of fry and juvenile production indices. This is especially true for the No Action Alternative because low minimum flow requirements could result in greater warming between North Battle Creek Feeder and Eagle Canyon Diversion Dams.
- Cool water temperatures below Inskip and Coleman Diversion Dams are dependent on discharge of cool North Fork Battle Creek water into warmer South Fork Battle Creek flow. Failure of the canal and powerhouse facilities could interrupt the discharge of North Fork Battle Creek water and result in warming of Inskip and Coleman reaches. Warmer water temperatures would reduce survival and result in lower fry and juvenile production indices for steelhead and chinook salmon.

Migration Habitat. The minimum flows required (i.e., existing FERC license flows) below the diversion dams in the steeper elevation reaches of the North Fork and South Fork Battle Creek result in conditions that impede passage of adult chinook salmon and steelhead. Passage over dams and natural barriers, as identified previously (Tables 4.1-3 and 4.1-4), is facilitated by flow in excess of the minimum effective flow and, for dams, less than the maximum effective flow. Barriers may impede passage of adult steelhead and chinook salmon under the No Action Alternative (Table 4.1-7). Impeded passage may result in lower survival of adults, minimal use of upstream spawning habitat, and spawning in locations supporting lower egg survival. Impeded passage occurs relatively far downstream under the No Action Alternative, indicating the potential of limited habitat access.

Although fish ladders on existing diversion dams would be maintained and replaced as needed under the No Action Alternative, the effective flow range for existing fish ladders at all dams except South Diversion Dam is between 2 and 7 cfs (Table 4.1-4). The ladder at South Diversion Dam has an effective flow range between 3 and 35 cfs. Flow less than 3 cfs and in excess of 35 cfs is assumed to impede passage. Fish ladders potentially impede passage of adult steelhead and chinook salmon at higher flows. The existing fish ladders are also susceptible to obstruction by debris and can be maintained only during low streamflows. Debris and maintenance issues may further impede passage of fish.

Under the No Action Alternative, flow diverted from North Fork Battle Creek is discharged into South Fork Battle Creek at South and Inskip Powerhouses. North Fork Battle Creek discharge mixes with the South Fork Battle Creek flow, resulting in a relatively high proportion of North Fork Battle Creek flow continuing downstream in the South Fork channel (Table 4.1-8). The presence of significant North Fork Battle Creek water in South Fork Battle Creek potentially increases the false attraction of North Fork chinook salmon and steelhead. Environmental conditions in South Fork Battle Creek (e.g., water temperature) support lower production of chinook salmon and steelhead than environmental conditions in North Fork Battle Creek. False attraction could result in lower overall production. The potential for increased false attraction is currently unknown, given that adults returning to their natal reach may be able to distinguish the correct pathway.

In addition to false attraction, the discharge of cool water at Inskip and Coleman Diversion Dams may cause winter- and spring-run chinook salmon to break off their upstream migration. The gradient of warm to cool water temperatures from downstream to upstream may be a primary cue for migration to natal spawning areas. Winter- and spring-run chinook salmon may not move to cool reaches upstream of South Diversion Dam and may hold and spawn downstream of Coleman and Inskip Diversion Dams. Failure of the canal and powerhouse facilities could interrupt the discharge of North Fork Battle Creek water and result in warming of Inskip and Coleman reaches. Warmer water temperatures could substantially reduce adult and egg survival, resulting in lower fry production.

Entrainment in Diversions. Diversions occur at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams. The proportion of flow diverted under the No Action Alternative is as high as 97% in some months (Table 4.1-9). The diversion fraction depends on the monthly flow and the monthly diversion (Section 4.3, "Hydrology"). The modeling has shown results for five levels of monthly flows, corresponding to each 20% increment of possible future flows during each month. These values are shown in Appendix L. The diversion flow was divided by the sum of the diversion flow and the flow released below the diversion dam to calculate the percentage of flow diverted at the dam (Table 4.1-9). Diversions entrain fish encountering the intake. Fish diverted into the hydropower canals are assumed to suffer total mortality and not contribute to annual production for the species populations in the stream. Under the No Action Alternative, most of the production of steelhead and chinook salmon would be lost to entrainment in diversions, especially during dryer years.

Predation, Pathogens, and Food. The existing dams and the associated fish ladders and other facilities are assumed to maintain predation above levels that would occur in the absence of dams. Juveniles passing over the dams are potentially disoriented by turbulent flow conditions. In addition, the dams may stop the upstream migration of predatory species, such as pikeminnow. Concentration of pikeminnow below the diversion dams coincident with the downstream migration of juvenile salmonids could increase predation losses. The potential effect on steelhead, chinook salmon, and other species, however, is unknown.

Prey abundance affects growth rate and the survival of individual fish. Prey abundance may be dependent on stream surface area and the associated primary productivity. The summer stream area under the No Action Alternative is approximately 109 acres (Table 4.1-10).

Five Dam Removal Alternative (Proposed Action)

The Five Dam Removal Alternative proposes to reoperate and modify the hydropower facilities on North Fork and South Fork Battle Creek and three of its minor tributaries: Soap, Ripley, and Baldwin Creeks (Table 4.1-5). Reoperation would increase and stabilize streamflow for the purpose of significantly increasing cold water and stream area and providing a reliable migratory pathway over obstacles in the project area.

The Five Dam Removal Alternative proposes to modify the facilities at remaining diversion dams to substantially improve the reliability and effectiveness of upstream and downstream fish passage (Table 4.1-5). New fish screens and fish ladders that meet NOAA Fisheries and DFG criteria would be constructed at three diversion dams (North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams). Five diversion dams would be removed (Wildcat, South, Coleman, Soap Creek Feeder, and Lower Ripley Creek Feeder Diversion Dams). Connectors are proposed that prevent the discharge of North Fork Battle Creek water to South Fork Battle Creek and the mixing of flow sources. Higher minimum flow requirements (i.e., MOU minimum flow requirements) would increase instream flows, subsequently cooling water temperature, increasing stream area, and providing reliable passage conditions for adult salmonids in downstream reaches. In addition, the MOU minimum flow requirements support future adaptive management that may incorporate new information related to flows needed to facilitate passage, increase habitat area, and improve water temperature conditions.

Construction-Related Effects

Short-term construction-related effects fall into four categories: key habitat quantity, migration habitat, contaminants, and direct injury.

Impact 4.1-1 Significant—Mortality and lowered growth rates and reproductive success of fish and other aquatic species in Battle Creek from an accidental spill of petroleum products and other construction-related materials (contaminants). Construction activities associated with removing the five dams would include dismantling and removing Wildcat, South, Coleman, Soap Creek Feeder, and Lower Ripley Creek Feeder Diversion Dams and their appurtenant facilities. Heavy equipment would be used in the channel to remove the concrete structure, gravel, rock, and other materials from the dam footprint. Construction of the fish screens and ladders would involve blasting and dismantling the existing structures and constructing new facilities. Construction of the Inskip Powerhouse bypass facility and the tailrace connectors at South and Inskip Powerhouses would include the use of heavy equipment. The use of heavy equipment in and near the stream channel would increase the potential for an accidental spill of petroleum products, concrete wash, and other construction-related materials into the channel.

Depending on the volume of petroleum products and other construction-related contaminants entering the stream, growth, reproduction, and survival could be adversely affected. The impact of contaminant spill is significant because the abundance of steelhead, spring-run chinook salmon, and other fish and aquatic life could be substantially reduced. Effects on population abundance and aquatic species diversity could be short term or could continue over several years. Implementing the following mitigation measures would reduce the impact to less-than-significant levels.

Mitigation Measures for Impact 4.1-1. Significant impacts attributable to accidental spill of petroleum products will be reduced to less-than-significant levels by requiring contractors to develop and implement toxic materials control and spill response plans. Toxic materials control and spill response plans will regulate the use of hazardous materials, such as petroleum-based products used as fuel and lubricants for equipment and other potentially toxic materials associated with project construction. Reclamation would implement a construction-area fish management program to emphasize the importance of protecting chinook salmon and steelhead trout and their habitat.

Impact 4.1-2 Significant—Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species because of increased sedimentation to North Fork and South Fork Battle Creek as a result of construction activities (contaminants). Construction activities would mobilize fine sediments through direct disturbance and increased erosion. Input of fine sediment to the stream could infiltrate gravel substrates and adversely affect the quality of spawning habitat for steelhead and chinook salmon. The occurrence of fine sediment in spawning gravel in excess of 30% substantially increases the mortality of eggs and larvae of chinook salmon and steelhead (Reiser and Bjornn 1979). Deposition of fine sediment on occupied redds would fill interstitial spaces between gravel and cobble substrates, inhibiting the flow of oxygen-rich water to the embryos and impeding the ability of larval fish to exit the redd after hatching. The impact of fine sediment is significant because the abundance of steelhead and spring-run chinook salmon could be substantially reduced. Effects on population abundance and aquatic species diversity could be short term or could continue over several years, depending on the extent and duration of fine sediment input and on flow conditions that mobilize and transport fine sediment through the stream ecosystem. Infiltration of fine sediment into gravel would also adversely affect habitat for other aquatic species, such as aquatic insects that live in gravel and that provide food for fish. Implementing the following mitigation measures would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.1-2. Significant impacts attributable to mobilization of fine sediments would be reduced to less-than-significant levels by requiring contractors to develop a vegetation protection plan (Section 4.2, “Botanical, Wetland, and Wildlife Resources”) and erosion and sediment control plans (Section 4.7, “Geology and Soils”). Contractors will be required to develop and implement a vegetation protection plan to protect vegetation during construction. Contractors will also be required to develop and implement an erosion and sediment control plan to minimize the potential for sediment input to the aquatic system. The plans will include Best Management Practices (BMPs) to control sediment discharge during construction of roads and excavation and other activities in the stream channel during installation of fish screens and fish ladders and during dam removal. A worker environmental education program will be implemented by Reclamation to emphasize the importance of protecting chinook salmon and steelhead trout and their habitat from construction-related impacts.

Impact 4.1-3 Significant—Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species as a result of removing South, Coleman, and Eagle Canyon Diversion Dams, which would release currently stored fine sediment to the stream channel (contaminants). The removal of South, Coleman, and Eagle Canyon Diversion Dams would release sediment currently stored behind the dams. The volume and type of sediment stored behind the dams varies, with 30,000 yd^3 at South Diversion Dam and 28,000 yd^3 at Coleman Diversion Dam. Eagle Canyon Diversion Dam is relatively small and would not release substantial sediment. Removal of the dams potentially increases the input of fine sediment to the stream channel. The input of fine sediment would increase turbidity and sedimentation of gravel substrates. Increased turbidity could adversely affect feeding efficiency of juvenile steelhead and chinook salmon and other species dependent on sight in locating prey. The impact of increased turbidity would be relatively minor because the effect would be temporary. Sedimentation of gravel, however, would be a significant impact.

This impact is similar to that described above for Impact 4.1-2. Implementing the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.1-3. Reclamation will remove diversion dams during low-flow conditions (July–October) to minimize the downstream transport of fine sediment. Fine sediment would subsequently be mobilized and transported by higher flows during winter storms, minimizing deposition in gravel substrates and potential adverse effects on egg and larvae of chinook salmon and steelhead and other aquatic organisms dependent on clean gravel.

Impact 4.1-4 Less than significant—Disturbed steelhead and chinook salmon habitat in the stream channel as a result of construction activities (key habitat quantity). Construction activities associated with removing the five dams would include dismantling and removing Wildcat, South, Coleman, Soap Creek Feeder, and Lower Ripley Creek Feeder Diversion Dams and their appurtenant facilities. Construction of the tailrace connectors between South Powerhouse and Inskip Canal and between Inskip Powerhouse and Coleman Canal would also include work in the stream channel. Heavy equipment would be used in the stream channel to remove the concrete structure, gravel, rock, and other materials from the dam footprint or to prepare the site for construction of facilities. To a lesser degree, construction of fish screens and fish ladders at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams would also disturb the channel bottom and bank.

The disturbance of the channel bottom and bank would alter the channel dimensions and form and the existing substrate. The changes in the channel may adversely affect conditions supporting spawning and rearing habitat (i.e., removal of gravel or changes in depth and velocity). This impact is considered less than significant because the affected spawning and rearing habitat area is small relative to total spawning and rearing habitat in Battle Creek; existing channel structure and substrate at these locations do not currently provide spawning and rearing habitat; and some of the affected areas would provide spawning and rearing habitat after construction is complete. No mitigation is required.

Impact 4.1-5 Less than significant—Disrupted movement and migration of fish species as a result of dewatering portions of the stream channel and temporarily removing fish ladders during construction (migration habitat). Construction activities within the stream channel may include placement of cofferdams to isolate constructed elements from the streamflow and temporary removal of existing fish ladders. Depth and velocity conditions that support movement and migration of fish species may be interrupted temporarily. This impact is considered less than significant because upstream passage of anadromous salmonids is currently blocked at Eagle Canyon and Coleman Diversion Dams. Although in-channel work will also occur at Wildcat Diversion Dam, which is downstream of Eagle Canyon Diversion Dam, removal of the existing dam is not expected to affect a substantial proportion of the migration period. This impact is considered less than significant. No mitigation is required.

Impact 4.1-6 Less than significant—Compromised feeding efficiency of sight-feeding fish from erosion and the input of fine sediment as a result of construction and demolition activities (contaminants). Vegetation would be removed and the soil would be graded in order to construct staging areas and new roads and expand existing roads in the project area. Construction and demolition activities adjacent to or in the flowing waters of Battle Creek and its tributaries would disturb soils and the streambed, potentially leading to erosion and input of fine sediment. The input of fine sediment would increase turbidity and sedimentation of gravel substrates. Increased turbidity could adversely affect feeding efficiency of juvenile steelhead and chinook salmon and other species dependent on sight to locate prey. The impact of increased turbidity is considered less than significant because the effect would be temporary. No mitigation is required.

Impact 4.1-7 Less than significant—Vulnerability of all life stages of fish to injury or mortality from percussion-related energy shock waves, operation of equipment, and becoming trapped in isolated pockets of water during construction activities (direct injury). Removal of the five diversion dams; construction of the Inskip Powerhouse bypass facility; construction of the tailrace connectors between South Powerhouse and Inskip Canal, and between Inskip Powerhouse and Coleman

Canal; and the construction of the fish screens and fish ladders at Eagle Canyon and Inskip Diversion Dams could physically injure and kill eggs, larvae, and juvenile fish. During incubation salmonid embryos are immobile and sensitive to percussion-related energy shock waves. During construction of fish facilities and demolition of dams, equipment may be operated in the streambed, potentially crushing incubating eggs, larvae, and juvenile fish that may be present.

The construction of access roads, trenches, and foundations for fish facilities and demolition of water management facilities may all require blasting of the bedrock common throughout the project area. Percussion-related shock waves created during these construction and deconstruction activities could cause mortality to chinook salmon and steelhead trout eggs incubating in the gravel. Juvenile fish may also be affected.

Cofferdams would be installed to divert flow and isolate the in-channel construction area from the main streamflow. Placement of cofferdams in the stream channel could trap salmonids and other fish species. Fish that become trapped in isolated pockets of water could be killed during desiccation of the construction area and construction activities.

Field surveys in the project area have revealed that chinook salmon and steelhead spawning and rearing habitat exists immediately below each diversion dam where construction activities are anticipated to occur. This impact is considered less than significant because the affected spawning and rearing habitat area is small relative to total spawning and rearing habitat in Battle Creek, construction will occur over a relatively short period of time, and measures will be implemented to exclude spawning within the construction foot print (see the general environmental protection measures listed in the introduction to this chapter, Section 4.0). In addition, salmon and steelhead access is currently being temporarily confined to the Restoration Project area downstream of Coleman and Eagle Canyon Diversion Dams (NOAA Fisheries, DFG, USFWS pers. comm.). No mitigation is required.

Long-Term and Ongoing Effects

Long-term and ongoing effects fall into five categories: key habitat quantity; water temperature; migration habitat; entrainment in diversions; and predation, pathogens, and food.

Impact 4.1-8 Less than significant—Reduced habitat and range of some resident warmwater species because of cooler water temperatures (water temperature). Cooler water temperatures, especially in the mainstem of Battle Creek, would reduce the linear extent of habitat area available to warmwater fish species currently found in Battle Creek (e.g., smallmouth bass, green sunfish, and Sacramento pikeminnow). The range of some resident warmwater species will be reduced. The impact is considered less than significant because the affected warmwater species are relatively abundant and found throughout the Central Valley; habitat area and quality may increase for all species in response to increased flow and increased productivity; and reestablishment of higher flows is consistent with restoration of conditions that existed prior to construction and operation of the Hydroelectric Project on Battle Creek. No mitigation is required.

Impact 4.1-9 Less than significant—Decreased rainbow trout abundance in canals as a result of eliminating some diversions and constructing effective fish screens at three dams (migration habitat). The extensive canal system for the hydropower facilities, including Cross Country Canal, South Canal, Union Canal, Inskip Canal, Eagle Canyon Canal, and Coleman Canal, supports juvenile and adult rainbow trout and other species (DFG 1966). Spawning habitat for rainbow trout within the canals is limited. The abundance of rainbow trout in the canals is dependent on entrainment of juvenile and adult rainbow trout from Battle Creek. Entrainment would continue to maintain rainbow trout abundance in the canals under the No Action Alternative but would not continue under the Five Dam Removal Alternative. The cessation of diversion at South, Coleman, and Wildcat Diversion Dams and the construction of effective fish screens at Inskip, North Battle Creek Feeder, and Eagle Canyon Diversion Dams (Table 4.1-5) would stop entrainment of rainbow trout. Rainbow trout abundance would likely be substantially less under the Five Dam Removal Alternative than under the No Action Alternative.

The adverse impact of reduced rainbow trout abundance in the canals is considered less than significant because the populations in the canals are not self-sustaining, and draining of the canals for maintenance periodically eliminates most of the rainbow trout from the canals. Most fish stranded in drained canals are rescued and released to Battle Creek. No mitigation is required. The substantial benefit of dam removal and fish screens to production of juvenile chinook salmon and steelhead (i.e., the anadromous form of rainbow trout) in Battle Creek is discussed in detail in the following section.

Impact 4.1-10 Less than significant—Increased exposure of rainbow trout to pathogens because of the increase of chinook salmon and steelhead in Battle Creek (predation, pathogens, and food). As indicated above, the Five Dam Removal Alternative would substantially increase the abundance of chinook salmon and steelhead in Battle Creek. The number of adult steelhead and chinook salmon spawning in Battle Creek may increase to several thousand adults, at least several times the abundance expected under the No Action Alternative. Increased abundance of chinook salmon and steelhead and occurrence upstream of Eagle Canyon, North Battle Creek Feeder, and Inskip Diversion Dams potentially increases the occurrence of pathogens in those reaches and in the water diverted from South Fork and North Fork Battle Creek. Rainbow trout populations in Battle Creek and the canals conveying Battle Creek diversions will have increased exposure to the pathogens, and the occurrence of pathogens in rainbow trout would potentially increase. Rainbow trout populations coexist with anadromous fish populations in the Sacramento River and other Central Valley Rivers. Therefore, the potential effects of increased occurrence of pathogens on rainbow trout in Battle Creek and the canals would likely be less than significant. No mitigation is required. Within aquaculture facilities, however, effects of pathogens may be amplified because of confined conditions. Effects of pathogens on rainbow trout raised by fish farms is discussed in Chapter 4.16 under Socioeconomics.

Impact 4.1-11 Beneficial—Substantially increased capacity indices for spawning and rearing of steelhead and chinook salmon resulting from increased minimum instream flows (key habitat quantity). The Five Dam Removal Alternative would increase the minimum instream flows in multiple reaches of Battle Creek (i.e., MOU minimum flow requirements). The increased flow would increase spawning and rearing habitat area, potentially increasing the capacity to produce additional fry and juvenile salmonids relative to the No Action Alternative. In addition, the MOU minimum flow requirements support future adaptive management of flow targets that may incorporate new information on flow-habitat relationships.

The increased spawning and rearing habitat area would be expected to increase the abundance of steelhead and spring-, winter-, and late fall–run chinook salmon through increased capacity for fry and juvenile life stages. Based on flow-habitat relationships, the flow under the Five Dam Removal Alternative potentially supports spawning habitat area with capacity index of 6.1 million fry, depending on the species (Figures 4.1-2 through 4.1-5). The fry production indices for all species under the Five Dam Removal Alternative are several times greater than indices for the No Action Alternative.

Similarly, flows under the Five Dam Removal Alternative support rearing habitat with a capacity index greater than 1.5 million juveniles, depending on the species (Figures 4.1-6 through 4.1-9). The juvenile capacity indices for the Five Dam Removal Alternative are, for most species, several times greater than indices for the No Action Alternative.

The increase in capacity indices is substantial relative to capacity indices under the No Action Alternative. Habitat capacity for fry exceeds the habitat capacity for juveniles, indicating that surplus fry could be produced in years when the abundance of adults is sufficient to use all available spawning habitat. A surplus of fry, however, assumes that other environmental conditions would not substantially reduce the production indices (i.e., see the assessment of water temperature effects described below).

Limited information is available for flow-habitat relationships on Soap, Ripley, and Baldwin Creeks. The removal of dams on Soap and Ripley Creeks and the substantial increase in minimum flow (i.e., greater than zero), would provide habitat that would support additional steelhead and possibly chinook salmon, contributing to the beneficial impact identified above. Although the contribution cannot be quantified, the increased flow would provide spawning and rearing habitat for salmonids that does not exist under the No Action Alternative, especially for steelhead (DFG file correspondence by Terry Healy, 1998, Redding, CA).

Soap Creek has a series of large cold springs that support a stable cold year-round flow. A self-sustaining rainbow trout population has been documented in a tributary to Soap Creek above the dam (DFG file correspondence by Douglas Parkinson, 1984, Redding, CA). In addition to habitat upstream of the Soap Creek Feeder Diversion Dam, approximately ¾ mile of habitat will become accessible to steelhead from the confluence of Battle Creek to the existing dam.

A small spring maintains a flow of approximately 3 cfs upstream of the dam on Ripley Creek. Within the upper Sacramento River basin, rainbow trout are known to use small tributaries like Ripley Creek in the wet season for spawning and rearing before the stream warms in the summer months. During the wet season, flow would provide habitat for spawning and rearing. With removal of the dam on Ripley Creek, more than a mile of stream would be accessible.

Baldwin Creek extends ¾ mile from Battle Creek to Asbury Dam. Flow released from Asbury Dam is contributed by Darrah Creek, a major cold spring–fed tributary. Flow below Asbury Dam in Baldwin Creek would provide rearing habitat for salmonids during the summer and during the wet season when spawning occurs.

Reestablishing higher streamflow under the Five Dam Removal Alternative benefits other species, including resident fish, aquatic invertebrates, amphibians and stream-dependent wildlife. Greater stream area potentially provides greater habitat area for other fish and other aquatic species. This impact is considered beneficial. No mitigation is required.

Impact 4.1-12 Beneficial—Substantially increased production indices for fry and juvenile life stages for steelhead and chinook salmon as a result of cooler water temperatures (water temperature). The water temperature assessment uses the capacity indices for fry and juvenile life stages identified in the assessment of key habitat quantity above. Increased flows (i.e., MOU minimum flow requirements) and subsequent cooler water temperature associated with the Five Dam Removal Alternative during the late spring, summer, and early fall months could substantially increase salmonid survival relative to survival under the No Action Alternative. Soap Creek inflow would also increase under the Five Dam Removal Alternative. The flow originates from cold springs and could further increase water temperature benefits in the South Fork of Battle Creek. Any additional benefit from Soap Creek inflow cannot be calculated from the available information. In addition, the MOU minimum flow requirements support future adaptive management of water temperature that may incorporate new information on water temperature needs during incubation and rearing life stages.

The increased production indices for fry and juvenile life stages under the Proposed Action would be expected to increase the abundance of steelhead and spring-, winter-, and late fall–run chinook salmon. The potential increase in production indices for fry and juvenile steelhead and chinook salmon in response to cooler water temperature under the Five Dam Removal Alternative would be substantial (Figures 4.1-2 through 4.1-5 and Figures 4.1-6 through 4.1-9, respectively).

The expected increase in survival of steelhead fry is substantial compared to the No Action Alternative (i.e., greater than 10 %) (Table 4.1-6). Juvenile steelhead survival is expected to increase by 30% relative to the No Action Alternative. Water temperature effects on spring- and winter-run chinook salmon also would be substantially beneficial. Survival of spring-run fry would increase by 8%, and juvenile survival by 40%. Survival of winter-run fry would increase by 7%, and juvenile survival by 2%. Late fall–run survival is less affected by water temperature than the other chinook salmon runs because spawning occurs in the winter. Winter- and spring-run chinook salmon would receive the most temperature benefits from increased flows and cool water accretions because spawning occurs during warmer months. This impact is considered beneficial. No mitigation is required.

Impact 4.1-13 Beneficial—Increased survival of adults and increased spawning success because higher instream flows would improve conditions that facilitate passage of chinook salmon and steelhead over natural barriers (migration habitat). The Five Dam Removal Alternative would increase the minimum flows (i.e., MOU minimum flow requirements) in multiple reaches of Battle Creek relative to the No Action Alternative (i.e., FERC minimum flow requirements). The increased minimum flow would improve passage conditions over natural barriers, facilitating upstream habitat use and increasing survival and spawning success of adult chinook salmon and steelhead. In addition, the MOU minimum flow requirements support future adaptive management of passage conditions that may incorporate new information on flow-passage relationships.

The maintenance of higher flows would improve passage conditions, substantially increasing unimpeded access to upstream spawning habitat (Table 4.1-7). Although the precise benefit of higher flows may not be illustrated by the required minimum flow, survival of adult chinook salmon and steelhead would increase because of reduced potential for injury and exhaustion related to multiple attempts at passing partial barriers. Improved passage would also facilitate distribution of adults to available upstream spawning habitat that could increase survival of eggs and production of fry.

Impact 4.1-14 Beneficial—Increased survival of adults and increased spawning success because removal of five dams and the construction of more reliable effective fish ladders would facilitate passage of chinook salmon and steelhead (migration habitat). Removal of Wildcat, Coleman, Soap Creek Feeder, Lower Ripley Creek Feeder, and South Diversion Dams under the Five Dam Removal Alternative and construction of improved fish ladders on North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams would provide significantly greater upstream passage efficiency relative to passage conditions provided in the No Action Alternative. The removal of dams and construction of ladders would substantially increase unimpeded access to upstream spawning habitat. Survival of adult chinook salmon and steelhead would increase because of reduced potential for injury and exhaustion related to multiple attempts at passing the dams. Improved passage would also facilitate distribution of adults to available upstream spawning habitat that could increase survival of eggs and production indices for fry.

The removal of dams and construction of more effective fish ladders under the Five Dam Removal Alternative would improve passage conditions for adult chinook salmon and steelhead. The proposed ladder capacity would be at least 10 times the capacity of existing ladders (Table 4.1-4). The ladders would be designed to convey 110% of the streamflow at average spill conditions for each diversion dam and facilitate adult passage under nearly all flow conditions. Where necessary, additional flow would be directed to facilitate attraction of adult salmonids into the ladder, minimizing delay associated with flow spilling over the dam. The new fish ladders would be designed to automatically clear debris and include safe maintenance access under all streamflow conditions. Detailed monitoring and operation and maintenance plans for the proposed ladders under the Five Dam Removal Alternative are included in this document for review (Appendix D). This impact is considered beneficial. No mitigation is required.

Impact 4.1-15 Beneficial—Potentially increased spawning success and fry production because eliminating the discharge of North Fork Battle Creek water to South Fork Battle Creek would facilitate the return of adult chinook salmon and steelhead to natal spawning habitat in South Fork and North Fork Battle Creek (migration habitat). Ceasing the discharge of North Fork Battle Creek water to South Fork Battle Creek would minimize the potential for increased false attraction to South Fork Battle Creek that exists under the No Action Alternative. The effect on population abundance is unknown, however, because the potential level of false attraction is uncertain given that adult chinook salmon and steelhead may be able to distinguish the correct pathway. Although the stream of origin is unknown, false attraction of winter-run chinook salmon to the South Fork is supported by observation of spawning below Coleman Diversion Dam (DFG 1966). Incubation of winter-run chinook salmon eggs is not supported by the warm summer water temperatures in this reach. Environmental conditions in South Fork Battle Creek (e.g., water temperature) support lower production indices for chinook salmon and steelhead than environmental conditions in North Fork Battle Creek. False attraction could result in lower overall production for the Battle Creek watershed.

With cessation of the discharge of North Fork Battle Creek water into the South Fork Battle Creek at Inskip and Coleman Diversion Dams, the gradient of warm to cool water temperatures from downstream to upstream would be restored. The restoration of the gradient may help ensure movement of adult winter- and spring-run chinook salmon to cool reaches upstream of South Diversion Dam. Flow and water temperature fluctuations that may occur during powerhouse outages would be minimized, and warming of Inskip and Coleman reaches would no longer occur. Successful adult holding and egg survival may be more consistently supported upstream of South Diversion Dam.

Under the Five Dam Removal Alternative, tailrace connectors would be constructed between South Powerhouse and Inskip Canal and between Inskip Powerhouse and Coleman Canal. Water delivered to South and Inskip Powerhouses originates from three locations in the North Fork Battle Creek watershed (i.e., Volta 2 Powerhouse, North Battle Creek Feeder Diversion Dam, and Eagle Canyon Diversion Dam). Flow diverted from North Battle Creek Feeder Diversion Dam would no longer be discharged into South Fork Battle Creek at South and Inskip Powerhouses. The absence of significant North Fork Battle Creek water in South Fork Battle Creek would facilitate return of adult chinook salmon and steelhead to natal spawning habitat in South Fork and North Fork Battle Creek. This impact on fish is considered beneficial. No mitigation is required.

Under the No Action Alternative, powerhouse outages result in canal flow spilling down natural pathways to enter South Fork Battle Creek near the existing powerhouses. The outage and subsequent canal spill cause short-term disruptions of flow to short segments of stream channel between the existing powerhouses and the canal intakes. In addition, the overland flow may warm the water temperature, depending on the weather during the outage.

Under the Five Dam Removal Alternative, tailrace connectors constructed between South Powerhouse and Inskip Canal and between Inskip Powerhouse and Coleman Canal and the Inskip bypass facility (i.e., designed to return bypass flow to the Coleman Canal), would minimize flow and water temperature fluctuations that may occur during powerhouse outages. The connectors and the bypass facility during would provide benefits during outages. The level of benefit would depend on the extent of stream affected by the outages and the frequency and duration of the outages. Historical outages have varied in frequency and duration (Table 4.1-11). The connectors would reduce the influence of outages on fish habitat in the South Fork. In addition, ramping rates would be implemented to gradually reduce high flows resulting from outages as the power plants and canals come back on line (Chapter 2). The ramping rates are designed to minimize stranding losses as flows are returned to normal following outages.

The removal of dams under the Five Dam Removal Alternative would also minimize adverse effects of powerhouse or canal outages that result in flow temporarily spilling down the South and North Forks of Battle Creek downstream of existing diversion dams (i.e., South Diversion Dam, Coleman Diversion Dam, and Wildcat Diversion Dam). The outages and subsequent canal spill cause short-term disruptions of flow in downstream reaches. When the canal and powerhouse come back on line, the drop in flow may result in desiccation of redds and stranding of juvenile and adult fish. The removal of dams would minimize flow fluctuations that may occur during canal outages. The level of benefit would depend on the extent of stream affected by the outages and the frequency and duration of the outages.

Under the Five Dam Removal Alternative, planned maintenance would be scheduled during the period of February 1 through April 30, as specified in the

MOU and AMP. Historical outages have varied in timing, frequency and duration (Table 4.1-11). The removal of dams, construction of connectors and the bypass, and subsequent minimization (i.e., ramping rates) and avoidance of flow fluctuation attributable to spill would avoid short-term fluctuation in habitat availability and the potential for stranding losses. This impact on fish is considered beneficial. No mitigation is required.

Impact 4.1-16 Beneficial—Substantially increased survival of juvenile steelhead and chinook salmon during downstream movement and migration as a result of eliminating some diversions and constructing fish screens at the remaining diversions from North Fork and South Fork Battle Creek (entrainment). Under the Five Dam Removal Alternative, diversions would no longer occur at South, Coleman, and Wildcat Diversion Dams (Table 4.1-5). Fish screens would be constructed on all remaining diversions at Inskip, North Battle Creek Feeder, and Eagle Canyon Diversion Dams from North Fork and South Fork Battle Creek. The removal of diversions and the new "failsafe" fish screens would minimize entrainment losses of juvenile chinook salmon and steelhead. The addition of tailrace connectors would also be a reliable way to avoid loss attributable to entrainment and impingement while reliably conveying the large quantities of power system water.

The No Action Alternative has very high diversion fractions at each of the six North Fork and South Fork diversion dams within the salmon and steelhead restoration area (Table 4.1-9). Under the No Action Alternative, diversions occur at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams. The proportion of flow diverted under the No Action Alternative is as high as 97% (Table 4.1-9). The diversion fractions will decrease dramatically under the Five Dam Removal Alternative because the MOU minimum flow requirements below each of the diversion dams are substantially greater than the FERC minimum flow requirements under the No Action Alternative. For those dams that are removed, the diversion fraction becomes zero.

Diversions would be screened using designs that meet or exceed criteria established by NOAA Fisheries and DFG. Proposed fish screens would include features that continuously monitor screen performance and, in the case of a malfunction, would automatically stop the diversion. Detailed monitoring and operation and maintenance plans have been developed for the proposed fish screens and bypass facilities (Appendix D).

Under the Five Dam Removal Alternative, entrainment losses would be reduced and the increased survival of the juvenile life stages would be expected to increase the abundance of steelhead and chinook salmon. Removal of diversions at South, Coleman, and Wildcat Diversion Dams would eliminate entrainment of juvenile chinook salmon, juvenile steelhead, and other fish species produced in the upstream segments of North Fork and South Fork Battle Creek. Effective fish screens at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams would be expected to virtually eliminate entrainment-related mortality of fish moving downstream past the diversion intakes. This impact on fish is considered substantially beneficial. No mitigation is required.

Impact 4.1-17 Beneficial—Reduction of predation-related mortality as a result of removing dams and improving fish ladders (predation, pathogens, and food). The dams and associated fish ladders that would be present under the No Action Alternative are assumed to maintain predation above levels that would occur in the absence of dams. The existing dams may stop the upstream migration of predatory species, such as pikeminnow; juveniles passing over the dams, likely disoriented by turbulent flow conditions, are vulnerable to predation. Concentration of pikeminnow below the diversion dams coincident with the downstream migration of juvenile salmonids could increase predation losses.

Removal of Wildcat, South, Soap Creek, Lower Ripley Creek, and Coleman Diversion Dams under the Five Dam Removal Alternative would remove any potential effects of the existing dams on predation. The improved fish ladders at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams would minimize disorientation of juveniles and improve conditions for downstream movement of chinook salmon and steelhead. The vulnerability to predation would be reduced. This impact is considered beneficial. No mitigation is required.

Although predation-related mortality may be reduced by removal of dams and fish ladder improvements, the benefit to fish species is unknown and may be minor given the area of stream affected. Fish species that prey on juvenile chinook salmon and steelhead would continue to occur throughout Battle Creek, especially in the mainstem where warmer water temperatures support known predators, including smallmouth bass, green sunfish, and Sacramento pikeminnow. Most salmonid predators occur below the Proposed Project area, and those populations may be reduced only if there is an increase in coldwater habitat below the restoration project.

Impact 4.1-18 Beneficial—Substantially increased production of food for fish resulting from increased minimum instream flows (predation, pathogens, and food). Prey abundance affects growth rate and the survival of individual fish. The quantity of habitat available for the production of periphyton and aquatic macroinvertebrates is at least partially dependent on the stream surface area. Periphyton is a key component of the aquatic food web and aquatic macroinvertebrates are a primary food for fish, especially juvenile chinook salmon and steelhead. Prey abundance may increase in response to increased stream surface area and subsequent increase in primary productivity. Minimum instream flows would increase under the Five Dam Removal Alternative (see Section 4.3, “Hydrology”), potentially increasing the abundance of food for fish.

Under the No Action Alternative, the summer stream surface area is approximately 175 acres (Table 4.1-10). In response to increased minimum instream flow requirements, the summer stream surface area would increase by approximately 66 acres (60%) under the Five Dam Removal Alternative. The increase in surface area may increase food availability for fish species, including juvenile chinook salmon and steelhead. This benefit is partially captured under key habitat quantity (described above), reflecting the effects of increased minimum flow requirements on habitat area and potential production of chinook salmon and steelhead.

Although the additional stream surface area provided by increased minimum flows in Soap, Ripley, and Baldwin Creeks is not simulated, the additional surface area in those streams would also increase production of food for fish in the Battle Creek watershed. The stream surface area in Soap, Lower Ripley, and Baldwin Creeks would increase dramatically compared to the surface area at a minimum instream flow of 0 cfs under the No Action Alternative. This impact on fish is considered beneficial. No mitigation is required.

No Dam Removal Alternative

The No Dam Removal Alternative would provide new fish screens and fish ladders at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams (Table 4.1-5). Fish screens would meet NOAA Fisheries and DFG criteria. The diversions, canals, and spring-water collection systems would remain at the same locations as under the No Action Alternative. The minimum flow requirements (i.e., AFRP minimum flow requirements) below the diversion dams would be higher than the instream flows for the No Action Alternative (i.e., FERC minimum flow requirements), but generally less than under the Five Dam Removal Alternative (i.e., MOU minimum flow requirements) (Section 4.3, “Hydrology”). Additional activities that would occur between dam sites or at off-site locations where disturbance is needed to facilitate construction includes: water conveyance upgrades, staging areas, road improvements, and other ground disturbing activities to support the construction of fish screens, fish ladders, and streamflow gages.

Construction-Related Effects

Short-term construction-related effects fall into four categories: key habitat quantity, migration habitat, contaminants, and direct injury. The impacts and mitigation measures are nearly the same as those described under the Five Dam Removal Alternative.

Impact 4.1-19 Significant—Mortality and lowered growth rates and reproductive success of fish and other aquatic species in Battle Creek from an accidental spill of petroleum products and other construction-related materials (contaminants). Impact 4.1-19 is the same as Impact 4.1-1 described above under the Five Dam Removal Alternative. Implementing the Mitigation Measure for Impact 4.1-1 would reduce this impact to a less-than-significant level.

Impact 4.1-20 Significant—Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species

because of increased sedimentation to North Fork and South Fork Battle Creek as a result of construction activities (contaminants). Impact 4.1-20 is the same as Impact 4.1-2 described above under the Five Dam Removal Alternative. Implementing the Mitigation Measure for Impact 4.1-2 would reduce this impact to a less-than-significant level.

Impact 4.1-21 Less than significant—Disturbed steelhead and chinook salmon habitat in the stream channel as a result of construction activities (key habitat quantity). Construction of fish screens and fish ladders at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams would disturb the channel bottom and bank. The disturbance of the channel bottom and bank would alter the channel dimensions and form and the existing substrate. The changes in the channel may adversely affect conditions supporting spawning and rearing habitat (i.e., removal of gravel or changes in depth and velocity). This impact is considered less than significant because the affected spawning and rearing habitat area is small relative to total spawning and rearing habitat in Battle Creek and existing channel structure and substrate at these locations do not currently provide spawning and rearing habitat. No mitigation is required.

Impact 4.1-22 Less than significant—Disrupted movement and migration of fish species as a result of dewatering portions of the stream channel and temporarily removing fish ladders during construction (migration habitat). Construction activities within the stream channel may include placement of cofferdams to isolate constructed elements from the streamflow and temporary removal of existing fish ladders. This impact is similar but less than the impact described under the Five Dam Removal Alternative under Impact 4.1-5. No mitigation is required.

Impact 4.1-23 Less than significant—Compromised feeding efficiency of sight-feeding fish from erosion and the input of fine sediment as a result of construction and demolition activities (contaminants). This impact is similar to Impact 4.1-6 described under the Five Dam Removal Alternative. No mitigation is required.

Impact 4.1-24 Less than significant—Vulnerability of all life stages of fish to injury or mortality from percussion-related energy shock waves, operation of equipment, and becoming trapped in isolated pockets of water during construction activities (direct injury). This impact is similar but less (i.e., no dams would be removed) than Impact 4.1-7 described under the Five Dam Removal Alternative. No mitigation is required.

Long-Term and Ongoing Effects

Long-term and ongoing effects fall into five categories: key habitat quantity, water temperature, migration habitat, entrainment in diversions, and predation, pathogens, and food.

Impact 4.1-25 Less than significant—Reduced habitat and range of some resident warmwater species because of cooler water

temperatures (water temperature). Cooler water temperatures, especially in the mainstem of Battle Creek, would reduce the linear extent of habitat area available to warmwater fish species currently found in Battle Creek (e.g., smallmouth bass, green sunfish, and Sacramento pikeminnow). The range of some resident warmwater species will be reduced. The impact is considered less than significant because all species are relatively abundant and found throughout the Central Valley; habitat area and quality may increase for all species in response to increased flow and increased productivity; and reestablishment of higher flows is consistent with restoration of conditions that existed prior to construction and operation of the Hydroelectric Project on Battle Creek. No mitigation is required.

Impact 4.1-26 Less than significant—Decreased rainbow trout abundance in canals as a result of eliminating some diversions and constructing effective fish screens at three dams (migration habitat). The extensive canal system for the Hydroelectric Project facilities, including Cross Country Canal, South Canal, Union Canal, Inskip Canal, Eagle Canyon Canal, and Coleman Canal, supports juvenile and adult rainbow trout and other species (DFG 1966). Spawning habitat for rainbow trout within the canals is limited. The abundance of rainbow trout in the canals is dependent on entrainment of juvenile and adult rainbow trout from Battle Creek. The construction of effective fish screens at North Battle Creek Feeder, Eagle Canyon Wildcat, South, Inskip, and Coleman Diversion Dams (Table 4.1-5) would stop entrainment of rainbow trout. Rainbow trout abundance would likely be substantially less under the No Dam Removal Alternative than would exist under the No Action Alternative. As described under the Five Dam Removal Alternative, the adverse impact of reduced rainbow trout abundance in the canals is considered less than significant.

Impact 4.1-27 Less than significant—Increased exposure of rainbow trout to pathogens because of the increase of chinook salmon and steelhead in Battle Creek (predation, pathogens, and food). As described under the Five Dam Removal Alternative, Impact 4.1-10, the No Dam Removal Alternative would substantially increase the abundance of chinook salmon and steelhead in Battle Creek and potentially increase the occurrence of pathogens in those reaches and in the water diverted from South Fork and North Fork Battle Creek. The potential effects of increased occurrence of pathogens on rainbow trout would likely be less than significant. No mitigation is required.

Impact 4.1-28 Beneficial—Substantially increased capacity indices for spawning and rearing of steelhead and chinook salmon resulting from increased minimum instream flows (key habitat quantity). The No Dam Removal Alternative would increase the minimum instream flow requirements in multiple reaches of Battle Creek (Section 4.3, “Hydrology”). The increased flow would increase spawning and rearing habitat area, potentially increasing the capacity indices for fry and juvenile salmonids relative to the No Action Alternative.

This beneficial impact is the same as Impact 4.1-11 described above under the Five Dam Removal Alternative. The increased capacity indices for spawning and rearing would be expected to increase the abundance of steelhead and chinook salmon through increased production of fry and juvenile life stages (Figures 4.1-2 through 4.1-5 and Figures 4.1-6 through 4.1-9).

The No Dam Removal alternative would not include the removal of dams on Soap and Ripley Creeks and would not include increases in minimum flow on Soap, Ripley, or Baldwin Creeks. Key habitat quantity in Soap, Ripley, and Baldwin Creeks would be the same as described under the No Action Alternative. The benefits described under the Five Dam Removal Alternative would not be realized under the No Dam Removal Alternative.

Reestablishing higher minimum flow requirements under the No Dam Removal Alternative would benefit other species, including resident fish, aquatic invertebrates, amphibians and stream-dependent wildlife. Greater stream area potentially provides greater habitat area for other fish and aquatic species.

Impact 4.1-29 Beneficial—Substantially increased production indices for fry and juvenile life stages for steelhead and chinook salmon as a result of cooler water temperatures (water temperature). The water temperature assessment uses the capacity indices for fry and juvenile life stages identified in the assessment of key habitat quantity described above. Increased flows and subsequent cooler water temperature associated with the No Dam Removal Alternative during the late spring, summer, and early fall months would substantially increase salmonid survival relative to survival under the No Action Alternative.

This beneficial impact is similar to Impact 4.1-12 described above under the Five Dam Removal Alternative. The increased production indices for fry and juvenile life stages would be expected to increase the abundance of steelhead and chinook salmon. The potential increase in production indices for fry and juvenile steelhead and chinook salmon in response to cooler water temperature under the No Dam Removal Alternative would be substantial (Figures 4.1-2 through 4.1-5 and Figures 4.1-6 through 4.1-9).

Relative to the Five Dam Removal Alternative, water temperature in South Fork Battle Creek would be cooler under the No Dam Removal Alternative, resulting in generally higher estimated survival, depending on species and life stage (Table 4.1-6). Relative to the No Action Alternative, the expected increase in survival attributable to cooler water temperature is substantial (Table 4.1-6). The tailrace connectors between South Powerhouse and Inskip Canal and between Inskip Powerhouse and Coleman Canal constructed under the Five Dam Removal Alternative would not be constructed for this alternative. Therefore, flow diverted from North Fork Battle Creek under the No Dam Removal Alternative would be discharged into South Fork Battle Creek at South and Inskip Powerhouses. The North Fork Battle Creek water would mix with South Fork Battle Creek flow and cool the water temperature, providing cooler water temperatures downstream of Inskip and Coleman Diversion Dams.

The apparent benefit of cooler water temperature in South Fork Battle Creek may be misleading. Cool water temperatures below Inskip and Coleman Diversion Dams are dependent on discharge of cool North Fork Battle Creek water into warmer South Fork Battle Creek flow. Failure of the canal and powerhouse facilities could interrupt the discharge of North Fork Battle Creek water and result in warming of Inskip and Coleman reaches. Warmer water temperatures would reduce survival and result in lower fry and juvenile production indices for steelhead and chinook salmon. The resulting production indices, depending on the distribution of spawning in response to North Fork Battle Creek discharge, could be equal to or less than the production indices under the Five Dam Removal Alternative. Interrupted discharge and subsequent effects on adult, egg, and juvenile survival may be relatively infrequent based on historical outages (Table 4.1-11). Production indices for steelhead and chinook salmon could be reduced periodically, resulting in lower production indices than identified in Figures 4.1-2 through 4.1-9. In addition, higher inflow from Soap Creek provides potential cooling benefits under the Five Dam Removal Alternative. The No Dam Removal Alternative would not include increased flow from Soap Creek, and potential cool water benefits would not occur.

Impact 4.1-30 Beneficial—Increased survival of adults and increased spawning success because higher instream flows would improve conditions that facilitate passage of chinook salmon and steelhead over natural barriers (migration habitat). The No Dam Removal Alternative would increase the required minimum flows (i.e., AFRP minimum flow requirements) in multiple reaches of Battle Creek (Section 4.3, "Hydrology"). The increased flow would improve passage conditions over natural barriers, facilitating upstream habitat use and increasing survival and spawning success of adult chinook salmon and steelhead.

The construction of more effective fish ladders under the No Dam Removal Alternative would improve passage conditions for adult chinook salmon and steelhead. The proposed ladder capacity would be at least 10 times the capacity of existing ladders. The ladders would be designed to convey 110% of the streamflow at average spill conditions for each diversion dam and facilitate adult passage under nearly all flow conditions. Where necessary, additional flow would be directed to facilitate attraction of adult salmonids into the ladder, minimizing delay associated with flow spilling over the dam. The new fish ladders would be designed to automatically clear debris and include safe maintenance access under all streamflow conditions. Detailed monitoring and operation and maintenance plans for the proposed ladders under the No Dam Removal Alternative are included in this document for review (Appendix D).

This beneficial impact is similar to Impact 4.1-13 described above under the Five Dam Removal Alternative. The higher minimum flow requirements would improve passage conditions, substantially increasing unimpeded access to upstream spawning habitat (Table 4.1-7). However, the minimum flow requirements would be lower than minimum flow requirements under the Five Dam Removal Alternative. The lower flow requirements may not provide the same level of adult passage that would be realized under the Five Dam Removal Alternative (Table 4.1-7).

Impact 4.1-31 Beneficial—The construction of more effective fish ladders on North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams would facilitate passage of chinook salmon and steelhead, which would increase survival of adults and increase spawning success (migration habitat). Construction of improved fish ladders would provide significantly greater upstream passage efficiency relative to passage conditions provided in the No Action Alternative. Improved passage would increase survival of adults and facilitate distribution of adults to available upstream spawning habitat that could increase survival of eggs and production of fry. The additional survival of adult chinook salmon and steelhead that might be realized with dam removal (i.e., additional survival of adult chinook salmon and steelhead described under the Five Dam Removal Alternative) would not occur under the No Dam Removal Alternative.

As under the No Action Alternative, water delivered to South and Inskip Powerhouses originates from three locations in the North Fork Battle Creek watershed (i.e., Volta 2 Powerhouse, North Battle Creek Feeder Dam, and Eagle Canyon Diversion Dam). Flow diverted from North Fork Battle Creek is discharged into South Fork Battle Creek at South and Inskip Powerhouses. Although the proportion of South Fork Battle Creek flow composed of North Fork Battle Creek water under the No Dam Removal Alternative is slightly lower than the proportion of North Fork Battle Creek water under the No Action Alternative (Table 4.1-8), the presence of significant North Fork water in South Fork Battle Creek may continue to cause false attraction of adult chinook salmon and steelhead to South Fork Battle Creek.

Based on the assessment of water temperature effects described above, environmental conditions in South Fork Battle Creek would support greater production of chinook salmon and steelhead than environmental conditions under the No Action Alternative. False attraction, therefore, may not be as detrimental to production as indicated for the No Action Alternative. False attraction in response to flow conditions under the No Dam Removal Alternative is not expected to adversely affect production of steelhead and chinook salmon relative to the No Action Alternative, but the benefit described under the Five Dam Removal Alternative would not be realized under the No Dam Removal Alternative.

In addition to false attraction, the discharge of cool water at Inskip and Coleman Diversion Dams may cause winter- and spring-run chinook salmon to break off their upstream migration (i.e., similar to conditions described under the No Action Alternative). The gradient of warm to cool water temperatures from downstream to upstream may be a primary cue for migration to natal spawning areas. Winter- and spring-run chinook salmon may not move to cool reaches upstream of South Diversion Dam and may hold and spawn downstream of Coleman and Inskip Diversion Dams. Failure of the canal and powerhouse facilities could interrupt the discharge of North Fork Battle Creek water and result in warming of Inskip and Coleman reaches. Although interrupted discharge and subsequent warmer water temperatures could substantially reduce adult and egg survival, the occurrence may be relatively infrequent based on historical outages (Table 4.1-11). Production indices for steelhead and chinook salmon could be reduced periodically, resulting in lower production indices than identified in Figures 4.1-2 through 4.1-9.

Impact 4.1-32 Beneficial—Constructing fish screens at the remaining diversions from North Fork and South Fork Battle Creek would substantially increase the survival of juvenile steelhead and chinook salmon during downstream movement and migration (entrainment). Under the No Dam Removal Alternative, fish screens would be constructed on all diversions at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams. The new "failsafe" fish screens would minimize entrainment losses of juvenile chinook salmon and steelhead. Diversions would be screened as described under the Five Dam Removal Alternative. Although the benefit of fish screens would be substantial, diversion-related effects on survival (e.g., exposure to predation) would occur. The full benefits of dam removal that would occur at Wildcat, South, and Coleman Diversion Dams under the Five Dam Removal alternative would not be realized under the No Dam Removal Alternative.

Under the No Action Alternative, diversions occur at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams. The proportion of flow diverted under the No Action Alternative is as high as 97% (Table 4.1-9). The higher minimum flow requirement under the No Dam Removal Alternative (i.e., AFRP minimum flow requirement), would reduce the proportion of flow diverted. Effective fish screens would be expected to virtually eliminate entrainment-related mortality of fish moving downstream past the diversion intakes. Without the fish screens, substantial entrainment would continue to occur at the hydropower diversions (Table 4.1-9). Under the No Dam Removal Alternative, entrainment losses would be reduced and the increased survival of the juvenile life stages would be expected to increase the abundance of steelhead and chinook salmon.

Impact 4.1-33 Beneficial—Reduction of predation-related mortality as a result of improving fish ladders (predation, pathogens, and food). The dams and associated fish ladders that would be present under the No Action Alternative are assumed to maintain predation above levels that would occur in the absence of dams (i.e., that would occur at South, Coleman, and Wildcat under the Five Dam Removal Alternative). Juveniles passing over the dams are potentially disoriented by turbulent flow conditions. In addition, the dams may stop the upstream migration of predatory species, such as pikeminnow. Concentration of pikeminnow below the diversion dams coincident with the downstream migration of juvenile salmonids could increase predation losses.

The continued presence of dams under the No Dam Removal Alternative would continue to create the potential for predation losses. The improved fish ladders at all dams, however, would reduce disorientation of juveniles, improving conditions for downstream movement of juvenile chinook salmon and steelhead. The improved passage could reduce vulnerability to predation.

Although predation-related mortality may be reduced by fish ladder improvements, the benefit to fish species is unknown and may be minor given the area of stream affected. Fish species that prey on juvenile chinook salmon and steelhead would continue to occur throughout Battle Creek, especially in the mainstem where warmer water temperatures support known predators, including smallmouth bass, green sunfish, and Sacramento pikeminnow.

Impact 4.1-34 Beneficial—Substantially increased production of food for fish resulting from increased minimum instream flows (predation, pathogens, and food). This beneficial impact is the same as Impact 4.1-18 described above under the Five Dam Removal Alternative. In response to increased minimum flow requirements, the summer stream surface area would increase by approximately 59 acres (54%) under the No Dam Removal Alternative (Table 4.1-10). The increase in surface area may increase food availability for fish species, including juvenile chinook salmon and steelhead. The benefits identified for Soap, Ripley, and Baldwin Creeks under the Five Dam Removal Alternative would not occur under the No Dam Removal Alternative.

Six Dam Removal Alternative

The Six Dam Removal Alternative proposes to reoperate and modify hydropower facilities on North Fork and South Fork Battle Creek and three minor tributaries, Soap, Ripley, and Baldwin Creeks (Table 4.1-5). Diversion dams would be removed at Eagle Canyon, Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams, and flow would no longer be diverted at those locations. Fish screens and new fish ladders would be constructed at North Battle Creek Feeder and Inskip Diversion Dams and would meet NOAA Fisheries and DFG criteria. Other physical changes to the Hydroelectric Project hydropower facilities include construction of tailrace connectors and flow bypass facilities. Higher minimum flow requirements (i.e., MOU minimum flow requirements) would increase instream flow, subsequently cooling water temperature, increasing stream area, and providing reliable passage conditions for adult salmonids in downstream reaches.

Construction-Related Effects

Short-term construction-related effects fall into four categories: key habitat quantity, migration habitat, contaminants, and direct injury. The impacts and mitigation measures are nearly the same as those described under the Five Dam Removal Alternative.

Impact 4.1-35 Significant—Mortality and lowered growth rates and reproductive success of fish and other aquatic species in Battle Creek from an accidental spill of petroleum products and other construction-related materials (contaminants). Impact 4.1-35 is the same as Impact 4.1-1 described above under the Five Dam Removal Alternative. Implementing the Mitigation Measure for Impact 4.1-1 would reduce this impact to a less-than-significant level.

Impact 4.1-36 Significant—Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species because of increased sedimentation to North Fork and South Fork Battle Creek as a result of construction activities (contaminants). Impact 4.1-36 is the same as Impact 4.1-2 described above under the Five Dam Removal Alternative. Implementing the Mitigation Measure for Impact 4.1-2 would reduce this impact to a less-than-significant level.

Impact 4.1-37 Significant—Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species as a result of removing South, Coleman, and Eagle Canyon Diversion Dams, which would release currently stored fine sediment to the stream channel (contaminants). Impact 4.1-37 is the same as Impact 4.1-3 described above under the Five Dam Removal Alternative. Implementing the Mitigation Measure for Impact 4.1-3 would reduce this impact to a less-than-significant level.

Impact 4.1-38 Less than significant—Disturbed steelhead and chinook salmon habitat in the stream channel as a result of construction activities (key habitat quantity). Construction activities associated with removing the six dams would include dismantling and removing Eagle, Wildcat, South, Coleman, Soap Creek Feeder, and Lower Ripley Creek Feeder Diversion Dams and their appurtenant facilities. Impact 4.1-38 is the same as Impact 4.1-4 described above under the Five Dam Removal Alternative. The changes in the channel may adversely affect conditions supporting spawning and rearing habitat (i.e., removal of gravel or changes in depth and velocity). This impact is considered less than significant because the affected spawning and rearing habitat area is small relative to total spawning and rearing habitat in Battle Creek; existing channel structure and substrate at these locations do not currently provide spawning and rearing habitat; and some of the affected areas would provide spawning and rearing habitat after construction is complete. No mitigation is required.

Impact 4.1-39 Less than significant—Disrupted movement and migration of fish species as a result of dewatering portions of the stream channel and temporarily removing fish ladders during construction (migration habitat). Impact 4.1-39 is the same as Impact 4.1-5 described above under the Five Dam Removal Alternative. This impact is considered less than significant. No mitigation is required.

Impact 4.1-40 Less than significant—Compromised feeding efficiency of sight-feeding fish from erosion and the input of fine sediment as a result of construction and demolition activities (contaminants). Impact 4.1-40 is the same as Impact 4.1-6 described above under the Five Dam Removal Alternative. The input of fine sediment would increase turbidity and sedimentation of gravel substrates. The impact of increased turbidity is considered less than significant because the effect would be temporary. No mitigation is required.

Impact 4.1-41 Less than significant—Vulnerability of all life stages of fish to injury or mortality from percussion-related energy shock waves, operation of equipment, and becoming trapped in isolated pockets of water during construction activities (direct injury). Removal of the six diversion dams; construction of the Inskip Powerhouse bypass facility; construction of the tailrace connectors between South Powerhouse and Inskip Canal, and between Inskip Powerhouse and Coleman Canal; and the construction of the fish screens and fish ladders could physically injure and kill eggs, larvae, and juvenile fish. Impact 4.1-41 is the same as Impact 4.1-7 described above under the Five Dam Removal Alternative. This impact is considered less than significant because the affected spawning and rearing habitat area is small relative to total spawning and rearing habitat in Battle Creek; construction will occur over a relatively short period of time; and measures will be implemented to exclude spawning within the construction foot print (see the general environmental protection measures listed in the introduction to this chapter, Section 4.0). No mitigation is required.

Long-Term and Ongoing Effects

Long-term and ongoing effects fall into five categories: key habitat quantity, water temperature, migration habitat, entrainment in diversions, and predation, pathogens, and food.

Impact 4.1-42 Less than significant—Reduced habitat and range of some resident warmwater species because of cooler water temperatures (water temperature). Impact 4.1-42 is the same as Impact 4.1-8 described above under the Five Dam Removal Alternative. The impact is considered less than significant because the affected warmwater species are relatively abundant and found throughout the Central Valley; habitat area and quality may increase for all species in response to increased flow and increased productivity; and reestablishment of higher flows is consistent with restoration of conditions that existed prior to construction and operation of the Hydroelectric Project on Battle Creek. No mitigation is required.

Impact 4.1-43 Less than significant—Decreased rainbow trout abundance in canals as a result of eliminating some diversions and constructing effective fish screens at three dams (migration habitat). Impact 4.1-43 is the same as Impact 4.1-9 described above under the Five Dam Removal Alternative. The adverse impact of reduced rainbow trout abundance in the canals is considered less than significant because the populations in the canals are not self-sustaining and draining of the canals for maintenance periodically eliminates most of the rainbow trout from the canals. No mitigation is required.

Impact 4.1-44 Less than significant—Increased exposure of rainbow trout to pathogens because of the increase of chinook salmon and steelhead in Battle Creek (predation, pathogens, and food). The potential increased occurrence of pathogens associated with increased abundance of chinook salmon and steelhead would be similar to that described under the Five Dam Removal Alternative, and the impact would be less than significant. The removal of the diversion at Eagle Canyon Diversion Dam could reduce the potential transfer of fish pathogens to the Coleman Canal relative to the Five Dam Removal Alternative. No mitigation is required.

Impact 4.1-45 Beneficial—Substantially increased capacity indices for spawning and rearing of steelhead and chinook salmon resulting from increased minimum instream flows (key habitat quantity). The Six Dam Removal Alternative would increase the minimum flow requirements in multiple reaches of Battle Creek (Section 4.3, "Hydrology"). The higher flow requirements and increased flow would increase spawning and rearing habitat area, potentially increasing the capacity indices for fry and juvenile salmonids relative to the No Action Alternative.

This beneficial impact is the same as Impact 4.1-11 described above under the Five Dam Removal Alternative. The increased capacity of spawning and rearing habitat would be expected to increase the abundance of steelhead and chinook salmon through increased production of fry and juvenile life stages (Figures 4.1-2 through 4.1-5 and Figures 4.1-6 through 4.1-9, respectively).

Impact 4.1-46 Beneficial—Substantially increased production indices for fry and juvenile life stages for steelhead and chinook salmon as a result of cooler water temperatures (water temperature). The water temperature assessment uses the capacity indices for fry and juvenile life stages identified in the assessment of key habitat quantity described above. Increased flows and subsequent cooler water temperature associated with the Six Dam Removal Alternative during the late spring, summer, and early fall months substantially increase salmonid survival relative to survival under the No Action Alternative.

This beneficial impact is the same as Impact 4.1-12 described above under the Five Dam Removal Alternative. The increased production indices for fry and juvenile life stages would be expected to increase the abundance of steelhead and chinook salmon (Figures 4.1-2 through 4.1-5 and Figures 4.1-6 through 4.1-9). Relative to the No Action Alternative, the expected increase in survival attributable to cooler water temperature is substantial (Table 4.1-6).

Impact 4.1-47 Beneficial—Increased survival of adults and increased spawning success because higher instream flows would improve conditions that facilitate passage of chinook salmon and steelhead over natural barriers (migration habitat). The Six Dam

Removal Alternative would increase the minimum flows in multiple reaches of Battle Creek (Section 4.3, "Hydrology"). The increased flow would improve passage conditions over natural barriers, facilitating upstream habitat use and increasing survival and spawning success of adult chinook salmon and steelhead.

This beneficial impact is the same as Impact 4.1-13 described above under the Five Dam Removal Alternative. The maintenance of higher flows would improve passage conditions, substantially increasing unimpeded access to upstream spawning habitat (Table 4.1-7).

Impact 4.1-48 Beneficial—Increased survival of adults and increased spawning success because removal of dams and the construction of more effective fish ladders would facilitate passage of chinook salmon and steelhead (migration habitat). The removal of dams and construction of more effective fish ladders under the Six Dam Removal Alternative would improve passage conditions for adult chinook salmon and steelhead. This beneficial impact is the same as Impact 4.1-14 described above under the Five Dam Removal Alternative, with the additional benefit of removing Eagle Canyon Diversion Dam. The removal of dams and construction of ladders would substantially improve fish passage under nearly all flow conditions.

Impact 4.1-49 Beneficial—Potentially increased spawning success and fry production because eliminating the discharge of North Fork Battle Creek water to South Fork Battle Creek would facilitate the return of adult chinook salmon and steelhead to natal spawning habitat in South Fork and North Fork Battle Creek (migration habitat). Under the Six Dam Removal Alternative, tailrace connectors would be constructed between South Powerhouse and Inskip Canal and between Inskip Powerhouse and Coleman Canal. The absence of significant North Fork Battle Creek water in South Fork Battle Creek would facilitate return of adult chinook salmon and steelhead to natal spawning habitat in North Fork Battle Creek. This beneficial impact is the same as Impact 4.1-15 described above under the Five Dam Removal Alternative.

Impact 4.1-50 Beneficial—Substantially increased survival of juvenile steelhead and chinook salmon during downstream movement and migration as a result of ceasing diversions and constructing fish screens at the remaining diversions from North Fork and South Fork Battle Creek (entrainment). Under the Six Dam Removal Alternative, diversions would no longer occur at Eagle Canyon, Wildcat, South, and Coleman Diversion Dams (Table 4.1-9). Fish screens would be constructed on all remaining diversions at North Battle Creek Feeder and Inskip Diversion Dams. The fish screens would be designed as described under the Five Dam Removal Alternative. This beneficial impact is the same as Impact 4.1-16 described above under the Five Dam Removal Alternative. Without the fish screens, substantial entrainment would continue to occur at the hydropower diversions (Table 4.1-9).

Impact 4.1-51 Beneficial—Substantially increased production of food for fish resulting from increased minimum instream flows (predation, pathogens, and food). Minimum instream flows would increase under the Six Dam Removal Alternative, potentially increasing the abundance of food for fish. This beneficial impact is the same as Impact 4.1-18 described above under the Five Dam Removal Alternative. In response to increased minimum flow requirements, the summer stream surface area would increase by approximately 66 acres (61%) under the Six Dam Removal Alternative (Table 4.1-10). The increase in surface area may increase food availability for fish species, including juvenile chinook salmon and steelhead.

Impact 4.1-52 Beneficial—Reduction of predation-related mortality as a result of removing dams and improving fish ladders (predation, pathogens, and food). Impact 4.1-52 is nearly the same as Impact 4.1-17 under the Five Dam Removal Alternative with an additional potential benefit associated with the removal of Eagle Canyon Diversion Dam.

Three Dam Removal Alternative

The Three Dam Removal Alternative proposes to reoperate and modify Hydroelectric Project hydropower facilities on North Fork and South Fork Battle Creek (Table 4.1-5). Diversion dams would be removed at Eagle Canyon, Wildcat, and Coleman Diversion Dams, and flow would no longer be diverted at those locations. Fish screens and new fish ladders would be constructed at North Battle Creek Feeder, South, and Inskip Diversion Dams and would meet NOAA Fisheries and DFG criteria. Other physical changes to the hydropower facilities include construction of tailrace connectors at South and Inskip Powerhouses. Higher minimum flow requirements (i.e., AFRP minimum flow requirements) would increase instream flows, subsequently cooling water temperature, increasing stream area, and providing reliable passage conditions for adult salmonids in downstream reaches.

Construction-Related Effects

Short-term construction-related effects fall into four categories: key habitat quantity, migration habitat, contaminants, and direct injury. The impacts and mitigation measures are the same as those described under the Five Dam Removal Alternative.

Impact 4.1-53 Significant—Mortality and lowered growth rates and reproductive success of fish and other aquatic species in Battle Creek from an accidental spill of petroleum products and other construction-related materials (contaminants). Impact 4.1-53 is the same as Impact 4.1-1 described above under the Five Dam Removal Alternative. Implementing the Mitigation Measure for Impact 4.1-1 would reduce this impact to a less-than-significant level.

Impact 4.1-54 Significant—Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species

because of increased sedimentation to North Fork and South Fork Battle Creek as a result of construction activities (contaminants). Impact 4.1-54 is the same as Impact 4.1-2 described above under the Five Dam Removal Alternative. Implementing the Mitigation Measure for Impact 4.1-2 would reduce this impact to a less-than-significant level.

Impact 4.1-55 Significant—Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species as a result of removing South, Coleman, and Eagle Canyon Diversion Dams, which would release currently stored fine sediment to the stream channel (contaminants). Impact 4.1-55 is the same as Impact 4.1-3 described above under the Five Dam Removal Alternative. Implementing the Mitigation Measure for Impact 4.1-3 would reduce this impact to a less-than-significant level.

Impact 4.1-56 Less than significant—Disturbed steelhead and chinook salmon habitat in the stream channel as a result of construction activities (key habitat quantity). Impact 4.1-56 is the same as Impact 4.1-4 described above under the Five Dam Removal Alternative. Construction activities associated with removing the 3 dams would include dismantling and removing Eagle, Wildcat, and Coleman Diversion Dams and their appurtenant facilities. Construction of the tailrace connectors between South Powerhouse and Inskip Canal and between Inskip Powerhouse and Coleman Canal would also include work in the stream channel. The disturbance of the channel bottom and bank would alter the channel dimensions and form and the existing substrate. This impact is considered less than significant. No mitigation is required.

Impact 4.1-57 Less than significant—Disrupted movement and migration of fish species as a result of dewatering portions of the stream channel and temporarily removing fish ladders during construction (migration habitat). Impact 4.1-57 is the same as Impact 4.1-5 described above under the Five Dam Removal Alternative. This impact is considered less than significant because upstream passage of anadromous salmonids is currently blocked at Eagle Canyon and Coleman Diversion Dams. No mitigation is required.

Impact 4.1-58 Less than significant—Compromised feeding efficiency of sight-feeding fish from erosion and the input of fine sediment as a result of construction and demolition activities (contaminants). Impact 4.1-58 is the same as Impact 4.1-6 described above under the Five Dam Removal Alternative. The input of fine sediment would increase turbidity. The impact of increased turbidity is considered less than significant because the effect would be temporary. No mitigation is required.

Impact 4.1-59 Less than significant—Vulnerability of all life stages of fish to injury or mortality from percussion-related energy shock waves, operation of equipment, and becoming trapped in isolated pockets of water during construction activities (direct injury). Impact

4.1-59 is the same as Impact 4.1-7 described above under the Five Dam Removal Alternative. Removal of the three diversion dams; construction of the Inskip Powerhouse bypass facility; construction of the tailrace connectors between South Powerhouse and Inskip Canal, and between Inskip Powerhouse and Coleman Canal; and the construction of the fish screens and fish ladders at Eagle Canyon and Inskip Diversion Dams could physically injure and kill eggs, larvae, and juvenile fish. This impact is considered less than significant because the affected spawning and rearing habitat area is small relative to total spawning and rearing habitat in Battle Creek; construction will occur over a relatively short period of time; and measures will be implemented to exclude spawning within the construction foot print (see the general environmental protection measures listed in the introduction to this chapter, Section 4.0). No mitigation is required.

Long-Term and Ongoing Effects

Long-term and ongoing effects fall into five categories: key habitat quantity, water temperature, migration habitat, entrainment in diversions, and predation, pathogens, and food.

Impact 4.1-60 Less than significant—Reduced habitat and range of some resident warmwater species because of cooler water temperatures (water temperature). Impact 4.1-60 is the same as Impact 4.1-8 described above under the Five Dam Removal Alternative. The impact is considered less than significant. No mitigation is required.

Impact 4.1-61 Less than significant—Decreased rainbow trout abundance in canals as a result of eliminating some diversions and constructing effective fish screens at three dams (migration habitat). Impact 4.1-61 is the same as Impact 4.1-9 described above under the Five Dam Removal Alternative. The adverse impact of reduced rainbow trout abundance in the canals is considered less than significant because the populations in the canals are not self-sustaining and draining of the canals for maintenance periodically eliminates most of the rainbow trout from the canals. No mitigation is required.

Impact 4.1-62 Less than significant—Increased exposure of rainbow trout to pathogens because of the increase of chinook salmon and steelhead in Battle Creek (predation, pathogens, and food). The potential increased occurrence of pathogens associated with increased abundance of chinook salmon and steelhead would be similar to that described under the Five Dam Removal Alternative (i.e., Impact 4.1-10), and the impact would be less than significant. The removal of the diversion at Eagle Canyon Diversion Dam could reduce the potential transfer of fish pathogens to the Coleman Canal relative to the Five Dam Removal Alternative. Additional transfer of fish pathogens to the canals, however, could occur through the diversion at South Diversion Dam.

Impact 4.1-63 Beneficial—Substantially increased capacity indices for spawning and rearing of steelhead and chinook salmon resulting from increased minimum instream flows (key habitat quantity). The Three Dam Removal Alternative would increase the minimum instream flow requirements (i.e., AFRP minimum flow requirements) in multiple reaches of Battle Creek (Section 4.3, "Hydrology"). The increased flow would increase spawning and rearing habitat area, increasing the capacity indices for fry and juvenile salmonids relative to the No Action Alternative.

This beneficial impact is similar to Impact 4.1-11 described above under the Five Dam Removal Alternative. The increased capacity of spawning and rearing habitat would be expected to increase the abundance of steelhead and chinook salmon through increased capacity indices for fry and juvenile life stages (Figures 4.1-2 through 4.1-5 and Figures 4.1-6 through 4.1-9, respectively). The lower minimum flow requirements under the Three Dam Removal Alternative may result in slightly less capacity for some life stages than capacity indicated under the Five Dam Removal Alternative. In addition, the lower minimum flow requirements would be less supportive of future adaptive management of flow targets that may incorporate new information on flow-habitat relationships. The Three Dam Removal alternative would also not include the removal of dams on Soap and Ripley Creeks and would not include increases in minimum flow on Soap and Ripley Creeks. The benefits described under the Five Dam Removal Alternative related to Soap and Ripley Creeks would not be realized under the Three Dam Removal Alternative. Key habitat quantity in Soap and Ripley Creeks would be the same as described under the No Action Alternative. Increased flow in Baldwin Creek would provide the benefits described under the Five Dam Removal Alternative.

Impact 4.1-64 Beneficial—Substantially increased production indices for fry and juvenile life stages for steelhead and chinook salmon as a result of cooler water temperatures (water temperature). The water temperature assessment uses the capacity indices for fry and juvenile life stages identified in the assessment of key habitat quantity described above. Increased flows and subsequent cooler water temperature associated with the Three Dam Removal Alternative during the late spring, summer, and early fall months would substantially increase salmonid survival relative to survival under the No Action Alternative.

This beneficial impact is similar to Impact 4.1-12 described above under the Five Dam Removal Alternative. The increased production indices for fry and juvenile life stages would be expected to increase the abundance of steelhead and chinook salmon (Figures 4.1-2 through 4.1-5 and Figures 4.1-6 through 4.1-9, respectively). Relative to the Five Dam Removal Alternative, the benefits of cool water temperature are slightly less under the Three Dam Removal Alternative (Table 4.1-6). Relative to the No Action Alternative, the expected increase in survival attributable to cooler water temperature is substantial.

As under the Five Dam Removal Alternative, the tailrace connectors constructed between South Powerhouse and Inskip Canal would minimize flow and water temperature fluctuations that may occur during South Powerhouse outages. As under the No Action Alternative, Inskip Powerhouse outages under the Three Dam Removal Alternative would result in canal flow spilling down natural pathways to enter South Fork Battle Creek near the Inskip Powerhouse. The outage and subsequent canal spill would cause short-term disruptions of flow to the short segment of stream channel between the existing powerhouses and the canal intake. In addition, the overland flow may warm the water temperature, depending on the weather during the outage. Based on the historical frequency of outages at Inskip Powerhouse (Table 4.1-11), however, the input of North Fork Battle Creek water would likely be infrequent and have minimal effect on water temperature.

The removal of South Diversion Dam under the Five Dam Removal Alternative would minimize adverse effects of powerhouse outages that result in flow temporarily spilling down the South Fork Battle Creek. South Diversion Dam would not be removed under the Three Dam Removal Alternative, and outage and subsequent canal spill could cause short-term disruptions of flow in downstream reaches. When the canal and powerhouse come back on line, the drop in flow may result in desiccation of redds and stranding of juvenile and adult fish. The level of effect would be less detrimental than effects under the No Action Alternative. The difference in benefit from the Five Dam Removal Alternative would depend on the extent of stream affected by the outages and the frequency and duration of the outages. Historical outages have varied in frequency and duration (Table 4.1-11). The removal of Eagle Canyon Diversion Dam under the Three Dam Removal Alternative would avoid flow fluctuation attributable to spill in North Fork Battle Creek and subsequent effects on habitat availability and the potential for stranding losses. The potential benefit relative to the Five Dam Removal Alternative, however, is unknown, partially because removal of Eagle Canyon Diversion Dam also reduces the potential to manage North Fork Battle Creek flow to derive cool water benefits from Eagle Canyon spring inflow.

Impact 4.1-65 Beneficial—Increased survival of adults and increased spawning success because higher instream flows would improve conditions that facilitate passage of chinook salmon and steelhead over natural barriers (migration habitat). The Three Dam Removal Alternative would increase minimum flow requirements in multiple reaches of Battle Creek (Section 4.3, “Hydrology”). The increased flow would improve passage conditions over natural barriers, facilitating upstream habitat use and increasing survival and spawning success of adult chinook salmon and steelhead. This beneficial impact is similar to Impact 4.1-13 described above under the Five Dam Removal Alternative. However, the minimum flow requirements would be lower than minimum flow requirements under the Five Dam Removal Alternative. The lower flow requirements may not provide the same level of adult passage that would be realized under the Five Dam Removal Alternative (Table 4.1-7).

Impact 4.1-66 Beneficial—Increased survival of adults and increased spawning success because removal of dams and the construction of more effective fish ladders would facilitate passage of chinook salmon and steelhead (migration habitat). This beneficial impact is the same as Impact 4.1-14 described above under the Five Dam Removal Alternative, with the additional benefit of removing Eagle Canyon

Diversion Dam and without the benefit that is associated with removal of South, Soap, and Ripley Diversion Dams under the Five Dam Removal Alternative. The removal of dams and construction of ladders would substantially improve fish passage.

Impact 4.1-67 Beneficial—Potentially increased spawning success and fry production because eliminating the discharge of North Fork Battle Creek water to South Fork Battle Creek would facilitate the return of adult chinook salmon and steelhead to natal spawning habitat in South Fork and North Fork Battle Creek (migration habitat). Under the Three Dam Removal Alternative, tailrace connectors would be constructed between South Powerhouse and Inskip Canal and between Inskip Powerhouse and Coleman Canal. The absence of significant North Fork Battle Creek water in South Fork Battle Creek would facilitate return of adult chinook salmon and steelhead to natal spawning habitat in North Fork Battle Creek. This beneficial impact is the same as Impact 4.1-15 described above under the Five Dam Removal Alternative, with the exception that water from North Fork Battle Creek would discharge to South Fork Battle Creek during an outage at Inskip Powerhouse. Based on the historical frequency of outages at Inskip Powerhouse (Table 4.1-11), however, the input of North Fork Battle Creek water would likely be infrequent and have minimal effect on false attraction of adult steelhead and chinook salmon.

Impact 4.1-68 Beneficial—Substantially increased survival of juvenile steelhead and chinook salmon during downstream movement and migration as a result of eliminating some diversions and constructing fish screens at the remaining diversions from North Fork and South Fork Battle Creek (entrainment). Under the Three Dam Removal Alternative, diversions would no longer occur at Eagle Canyon, Wildcat, and Coleman Diversion Dams (Table 4.1-5). Fish screens would be constructed on all remaining diversions at North Battle Creek Feeder, South, and Inskip Diversion Dams. The fish screens are designed as described under the Five Dam Removal Alternative. This beneficial impact is similar to Impact 4.1-16 described above under the Five Dam Removal Alternative. Without the fish screens, substantial entrainment would continue to occur at the hydropower diversions (Table 4.1-9).

Impact 4.1-69 Beneficial—Reduction of predation-related mortality as a result of removing dams and improving fish ladders (predation, pathogens, and food). The benefits related to reduced predation are similar to those described under the Five Dam Removal Alternative, Impact 4.1-17, with an additional potential benefit with removal of Eagle Canyon Diversion Dam and a lesser benefit with South Diversion Dam remaining.

Impact 4.1-70 Beneficial—Substantially increased production of food for fish resulting from increased minimum instream flows (predation, pathogens, and food). This beneficial impact is similar to Impact 4.1-18 described above under the Five Dam Removal Alternative. In response to increased minimum flow requirements, the summer stream surface area would increase by approximately 59 acres (54%) under the Three Dam Removal Alternative (Table 4.1-10). The increase in surface area may increase food availability for fish species, including juvenile chinook salmon and steelhead.

Cumulative Impacts

Cumulative adverse impacts on fish and aquatic species associated with the Proposed Action and past, present, or reasonably foreseeable future projects would not occur in the Battle Creek watershed because no other projects (including related projects described in Chapter 6) would contribute to the cumulative decline of fish species or the degradation of fish habitat in Battle Creek.

Upon implementing the Proposed Action, steelhead and winter- and spring-run chinook salmon, species listed under the ESA, are expected to increase substantially in abundance. The increased population abundance of steelhead and winter- and spring-run chinook salmon associated with the Proposed Action is likely to increase the resistance and resilience of the populations in Battle Creek.

Downstream of the Restoration Project area, several modifications are proposed for the Coleman National Fish Hatchery (managed by USFWS), including screening of the hatchery's water intakes and modifying the hatchery's barrier weir and upstream fish ladder. Construction of an ozonation water treatment plant and water filtration system has already been completed. To correct sediment and disease problems at the Coleman National Fish Hatchery, USFWS has expanded the hatchery's water treatment and filtration system, which will minimize the risk of catastrophic hatchery events and optimize the hatchery's production capabilities. In addition, USFWS has initiated a process to modify the hatchery's intakes, which currently do not meet federal or state guidelines, to protect salmonids at water diversions. In anticipation of Restoration Project implementation, management of the hatchery's fish barrier weir and upstream ladder will be modified to accommodate the movement of naturally produced salmon and steelhead so they can access the best stream reaches at the right times. Each modification proposed for the Coleman National Fish Hatchery would benefit salmonids at the hatchery and potentially the populations in Battle Creek as well.

Additional future projects that would be beneficial to anadromous fish include DWR's proposition to place spawning-sized gravel in the lower reaches of Battle Creek to double or triple the area available for salmon spawning. DFG has also proposed enhancing existing spawning gravel supplies on a ¼-mile stretch of Baldwin Creek and improving a partial natural barrier on Baldwin Creek.

In summary, the Proposed Action and past, present, or probable future projects, including those proposed by USFWS for the Coleman National Fish Hatchery, by

DWR for Battle Creek, and by DFG for Baldwin Creek, would substantially benefit fish populations in the Battle Creek watershed.

Table 4.1-3. Distribution of Potential Natural Barriers and Diversion Dams That May Impede Fish Passage

Location (River Mile)	Type of Barrier/ Name of Dam	Distance to Next Upstream Barrier (miles)
North Battle Creek		
13.48	Absolute Barrier	0
11.48	Falls/Cascade	2.00
11.46	Falls	2.02
11.45	Falls/Cascade	2.03
11.31	Cascade/Chute	2.17
11.10	Falls	2.38
10.79	Falls/Cascade	2.69
10.78	Falls/Cascade	2.70
10.72	Falls/Cascade	2.76
10.48	Rock Creek	-
9.92	Falls	3.56
9.35	North Battle Creek Feeder Diversion Dam	4.13
6.96	Falls	6.52
6.02	Falls	7.46
5.40	Falls/Cascade	8.08
5.29	Eagle Canyon Diversion Dam	8.19
4.50	Falls	8.98
2.48	Wildcat Diversion Dam	11.00
2.36	Falls	11.12
2.16	Subsurface Flow	11.32
South Battle Creek		
18.85	Absolute Barrier	0
14.35	South Diversion Dam	4.50
11.68	Cascade	7.17
7.96	Inskip Diversion Dam	10.89
3.81	Falls/Cascade/Chute	15.04
3.61	Falls/Cascade	15.24
3.40	Falls/Cascade/Chute	15.45
3.15	Falls	15.70
2.54	Coleman Diversion Dam	16.31

Table 4.1-4. Effective Flows at Fish Ladders Under the Action Alternatives

	Effective Flow Range (cfs)			
Name of Dam	Five Dam Removal Alternative	No Dam Removal Alternative	Six Dam Removal Alternative	Three Dam Removal Alternative
North Battle Creek Feeder Diversion Dam	4 to 110[1]	4 to 110[1]	4 to 110[1]	4 to 110[1]
Eagle Canyon Diversion Dam	20 to 71[1]	20 to 71[1]	Dam removed	Dam removed
Wildcat Diversion Dam	Dam removed	30 to 80	Dam removed	Dam removed
South Diversion Dam	Dam removed	35 to 80	Dam removed	35 to 80
Inskip Diversion Dam[2]	35[3] to 170	35[3] to 170	35[3] to 170	35[3] to 170
Coleman Diversion Dam	Dam removed	35 to 80	Dam removed	Dam removed
Lower Ripley Creek Diversion Dam	Dam removed	No fish ladder, No fish passage	Dam removed	No fish ladder, No fish passage
Soap Creek Diversion Dam	Dam removed	No fish ladder, No fish passage	Dam removed	No fish ladder, No fish passage

Notes:

1 Kennedy, DWR (2001).

2 Gravel may accumulate in the entrance pool to the fish ladder at Inskip Diversion Dam under the proposed design leading to an ongoing operations impact between the dam and the ladder.

3 The fish ladder at Inskip Diversion Dam could function at (as yet unspecified) lower flows if the orifices were blocked (Kennedy, DWR 2001).

Table 4.1-6. Estimated Survival of Fry and Juvenile Life Stages Attributable to Water Temperature Conditions in Battle Creek for the Minimum Flow Requirements under Each Alternative

		Alternatives				
Species	Life Stage	No Action	Five Dam Removal	No Dam Removal	Six Dam Removal	Three Dam Removal
Steelhead	Fry	78%	88%	86%	88%	87%
	Juvenile	44%	74%	91%	74%	66%
Spring-Run Chinook Salmon	Fry	20%	28%	35%	28%	25%
	Juvenile	60%	100%	100%	100%	100%
Winter-Run Chinook Salmon	Fry	5%	12%	12%	12%	10%
	Juvenile	44%	46%	56%	46%	37%
Late Fall-Run Chinook Salmon	Fry	61%	72%	71%	72%	68%
	Juvenile	58%	66%	79%	66%	59%

Table 4.1-7. Potential Steelhead and Chinook Salmon Passage over Natural Barriers in Battle Creek for Minimum Required Instream Flows[1] under All Alternatives

Stream Reach	Barrier Location[2] (river mile)	Minimum Passage Flow[3] (cfs)	Potential passage by species for each alternative: No Action	Five Dam Removal	No Dam Removal	Six Dam Removal	Three Dam Removal
North Fork Battle Creek							
Keswick	11.48	All flows	None[4,5]	None[4,5]	None[4,5]	None[4,5]	None[4,5]
	11.46	90*	None[5]	None[5]	None[5]	None[5]	None[5]
	11.45	90*	None[5]	None[5]	None[5]	None[5]	None[5]
	11.31	90*	None[5]	None[5]	None[5]	None[5]	None[5]
	11.10	7	None[5]	None[5]	None[5]	None[5]	None[5]
	10.79	7	None[5]	None[5]	None[5]	None[5]	None[5]
	10.78	20	None[5]	None[5]	None[5]	None[5]	None[5]
	10.72	90*	None[5]	None[5]	None[5]	None[5]	None[5]
	9.92	90*	None[5]	None[5]	None[5]	None[5]	None5
North Battle Feeder	6.96	30*	None[5]	Steelhead, spring- and winter-run chinook salmon (all months)	Steelhead, spring- and winter-run chinook salmon (September-April; winter run not supported in May-June)	Steelhead, spring- and winter-run chinook salmon (all months)	Steelhead, spring- and winter-run chinook salmon (September-April; winter run not supported in May-June)
	6.02	30*	None[5]				
	5.40	35	None[5]				
Eagle Canyon	4.50	30*	None[5]				
Wildcat	2.36	20	None[5]				
	2.16	20	None[5]				

Table 4.1-7. Continued

Stream Reach	Barrier Location[2] (river mile)	Minimum Passage Flow[3] (cfs)	Potential passage by species for each alternative				
			No Action	Five Dam Removal	No Dam Removal	Six Dam Removal	Three Dam Removal
South Fork Battle Creek							
South	11.68	50	None[5]	Steelhead, spring- and winter-run chinook salmon (all months)	None[5]	Steelhead, spring- and winter-run chinook salmon (all months)	None5
Inskip	3.81	30*	None[5]		None[4,5]		None4,5
	3.61	40	None[5]		None[5]		None5
	3.40	<5	None[4,5]		Steelhead, spring- and winter-run chinook salmon		Steelhead, spring- and winter-run chinook salmon
	3.15	20	None[5]				

Notes:

* Indicates that the exact flow need is unknown and could be lower or higher than indicated.

[1] The minimum required instream flows are discussed in Appendix J.

[2] Location is the distance upstream from the confluence of the North and South Forks of Battle Creek

[3] Minimum passage flow is from the analysis by Thomas R. Payne and Associates (1998)

[4] Although chinook salmon or steelhead could pass this barrier, downstream barriers prevent access.

[5] The conclusion does not consider that high flows of short duration in response to storms would occur and provide passage during wetter months and years.

Table 4.1-8. Proportion of South Fork Flow Composed of North Fork Water Downstream of Coleman Diversion Dam for the No Action and No Dam Removal Alternatives

Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No Action Alternative												
10th percentile	65%	65%	65%	65%	65%	65%	65%	66%	65%	65%	65%	65%
30th percentile	64%	61%	60%	63%	65%	65%	65%	65%	65%	65%	65%	65%
50th percentile	58%	55%	54%	57%	57%	64%	65%	65%	65%	65%	65%	63%
70th percentile	47%	48%	48%	52%	51%	60%	65%	65%	65%	65%	65%	58%
90th percentile	39%	42%	37%	43%	48%	51%	65%	65%	65%	65%	50%	43%
No Dam Removal Alternative												
10th percentile	57%	57%	57%	57%	61%	60%	58%	57%	58%	58%	59%	54%
30th percentile	59%	60%	60%	60%	62%	61%	59%	59%	59%	59%	60%	57%
50th percentile	58%	55%	54%	57%	57%	62%	60%	59%	59%	60%	61%	60%
70th percentile	47%	48%	48%	52%	51%	60%	61%	60%	60%	61%	62%	58%
90th percentile	39%	42%	37%	43%	48%	51%	62%	61%	61%	61%	50%	43%

Note: North Fork flow would not be discharged into the South Fork under most operations expected for the Five Dam Removal, Six Dam Removal and Three Dam Removal Alternatives.

Table 4.1-9. Proportion of Flow Diverted at Each Diversion Dam for All Alternatives, Median Value for All Months and All Years

	Alternative				
Diversion Dam	No Action	Five Dam Removal *	No Dam Removal *	Six Dam Removal *	Three Dam Removal *
North Fork Feeder	89%	0%	16%	0%	16%
Eagle Canyon	89%	45%	47%	R	R
Wildcat	79%	R	26%	R	R
South	85%	R	53%	R	53%
Inskip	96%	36%	75%	36%	30%
Coleman	97%	R	77%	R	R

Notes:

* indicates that fish screens would minimize entrainment loss of fish.

R indicates the dam has been removed and diversion no longer occurs.

Table 4.1-10. Approximate Summer Stream Surface Area (acres) by Reach for Minimum Required Instream Flows for Each Alternative

	Alternative				
	No Action	Five Dam Removal	No Dam Removal	Six Dam Removal	Three Dam Removal
Below Keswick	7.7	7.7	7.7	7.7	7.7
Below NFBC Feeder	9.9	15.1	14.1	15.1	14.1
Below Eagle	5.8	9.2	8.9	9.2	8.9
Below Wildcat	5.7	8.0	7.8	8.0	7.8
Above South Dam	23.2	23.2	23.2	23.2	23.2
Below South Dam	19.4	24.2	22.2	24.2	22.2
Below Inskip Dam	16.1	22.6	21.5	22.6	21.5
Below Coleman Dam	7.4	10.8	10.2	10.8	10.2
Below Confluence	13.7	54.6	52.6	54.6	52.6
Total	108.9	175.3	168.3	175.3	168.3

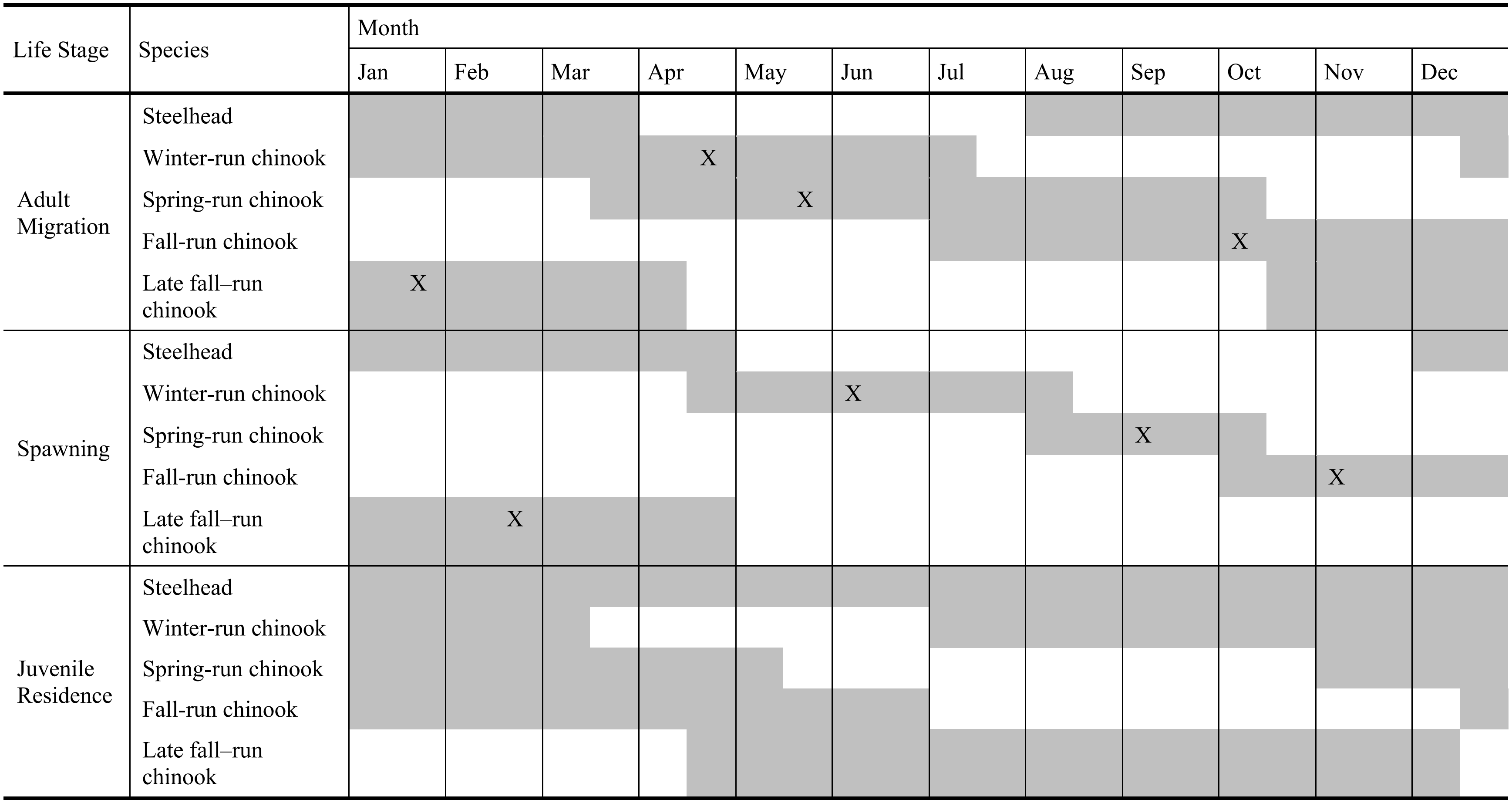
Table 4.1-11. Number of days of powerhouse outages on Battle Creek, 1983–2001.

		Year											
Site		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1983	South	-	-	-	-	3	-	-	-	-	-	-	-
	Inskip	-	-	-	-	-	3	-	-	-	-	-	-
	Coleman	-	-	-	-	-	-	-	-	-	-	5	-
1984	South	-	-	-	-	-	-	-	-	-	13	-	-
	Inskip	-	-	-	-	-	-	-	-	-	-	-	12
	Coleman	-	-	-	-	-	-	-	-	-	-	7	-
1985	South	1	4	-	-	-	-	-	-	7	6	-	-
	Inskip	-	-	-	-	-	-	-	-	-	-	17	-
	Coleman	-	-	-	-	-	-	-	-	-	7	-	-
1986	South	-	-	-	-	-	-	-	-	-	9	-	-
	Inskip	-	-	-	-	-	-	-	-	-	11	13	-
	Coleman	-	-	-	2	9	-	-	-	-	-	-	-
1987	South	-	-	-	-	-	-	-	-	-	15	-	-
	Inskip	-	-	-	-	-	-	-	21	23	-	-	-
	Coleman	-	-	-	-	3	-	-	-	-	-	-	-
1988	South	-	-	-	-	-	-	-	-	-	3	-	-
	Inskip	-	-	-	-	-	-	-	-	-	20	21	-
	Coleman	-	-	-	-	-	-	-	-	9	-	-	-
1989	South	-	-	-	-	-	-	-	-	-	4	-	-
	Inskip	-	-	-	-	-	-	-	-	-	7	-	-
	Coleman	-	-	-	-	-	-	-	-	23	-	-	-
1990	South	-	-	-	-	-	-	-	-	-	8	-	-
	Inskip	-	-	-	-	-	-	-	-	6	10	-	-
	Coleman	-	-	-	-	-	1	-	3	7	-	-	-
1991	South	-	-	-	-	-	-	-	-	-	6	-	-
	Inskip	-	-	-	-	-	-	-	2	-	-	-	-
	Coleman	-	-	-	-	-	-	-	-	11	-	-	-
1992	South	-	-	-	-	-	-	-	-	-	9	-	-
	Inskip	-	-	-	-	-	-	-	-	-	7	-	-
	Coleman	-	-	-	-	-	-	-	14	28	-	-	-
1993	South	-	-	-	-	-	-	-	-	-	2	-	-
	Inskip	-	-	-	-	-	-	-	1	2	-	-	-
	Coleman	6	1	-	-	-	-	-	-	2	-	-	-

Table 4.1-11. Continued

Site		Year											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1994	South	-	-	-	-	-	-	-	-	-	1	-	-
	Inskip	-	-	-	-	-	-	-	-	8	-	-	-
	Coleman	-	-	-	-	-	-	-	1	-	-	-	-
1995	South	-	-	-	-	-	-	-	-	-	1	-	-
	Inskip	-	-	-	-	-	-	-	-	-	2	-	-
	Coleman	-	-	-	-	14	-	-	-	1	-	-	4
1996	South	-	-	-	-	-	-	-	-	1	-	-	-
	Inskip	-	-	-	-	-	-	-	2	-	-	-	-
	Coleman	-	-	-	-	-	-	-	3	1	-	-	-
1997	South	-	-	1	-	-	-	-	-	2	-	-	-
	Inskip	28	24	-	-	-	-	-	-	-	-	-	-
	Coleman	1	-	-	-	-	-	-	6	30	3	-	-
1998	South	-	-	22	8	-	-	-	-	-	-	-	-
	Inskip	-	-	-	1	-	-	-	-	-	-	-	-
	Coleman	-	-	-	-	-	9	-	-	-	-	7	6
1999	South	0	0	2	-	-	-	-	-	-	-	-	-
	Inskip	-	-	3	-	-	-	-	-	-	-	-	-
	Coleman	-	-	-	2	-	-	-	-	-	-	-	-
2000	South	-	-	-	2	-	-	-	-	-	-	-	-
	Inskip	-	-	3	-	-	-	-	-	-	-	-	-
	Coleman	-	-	20	-	-	9	-	-	-	-	-	-
2001	South	-	-	1	-	-	-	-	-	-	-	-	-
	Inskip	-	-	1	-	-	-	-	-	-	-	-	-
	Coleman	-	-	1	-	30	30	9	-	-	-	-	-

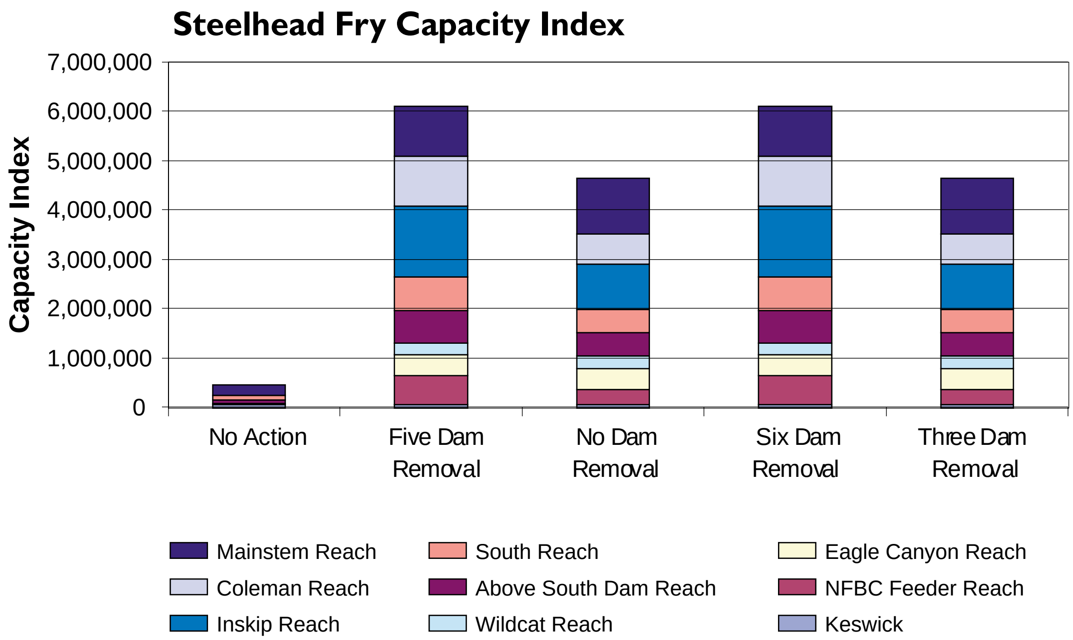
Figure 4.1-1. Seasonal Occurrence of Selected Life Stages of Anadromous Salmonids in the Upper Sacramento River

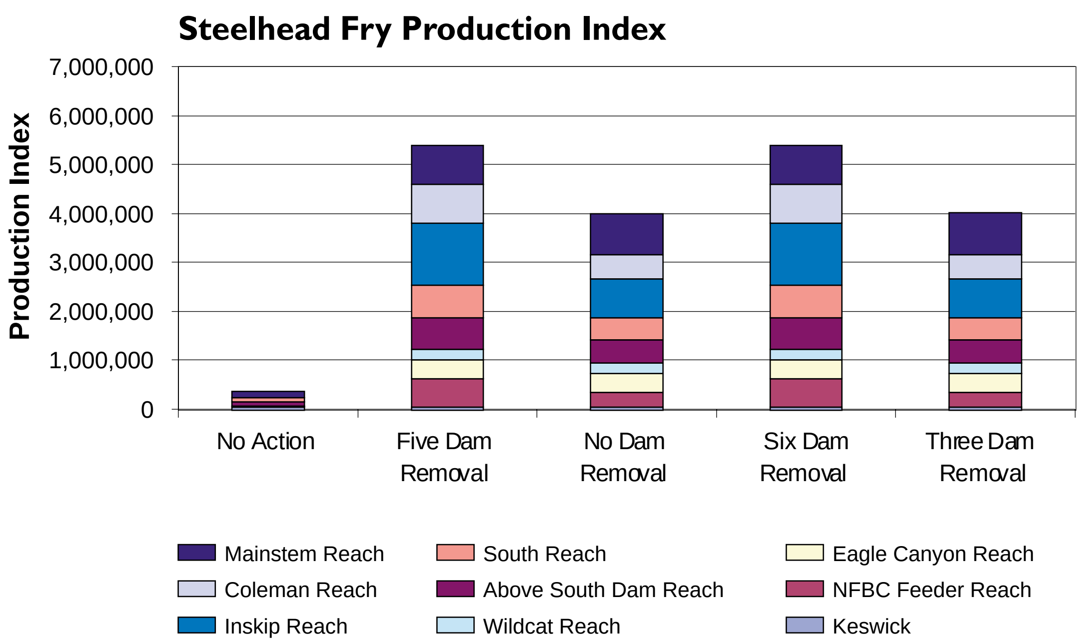


Notes

Source: Schafter 1980; Vogel and Marine 1991.

X denotes the approximate peak of life stage if a significant peak occurs.



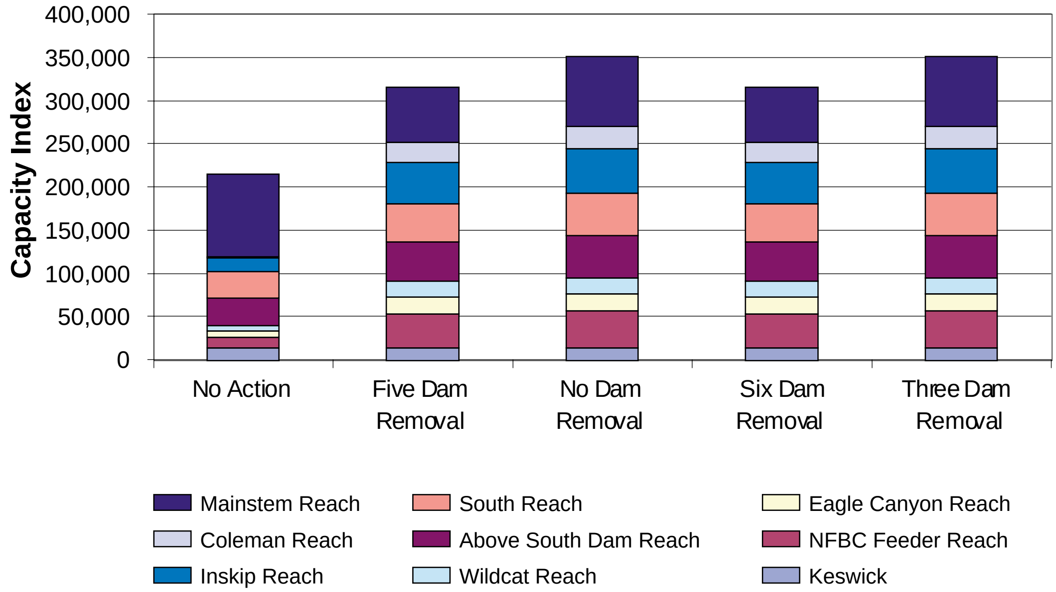


Note:
Indices are based on the minimum flow requirements for each alternative.

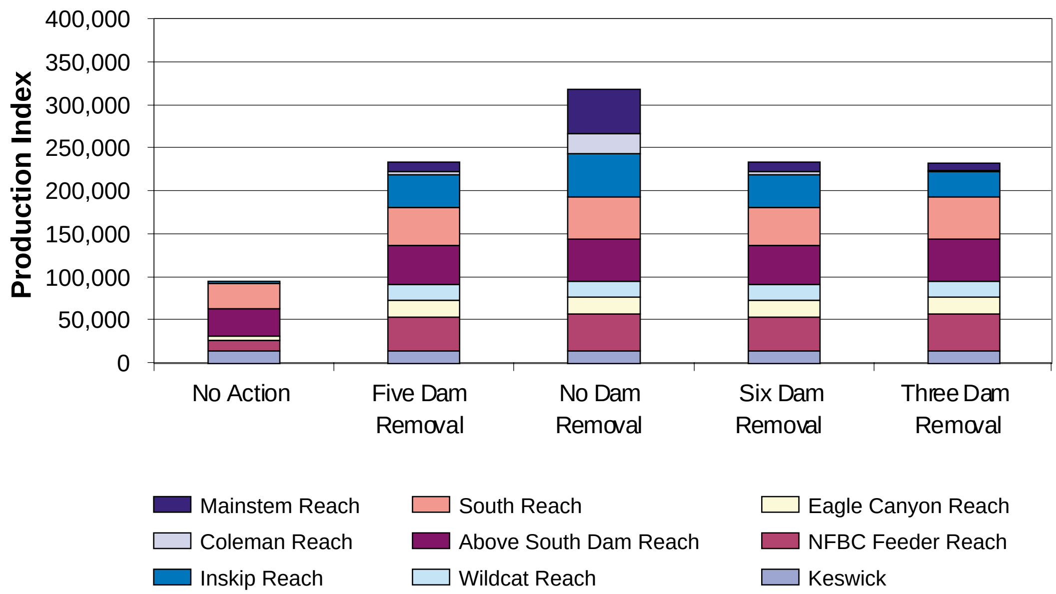
03035.03-004

Figure 4.1-2
Effects of Spawning Area and Water Temperature on Capacity and Production Indices for Steelhead in All Reaches of Battle Creek

Steelhead Juvenile Capacity Index



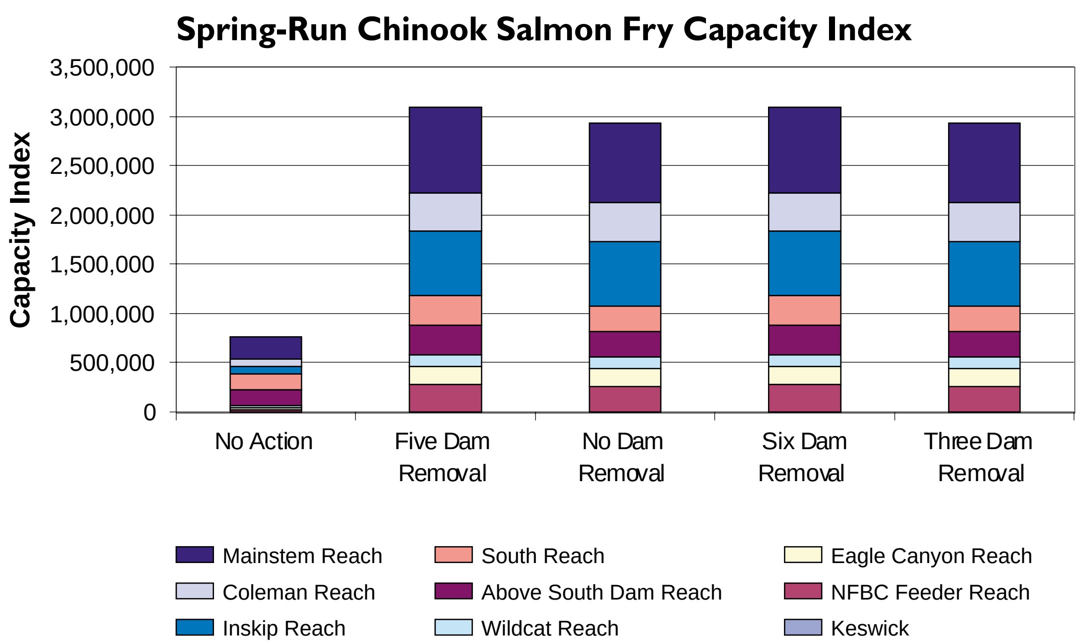
Steelhead Juvenile Production Index

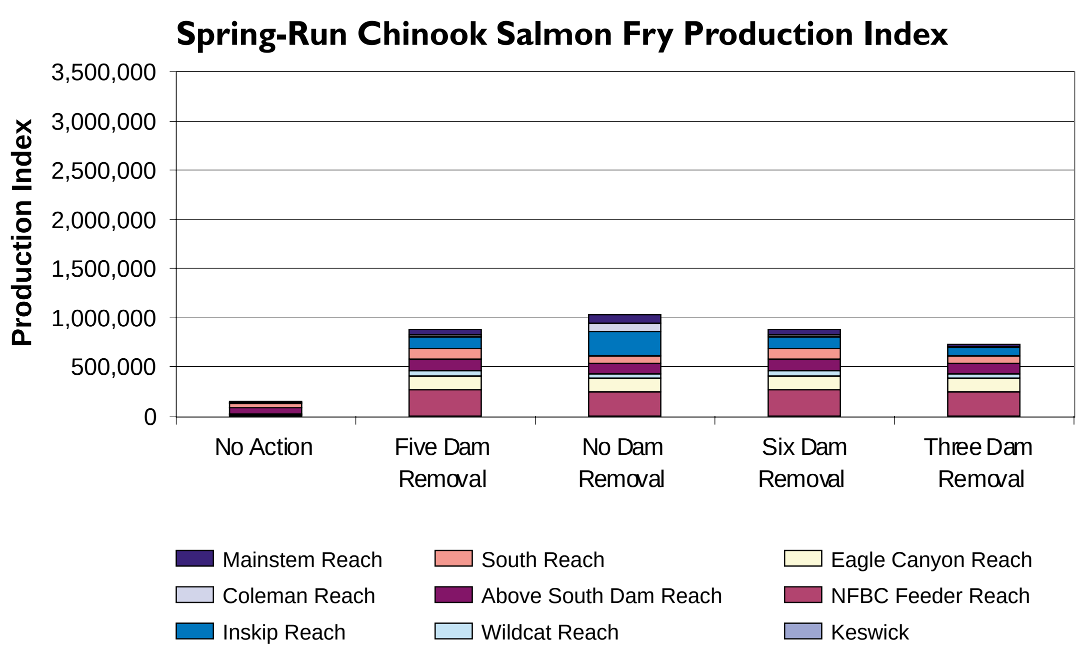


Note:
Indices are based on the minimum flow requirements for each alternative.

03035.03-004

Figure 4.1-3
Effects of Rearing Area and Water Temperature on Capacity and Production Indices for Steelhead in All Reaches of Battle Creek

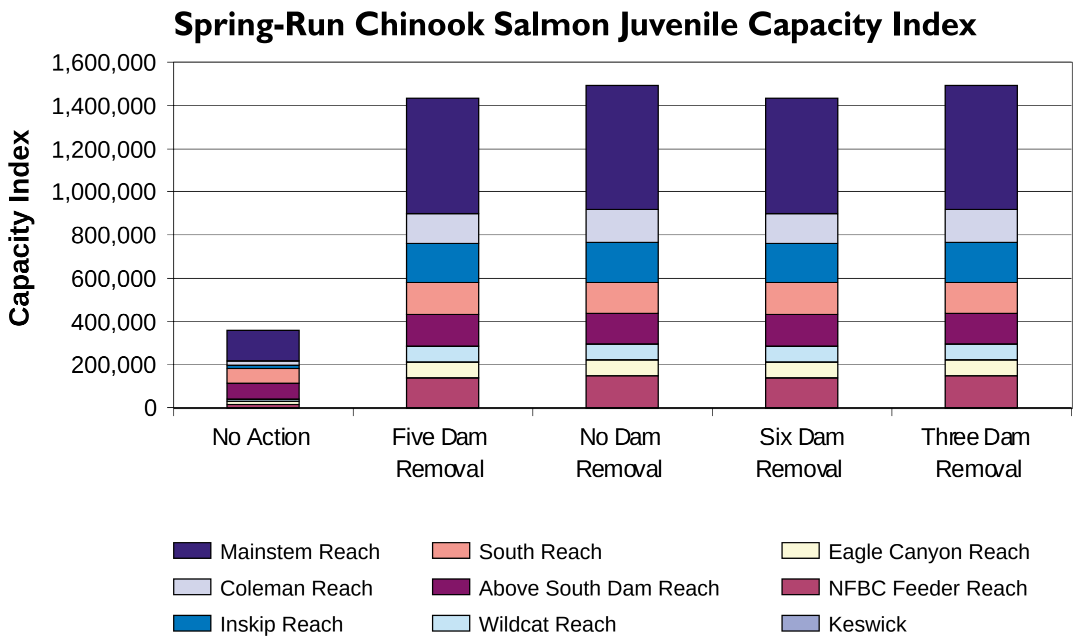


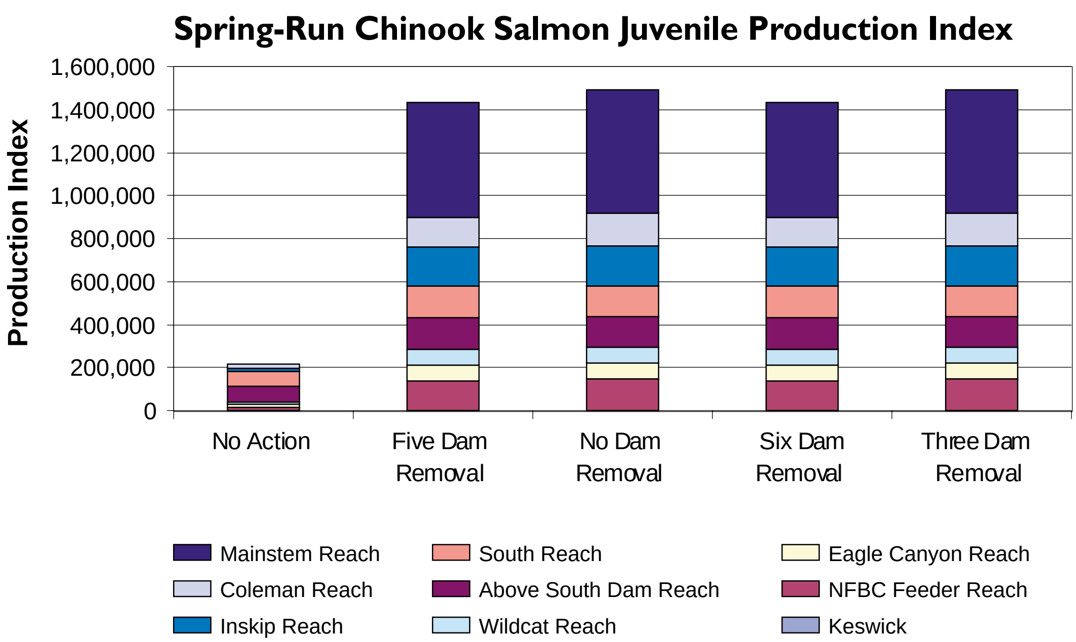


Note:
Indices are based on the minimum flow requirements for each alternative.

03035.03-004

Figure 4.1-4
Effects of Spawning Area and Water Temperature on Capacity and Production Indices for Spring-Run Chinook Salmon in All Reaches of Battle Creek

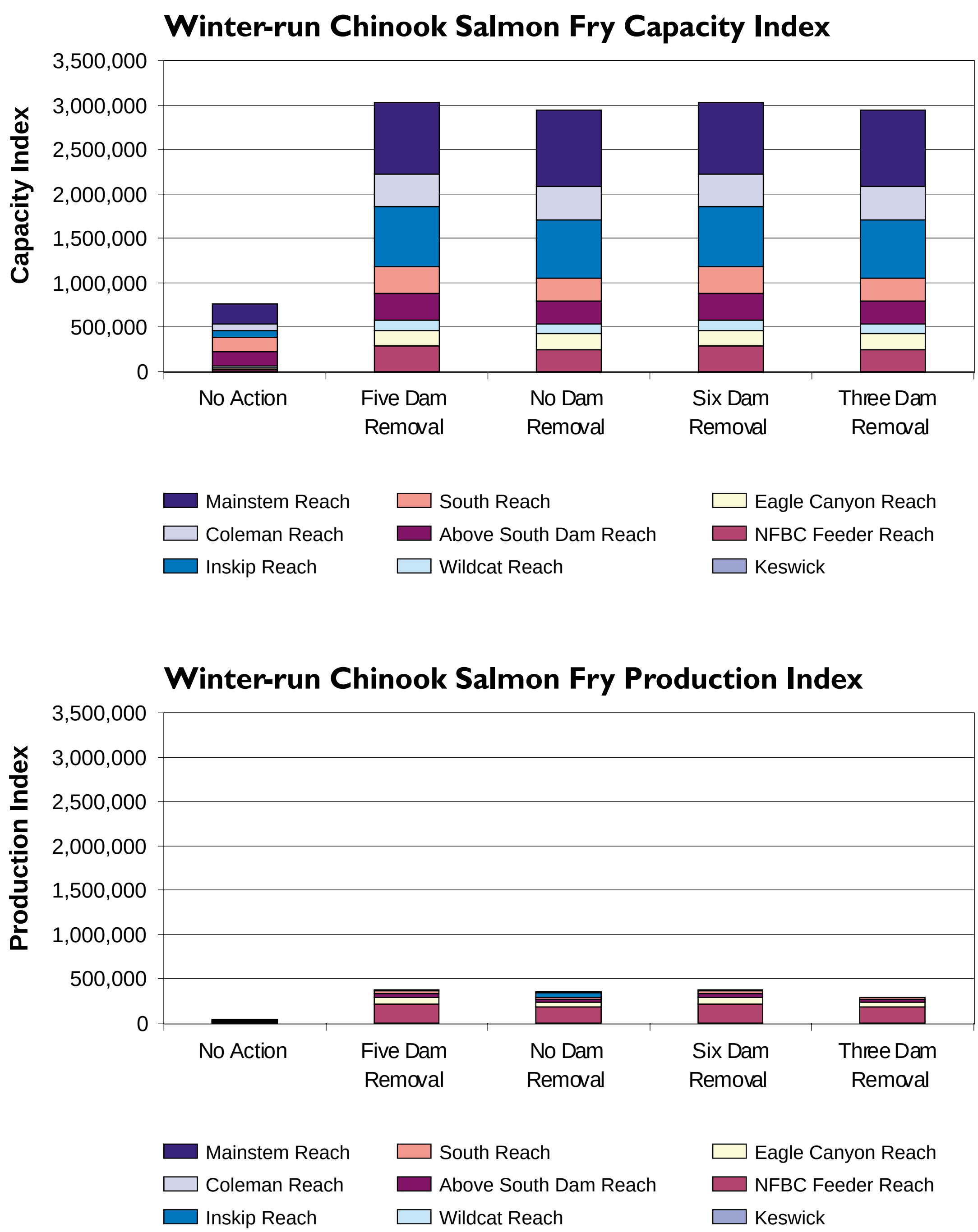




Note:
Indices are based on the minimum flow requirements for each alternative.

03035.03-004

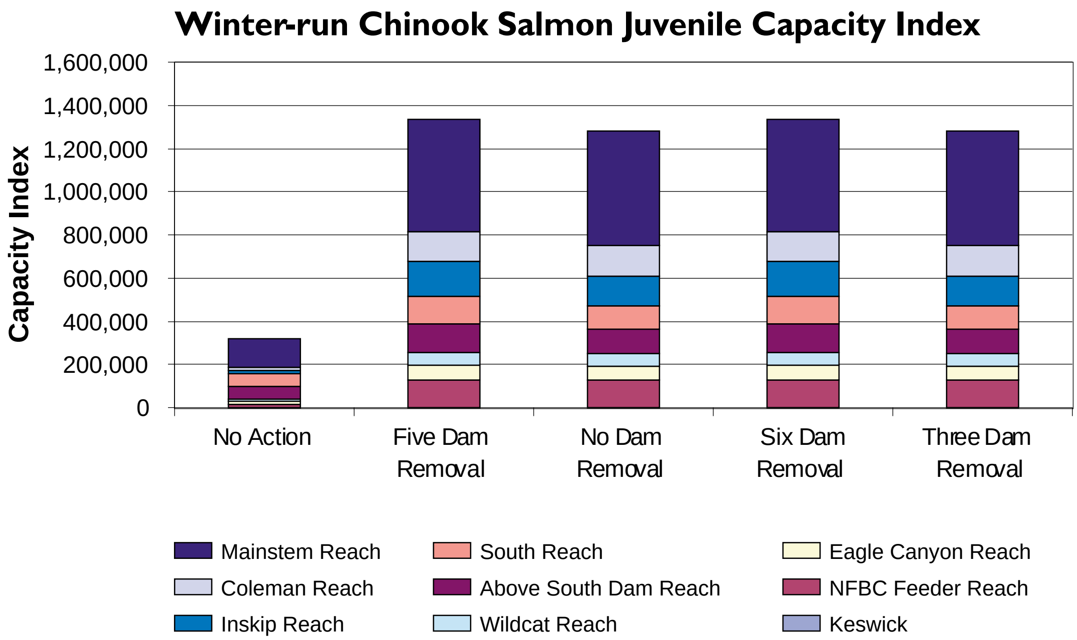
Figure 4.1-5
Effects of Rearing Area and Water Temperature on Capacity and Production Indices for Spring-run Chinook Salmon in All Reaches of Battle Creek

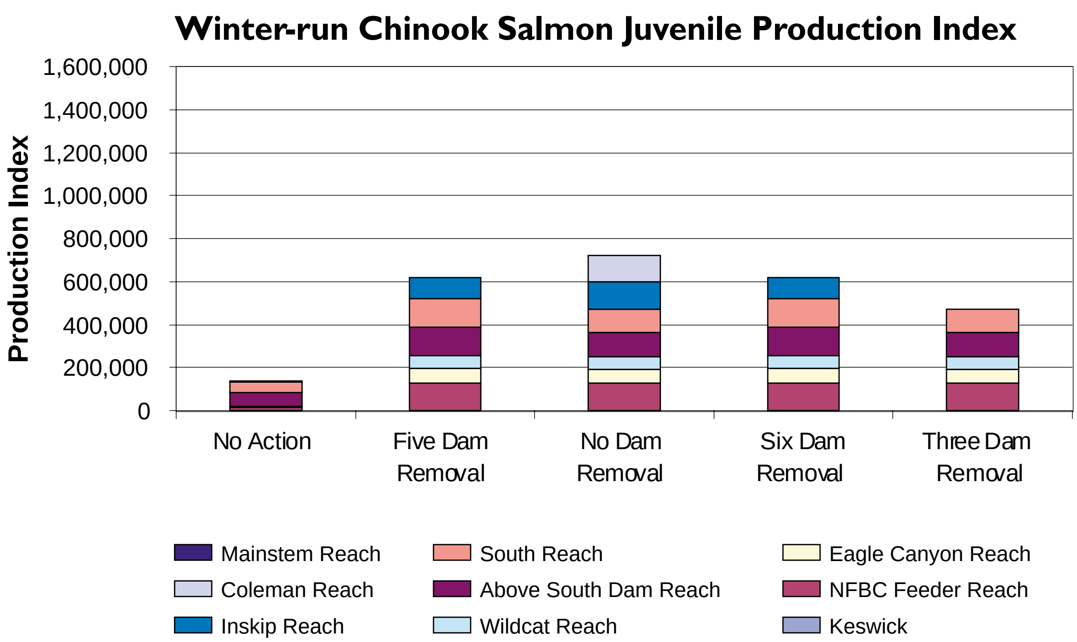


Note:
Indices are based on the minimum flow requirements for each alternative.

03035.03-004

Figure 4.1-6
Effects of Spawning Area and Water Temperature on Capacity and Production Indices for Winter-run Chinook Salmon in All Reaches of Battle Creek

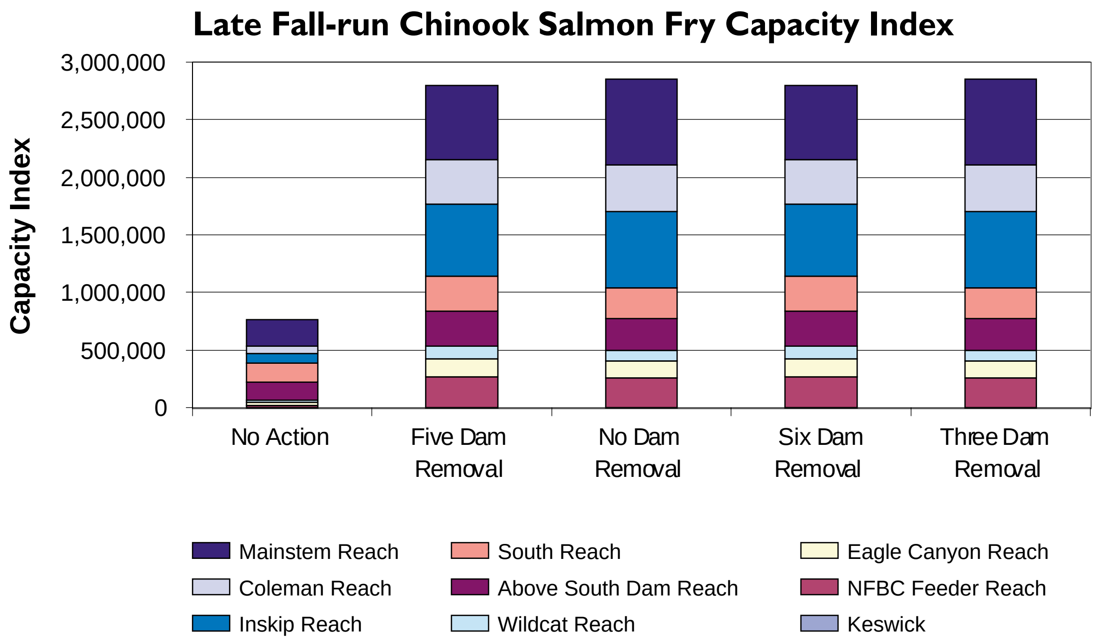


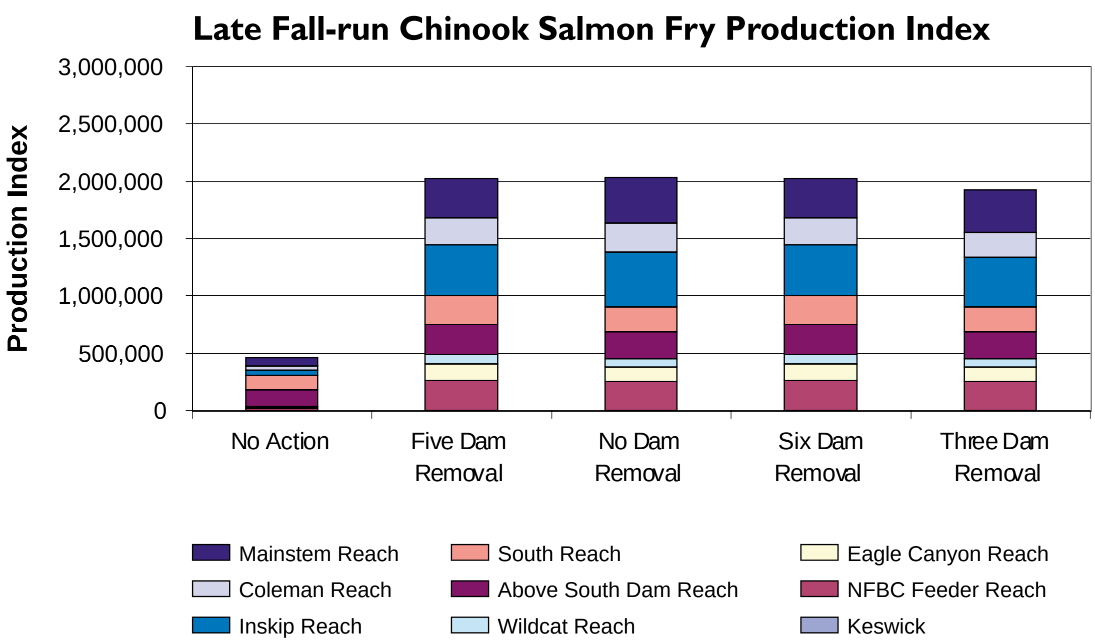


Note:
Indices are based on the minimum flow requirements for each alternative.

03035.03-004

Figure 4.1-7
Effects of Rearing Area and Water Temperature on Capacity and Production Indices for Winter-run Chinook Salmon in All Reaches of Battle Creek

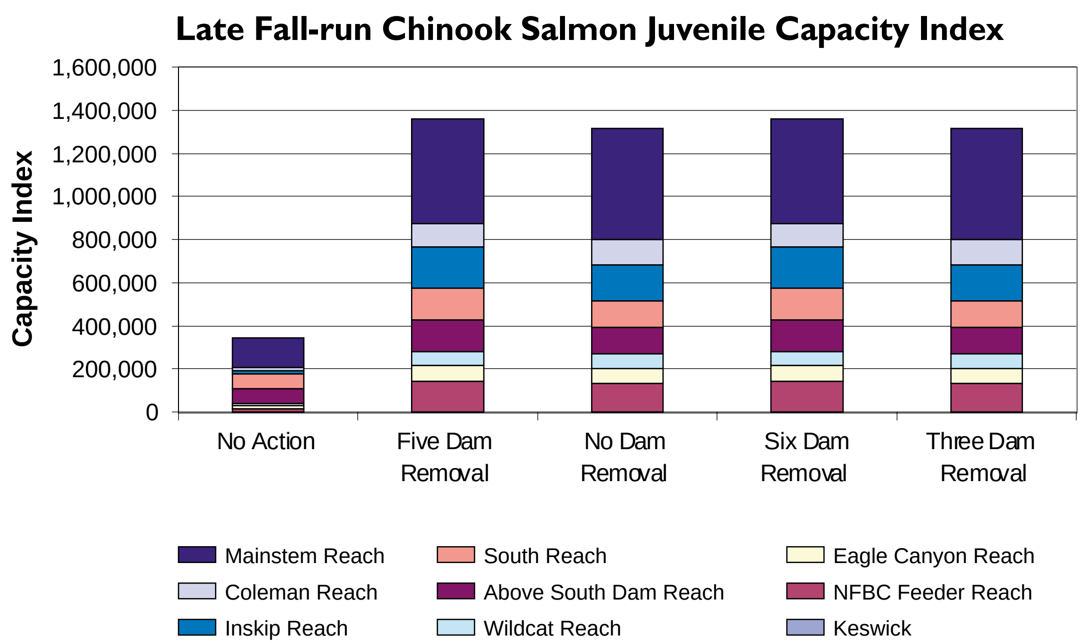


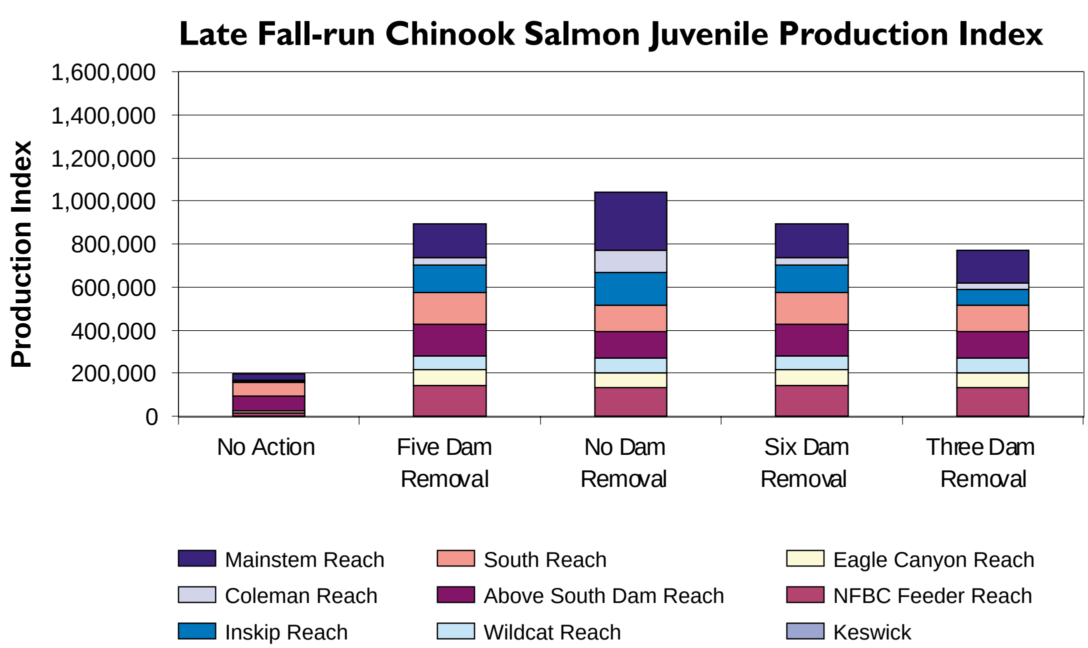


Note:
Indices are based on the minimum flow requirements for each alternative.

03035.03-004

Figure 4.1-8
Effects of Spawning Area and Water Temperature on Capacity and Production Indices for Late Fall-run Chinook Salmon in All Reaches of Battle Creek





Note:
Indices are based on the minimum flow requirements for each alternative.

03035.03-004

Figure 4.1-9
Effects of Rearing Area and Water Temperature on Capacity and Production Indices for Late Fall-run Chinook Salmon in All Reaches of Battle Creek

4.2 Botanical, Wetland, and Wildlife Resources

This section provides information on botanical, wetland, and wildlife resources that have been documented or have the potential to occur in or near the Restoration Project area. A qualitative and quantitative assessment of potential impacts on biological resources is described in the impact and mitigation portion of this section, along with measures that will be implemented to mitigate significant impacts. These mitigation measures have been developed through coordination with resource agencies and focus on avoiding, reducing, or compensating for potentially significant impacts on botanical, wetland, and wildlife resources.

Biological survey and documentation methods are discussed in Appendix G, "Methodologies." Methods and survey results are described in detail in the following reports:

- *Site Assessment for the California Red-Legged Frog, Battle Creek Salmon and Steelhead Restoration Project, Shasta and Tehama Counties* (Jones & Stokes 2001a);
- *Biological Survey Summary Report for the Battle Creek Salmon and Steelhead Restoration Project, Volumes I and II* (Summary Report) (Jones & Stokes 2001b, 2001c);
- *Site Assessment of the Battle Creek Salmon and Steelhead Restoration Project Area—Assessment of Bat Habitat in Water Diversion Tunnels* (Jones & Stokes pers. comm. 2002a);
- *California Spotted Owl Survey Results, Addendum to the Biological Survey Summary Report for the Battle Creek Salmon and Steelhead Restoration Project* (Jones & Stokes pers. comm. 2002b); and
- *Preliminary Delineation of Waters of the United States for the Battle Creek Salmon and Steelhead Restoration Project* (Jones & Stokes 2001c).

The wetland delineation report is considered preliminary until verified by the U.S. Army Corps of Engineers (Corps). The delineation is expected to be verified by August 2003. The documents listed above are available upon request at the U.S. Department of the Interior, Bureau of Reclamation, Mid-Pacific Region.

Biological resources in the Restoration Project area were identified on the basis of a review of existing information, a search of the California Natural Diversity Database (CNDDB) (2000 and 2003), a special-status species list provided by USFWS (Appendix H), and field surveys conducted by Jones & Stokes between 2000 and 2002. Biological survey results of habitat types, wildlife, and waters of the United States identified within the Restoration Project study areas are presented in Figures 4.2-1 through 4.2-19.

As described in Appendix G, "Methodologies," the study areas varied at each Restoration Project site and included a combination of diversion dams, flumes, pipelines, open canals, access roads, and staging areas. The study area for each site was based on proposed construction methods, use of existing or new access roads, terrain constraints, private property boundaries, fence lines, and dense vegetation that would not be removed during construction. The Restoration Project study areas are shown on the maps presented in Volume II of the Survey Summary Report (Jones & Stokes 2001c). The study area along existing access roads consisted of a 20-foot corridor on each side of the road edge (approximately 60 feet total).

Affected Environment

Regional Setting

The Restoration Project is located in the Battle Creek watershed in the Cascade Range Foothill physiographic region (Hickman 1993). The Battle Creek watershed is located on the volcanic slopes of Mt. Lassen in Tehama and Shasta Counties. The climate becomes increasingly Mediterranean from the higher portions of the project area towards the lower elevations in the northern Sacramento Valley. Summers are hot and dry and winters are mild and wet, with precipitation falling mostly as rain during late fall, winter, and early spring.

Plant Communities and Associated Wildlife Habitats

Table 4.2-1 summarizes the plant communities and associated wildlife habitats observed at each of the Restoration Project sites. Tables 4.2-2 through 4.2-5 summarize the total acreage of sensitive and common plant communities located on each of the Restoration Project sites for each alternative. Scientific names of plant and wildlife species mentioned in this section are provided in Appendix I.

Descriptions and names of plant communities were based on field surveys and on descriptions in the list of California terrestrial natural communities recognized by the CNDDB (2000), Holland (1986), and Sawyer and Keeler-Wolf (1995). Although the Sawyer and Keeler-Wolf classification system represents the most recent treatment and includes greater community detail than the CNDDB list, it is incomplete for many geographical areas in California. Additionally, some of the plant communities described in this report do not fit well into the communities that were defined by either Sawyer and Keeler-Wolf or Holland. Accordingly, some community-type names have been modified based on field observations.

Common Plant Communities and Associated Wildlife Habitats

The plant communities listed below comprise native or naturalized habitats that have not been substantially altered and that provide important wildlife habitat functions and values. Plant species and associated wildlife typically found in each common plant community are described in this section. All birds mentioned in this section were observed during wildlife surveys conducted in 2000, 2001, and 2002 at the Restoration Project area (Jones & Stokes 2001b, 2001c, 2002a) unless noted otherwise. The following common plant communities occur in the Restoration Project area:

- Annual grassland,
- Mixed chaparral,
- Live oak woodland,
- Blue oak woodland/savanna,
- Gray pine/oak woodland, and
- Westside ponderosa pine.

Figures 4.2-2, 4.2-4, 4.2-6, 4.2-8, 4.2-10, 4.2-12, 4.2-14, 4.2-16, and 4.2-18 show common plant communities and associated wildlife habitats at the proposed construction areas.

Annual Grassland

Annual grassland is the most common plant community in the Restoration Project area. It occupies understory and open areas in the gray pine/oak woodland and blue oak woodland/savanna communities. Annual grassland is dominated by mostly nonnative annual grass species, including soft chess, red brome, ripgut brome, medusahead, annual fescues, silver hairgrass, wild oat, lesser quaking-grass, and Italian ryegrass. Common native herbaceous species include tidy-tips, goldfields, yellowcarpet, popcornflowers, lowland shooting star, saxifrage, erect plantain, dwarf stonecrop, Fitch's spikeweed, filago, tarweeds, q-tips, marigold navarretia, downy navarretia, vetch, cowbag clover, tomcat clover, and white-tipped clover. Native perennial species include some of those mentioned in the description of blue oak woodland/savanna. Nonnative weedy species include filarees, star-thistle, and prickly lettuce.

Raptors that were observed foraging in grasslands of the Restoration Project area during the spring and summer included golden eagle, red-tailed hawk, American kestrel, and barn owl. Western kingbird and loggerhead shrike were seen perching on fence posts and searching for prey in grassland habitats. Ground-foraging birds observed included American crow, horned lark, American pipit, vesper sparrow, lark sparrow, savannah sparrow, western meadowlark, Brewer's blackbird, brown-headed cowbird, and house finch. Several species of swallows foraged over the grasslands for flying insects. Special-status raptor species that probably winter in grasslands of the Restoration Project area include white-tailed kite, northern harrier, ferruginous hawk, rough-legged hawk, golden eagle, prairie falcon, and merlin. However, because no winter surveys were performed, none of these species, except golden eagle, were observed in the Restoration Project area.

Representative reptiles and mammals of annual grasslands include gopher snake, western rattlesnake (mostly near rock outcrops), garter snakes, racer, western fence lizard, coyote, mule deer, and California ground squirrel.

Mixed Chaparral

Mixed chaparral is common throughout the Restoration Project area, but is typically found on north-facing slopes in canyons and in openings of other community types after fires have removed overstory trees. This community is dominated by broad-leaved shrubs with small hard leaves, typically 10–16 feet tall, forming a dense overstory. Common shrubs include buckbrush, big manzanita, green-leaved manzanita, birch-leaved mountain-mahogany, coffeeberry, poison-oak, California yerba santa, and California buckeye. Overstory trees are typically absent except in the transition zone between community types, where scattered canyon live oaks and interior live oaks are present.

Bird species observed in chaparral habitats of the Restoration Project area included mountain quail, California quail, mourning dove, Anna's hummingbird, western scrub-jay, oak titmouse, bushtit, Bewick's wren, blue-gray gnatcatcher, wrentit, California thrasher, spotted towhee, California towhee, rufous-crowned sparrow, lesser goldfinch, fox sparrow, golden-crowned sparrow, white-crowned sparrow, dark-eyed junco, hermit thrush, western tanager, black-headed grosbeak, orange-crowned warbler, and lazuli bunting. The latter two species are common nesters in chaparral habitats.

Representative reptiles and mammals in mixed chaparral habitats include western fence lizard, western skink, gopher snake, common kingsnake, western rattlesnake, mule deer, coyote, and gray fox.

Live Oak Woodland

Live oak woodland is common in the Restoration Project area, typically occurring in canyons and valley bottoms near streams. This plant community forms a mosaic in the transition zones between gray pine/oak woodland and chaparral on north-facing slopes. Live oak woodland is dominated by a mixture of canyon live oak and interior live oak, usually forming a dense overstory. Other trees such as California bay, buckeye, and black oak are usually present, but are a minor component of the overstory. The understory typically is poorly developed or absent in areas with dense overstory, but poison-oak, pipevine, California melic grass, Pacific sanicle, and sword fern are common in open areas.

Representative nesting raptors of live oak woodland habitats observed in the Restoration Project area included red-tailed hawk, American kestrel, barn owl, great horned owl, western screech owl, and northern pygmy-owl. Other species observed included California quail, mourning dove, spotted towhee, California towhee, lark sparrow, dark-eyed junco, Anna's hummingbird, acorn woodpecker, Nuttall's woodpecker, northern flicker, white-breasted nuthatch, Pacific-slope flycatcher, Hammond's flycatcher, ash-throated flycatcher, house wren, blue-gray gnatcatcher, orange-crowned warbler, black-throated gray warbler, Bullock's oriole, lazuli bunting, Hutton's vireo, western scrub-jay, oak titmouse, bushtit, Bewick's wren, western bluebird, American robin, California thrasher, brown-headed cowbird, house finch, lesser goldfinch, white-crowned sparrow, and golden-crowned sparrow.

Representative reptiles and mammals in live oak woodlands include western skink, northern alligator lizard, common kingsnake, gopher snake, western rattlesnake, deer mouse, western gray squirrel, striped skunk, ringtail, raccoon, bobcat, and mule deer.

Blue Oak Woodland/Savanna

Blue oak woodland/savanna in the Restoration Project area is located on sites with relatively thin, rocky soils. The community intergrades with gray pine/oak woodland at higher elevations and is replaced by annual grassland in thinner soils and at lower elevations.

Blue oak woodland/savanna is characterized by a relatively open canopy of trees dominated almost entirely by blue oaks. Shrubs are mostly lacking, but scattered individuals or occasional aggregations of mixed chaparral species may be present. Herbaceous species commonly found in the openings include blue dicks, grass nuts, soaproot, western buttercup, sanicle, manroot, bedstraws, puttyroot, and miner's lettuce. Most annual species are the same as those listed above for the annual grassland plant community.

Representative raptors observed in the Restoration Project area included red-tailed hawk, American kestrel, barn owl, great horned owl, and western screech owl. Other species observed included California quail, mourning dove, greater roadrunner, acorn woodpecker, Nuttall's woodpecker, northern flicker, white-breasted nuthatch, ash-throated flycatcher, blue-gray gnatcatcher, orange-crowned warbler, Bullock's oriole, Hutton's vireo, western scrub-jay, oak titmouse, bushtit, Bewick's wren, western bluebird, lark sparrow, brown-headed cowbird, California towhee, house finch, lesser goldfinch, white-crowned sparrow, and golden-crowned sparrow.

Representative reptiles and mammals in blue oak woodland/savanna include western fence lizard, gopher snake, California ground squirrel, coyote, striped skunk, and mule deer.

Gray Pine/Oak Woodland

Gray pine/oak woodland is common in the Restoration Project area where it transitions into westside ponderosa pine forest at higher elevations and into blue oak woodland and annual grassland at lower elevations. Mixed chaparral occurs in inclusions and forms the shrubby understory in places.

A varying mixture of blue oak and gray pine dominates gray pine/oak woodland. At higher elevations, scattered black oak, big-leaf maple, and California bay are also present. Associated shrub and sub-shrub species include many that are common to mixed chaparral, such as toyon, manzanita, coffeeberry, redberry, California buckeye, redbud, buckbrush, mountain-mahogany, poison-oak, lemonadeberry, bedstraws, and live oaks. Herbaceous species are mostly lacking where the shrub layer is best developed. In open areas, herbaceous species include many that are common to the adjacent blue oak woodland/ savanna and annual grassland plant communities.

Representative wildlife species include the species representative of live oak woodland habitats (see above).

Westside Ponderosa Pine Forest

Westside ponderosa pine forest occupies the upper elevations along access roads to the southern end of the Restoration Project area. Westside ponderosa pine forest also mixes with gray pine/oak woodland and mixed chaparral at lower elevations. Inclusions of Douglas-fir forest also occur at higher elevations adjacent to Westside ponderosa pine forest.

A relatively dense to open canopy of ponderosa pine with scattered incense cedar, black oak, and canyon live oak dominates westside ponderosa pine forest. Also present at lower elevations are occasional California bay and gray pine. Shrub and sub-shrub species include mountain lilac, manzanita, and live oak. At lower elevations, coffeeberry, redbud, blackberry, and poison-oak are found. Common herbaceous species include wild iris, snub pea, Indian-pink, aster, goldenrod, bracken fern, and woodland strawberry. Grasses include mountain brome, orchard grass, needlegrass, hedgehog dogtail, nitgrass, and annual fescues. Other species common to the annual grassland reach their higher elevation limits here.

Representative raptors observed in the Restoration Project area included red-tailed hawk, sharp-shinned hawk during migration, western screech owl, great horned owl, and northern pygmy-owl. Other species observed included band-tailed pigeon, red-breasted sapsucker, hairy woodpecker, northern flicker, pileated woodpecker (expected to occur but not observed), red-breasted nuthatch, white-breasted nuthatch, olive-sided flycatcher, western wood-pewee, Pacific-slope flycatcher, Cassin's vireo, warbling vireo, Nashville warbler, black-throated gray warbler, hermit warbler, Wilson's warbler, western tanager, black-headed grosbeak, lazuli bunting, chipping sparrow, Hutton's vireo, Steller's jay, western scrub-jay, oak titmouse, bushtit, brown creeper, winter wren, golden-crowned kinglet, American robin, spotted towhee, dark-eyed junco, mountain quail, brown-headed cowbird, purple finch, pine siskin, lesser goldfinch, and violet green swallows. Pileated woodpecker was not observed but is expected to occur.

Representative amphibians, reptiles, and mammals of ponderosa pine forests include California slender salamander, ring-necked snake, common kingsnake, deer mouse, western gray squirrel, striped skunk, mule deer, raccoon, bobcat, and mountain lion.

Sensitive Plant Communities and Associated Wildlife Habitats

For the purpose of this EIS/EIR, sensitive communities are defined as those communities that are especially diverse or regionally uncommon, considered sensitive natural communities (as defined by DFG) (Holland 1986), or regulated by federal or state agencies including DFG, USFWS, and the Corps. Sensitive plant communities (e.g., wetlands and riparian areas) are given special consideration because they provide important ecological functions or support a unique or diverse assemblage of plant species.

Plant species and associated wildlife typically found in each sensitive plant community are described in this section. The following sensitive plant communities are present in the Restoration Project area:

- Emergent wetland,
- Seasonal wetland,
- Emergent scrub wetland,
- Groundwater seep wetland, and
- Riparian forest and scrub.

Four of these communities are classified as wetland communities. Wetlands are significant natural communities because of historical and current regional and statewide losses and because of the laws and policies that pertain to their protection, including Section 404 of the Clean Water Act (33 USC 1251–1376), the Governor of California's Wetlands Conservation Policy (Executive Order W-59-93, August 23, 1993), and the no-net-loss policy established by Executive Order 11990 (42 FR 26961, May 25, 1997). Wetland communities in the Restoration Project area play a role in groundwater discharge by supporting stream base flow; capture sediment and nutrient runoff; and provide habitat for dependent wildlife and plant species.

Figures 4.2-3, 4.2-5, 4.2-7, 4.2-9, 4.2-11, 4.2-13, 4.2-15, 4.2-17, and 4.2-19 show wetlands and other waters of the United Stated identified within the proposed construction areas. The occurrences of wetland communities identified during field surveys are also documented as part of the wetland delineation report (Jones & Stokes 2001c). Wetlands are also listed in Table II-1 and their locations are shown on Maps D-1 through D-9 in Volume II of the Summary Report (Jones & Stokes 2001c). Sensitive plant communities are briefly described below.

Emergent Wetland

Approximately 3.13 acres of emergent wetlands were delineated on the Restoration Project sites (see Table II-1 in Volume II of the Summary Report [Jones & Stokes 2001c] for a list of individual wetland sites). Emergent wetlands are characterized by erect, rooted, herbaceous plants that are adapted to living in water (Cowardin et al. 1979). Perennial plants present for most of the growing season in most years usually dominate these wetlands. Dominant species include narrow-leaved cattail, rush, Parish's spike-rush, monkeyflower, and Himalayan blackberry. On the Restoration Project sites, emergent wetlands were delineated as potential waters of the United States because they are characterized by a prevalence of hydrophytic vegetation, hydric soils, and wetland hydrologic conditions, and are adjacent to Battle Creek (Jones & Stokes 2001c).

Representative waterbirds that forage and rest in emergent wetlands and associated open water habitats in the Sierra Nevada foothills include pied-billed grebe, great blue heron, and great egret. Various ducks, including wood duck, green-winged teal, mallard, cinnamon teal, gadwall, American widgeon, and ring-necked duck, frequent emergent wetlands where they are joined by American coot, killdeer, black-necked stilt, greater yellowlegs, and common snipe. Typical amphibians and reptiles in these habitats are California newt, foothill yellow-legged frog, northwestern pond turtle, and garter snakes. Large mammals such as black-tailed deer may frequent emergent wetlands and use them as sources of drinking water.

Seasonal Wetland

Approximately 1.01 acres of seasonal wetlands were delineated on the Restoration Project sites and along access roads (see Table II-1 in Volume II of the Summary Report [Jones & Stokes 2001c] for a list of individual wetland sites). Seasonal wetlands are characterized by short-duration ponding sufficient to support hydrophytic plant species. These areas differ from vernal pools in various respects but are distinguished from them by the lack of vernal pool plant species. Seasonal wetlands in the Restoration Project area are dominated by Italian ryegrass, curly dock, cocklebur, annual hairgrass, Mediterranean barley, long-beaked hawkbit, hyssop loosestrife, toad rush, and occasional vernal pool species such as coyote thistle, Freemont's goldfields, woolly marbles, and water starwort.

On the Restoration Project sites, seasonal wetlands were delineated as potential waters of the United States because they are characterized by a prevalence of hydrophytic vegetation, hydric soils, and wetland hydrologic conditions, and are adjacent to Battle Creek (Jones & Stokes 2001c). Seasonal wetlands can attract the same wetland-dependent birds and other wildlife that frequent emergent wetlands.

Emergent Scrub Wetland

Approximately 1.57 acres of emergent scrub wetlands were delineated on the Restoration Project sites (see Table II-1 in Volume II of the Summary Report [Jones & Stokes 2001c] for a list of individual wetland sites). Emergent scrub wetlands are characterized by the same erect, rooted, herbaceous hydrophytes described above for emergent wetlands. In addition, these wetlands are dominated by broad-leaved, deciduous, hydrophytic trees and shrubs, usually less than 20 feet tall, such as willows and white alder. These wetlands may represent a successional stage leading to forested wetlands, or they may be relatively stable communities.

On the Restoration Project sites, emergent scrub wetlands were delineated as potential waters of the United States because they are characterized by a prevalence of hydrophytic vegetation, hydric soils, and wetland hydrologic conditions, and are adjacent to Battle Creek (Jones & Stokes 2001c).

Representative wildlife species are similar to those species described above for emergent and seasonal wetlands.

Groundwater Seep Wetland

Approximately 1.11 acres of groundwater seep wetlands were delineated on the Restoration Project sites (see Table II-1 in Volume II of the Summary Report [Jones & Stokes 2001c] for a list of individual wetland sites). Groundwater seep wetlands are dominated by annual or perennial hydrophytes. The substrate is usually saturated to the surface for extended periods, especially early in the growing season, but saturation can be absent by the end of the season in most years. Dominant plant species include watercress, monkeyflower, various sedges, and liverworts.

On the Restoration Project sites, groundwater seeps were delineated as potential waters of the United States because they are characterized by a prevalence of hydrophytic vegetation, hydric soils, and wetland hydrologic conditions, and are adjacent to Battle Creek (Jones & Stokes 2001c).

Representative wildlife species are similar to those species described above for other wetland habitats.

Riparian Forest and Scrub

Riparian forest and scrub communities occur along perennial drainages in the Restoration Project area. For example, they occur along North Fork and South Fork Battle Creek, Ripley Creek, and Soap Creek; along several unnamed drainages; and in several emergent wetlands (Figures 4.2-3, 4.2-5, 4.2-7, 4.2-9, 4.2-11, 4.2-13, 4.2-15, 4.2-17 and 4.2-19; see also Table II-1 in Volume II of the Summary Report [Jones & Stokes 2001c] for a list of individual drainages that support riparian forest and scrub). Riparian scrub dominates areas along channels in most creeks and forms a mosaic with riparian forest or live oak woodland.

In areas with broader floodplains, riparian trees such as valley oak and western sycamore tend to dominate the overstory. Patches of Himalayan blackberry, scattered willows, and California wild grape usually comprise the understory in these areas.

In canyons with perennial streams (such as North Fork Battle Creek), several species are common in addition to the species listed above. Overstory species include California bay, white alder, big-leaf maple, fig, white mulberry, Douglas-fir, Pacific yew, and Oregon ash. Understory shrubs include poison-oak, western spicebush, dogwood, and several species of willow.

In the Restoration Project area, riparian communities are generally dominated by hydrophytic vegetation and hydrologic conditions, but lack hydric soil indicators. These riparian communities do not meet the Corps' definition of wetlands for purposes of the Clean Water Act because they lack all three indicators. Riparian communities that occur within the ordinary high water mark of Battle Creek and other drainages would be considered other waters of the United States, subject to regulation by the Corps under Section 404 of the Clean Water Act (33 USC 1251–1376).

Riparian forest and scrub habitats are among the most important wildlife habitats in the Restoration Project area. These habitats attract a high diversity of resident and neotropical migratory birds; species observed during field visits included belted kingfisher, downy woodpecker, black phoebe, warbling vireo, orange-crowned warbler, bushtit, western scrub-jay, Bewick's wren, house wren, American robin, yellow-breasted chat, western tanager, black-headed grosbeak, lazuli bunting, spotted towhee, and song sparrow. Important seed-eating species included house finch and lesser goldfinch.

Other representative wildlife species in riparian habitats of the Restoration Project area include most mammals, amphibians, and reptiles that are attracted by a source of flowing water. Riparian corridors are important deer migratory habitat. Bats may forage for insects over riparian areas in the canyons and roost in trees. The number of bat species using the Restoration Project area was not determined during the field surveys. Although not confirmed during field surveys, spotted bat, western red bat, fringed myotis, long-eared myotis, small-footed myotis, long-legged myotis, Yuma myotis, pallid bat, and Townsend's big-eared bat potentially occur, and all are considered species of concern by USFWS.

Noxious Weeds

For the purpose of this analysis, a *noxious weed* is a plant that has the potential to displace native plants and natural habitats, affect the quality of forage on rangelands, or affect cropland productivity. High-priority noxious weeds include all of the California Department of Food and Agriculture's A-rated species. Some B- and C-rated species were included in this analysis if they were identified by the county agricultural commissions as target noxious weeds. Additional weeds were included if they were considered to have great potential for displacing native plants and damaging natural habitats and were not considered too widespread to be effectively controlled.

During the field surveys, populations of five noxious weed species were located at several Restoration Project sites: medusahead, yellow star-thistle, Klamath weed, Scotch broom, and Chinese tree-of-heaven. Medusahead, yellow star-thistle, and Klamath weed are common in the Restoration Project region and are considered ubiquitous in California. These species are generally no longer targeted for eradication and control because they are so widespread and are very difficult to control (California Department of Food and Agriculture 2001). However, the Battle Creek Watershed Conservancy Noxious Weeds Removal Program does have measures for removal and control of these species (Paquin-Gilmore 1999).

Scotch broom, Klamath weed, yellow star-thistle, and medusahead are rated as list C species on the California Department of Food and Agriculture list of noxious weeds (California Department of Food and Agriculture 2001). Such species are so widespread that the agency generally does not endorse state- or county-funded eradication or containment efforts except in nurseries or seed lots. Although Chinese tree-of-heaven is not considered a noxious weed by the California Department of Food and Agriculture, it is a highly invasive horticultural species that displaces native riparian species (Bossard et al. 2000). Chinese tree-of-heaven was identified on the Wildcat Diversion Dam site, and Scotch broom was identified at the Coleman Diversion Dam/Inskip Powerhouse and Inskip Diversion Dam/South Powerhouse sites (Jones & Stokes 2001b, 2001c).

Special-Status Plants

Thirty-one special-status plants were identified during prefield investigations and field surveys as occurring or potentially occurring in the Restoration Project area (Table 4.2-6). No state- or federally listed plant species were previously documented in the Restoration Project study area, and no such plants were located during the field surveys.

Four species that are considered “plants of limited distribution,” or List 4 plants, by the California Native Plant Society (CNPS) (Skinner and Pavlik 1994; California Native Plant Society 2001) were located on the Restoration Project sites during the field surveys: woolly meadowfoam, shield-bracted monkeyflower, depauperate milk-vetch, and Bidwell’s knotweed. After considering available distribution information and reviewing file information, it was determined that none of these four species warrants evaluation as a special-status plant. These CNPS List 4 plants lack special significance in the Restoration Project area. Although considered plants of limited distribution by CNPS, they are not considered rare under CEQA (Public Resources Code §21000 *et seq.*), they are locally common in the Restoration Project area, and most populations will not be significantly affected during Restoration Project activities. Therefore, these species are not discussed in the Impact Assessment below.

The CNPS List 4 species were observed at multiple locations in the Restoration Project area including Coleman Diversion Dam, Inskip Powerhouse, South Canal, and South Diversion Dam and along several access roads. More information on each population is provided in Volume I of the Summary Report (Jones & Stokes 2001b).

Special-Status Wildlife

Thirty-seven special-status wildlife species were identified during the prefield survey investigation as having the potential to occur in the Restoration Project area (Table 4.2-7). The regulatory status of each species is listed in Table 4.2-7. The presence of the following 13 special-status animals or their potential habitats was documented during the field surveys:

- Valley elderberry longhorn beetle,
- Foothill yellow-legged frog,
- Northwestern pond turtle,
- Bald eagle,
- Golden eagle,
- Osprey,
- Cooper's hawk,
- Sharp-shinned hawk,
- American peregrine falcon,
- California spotted owl,
- Vaux's swift,
- Little willow flycatcher, and
- Yellow-breasted chat.

In addition to the species listed above, numerous bats were observed foraging over the Restoration Project area, and roosting bats were observed in abandoned tunnels near South Powerhouse and at Inskip Diversion Dam. The bats were not identified to the specific level; however, species that could occur in the Restoration Project area are listed in Table 4.2-7.

Valley Elderberry Longhorn Beetle

Valley elderberry longhorn beetle is federally listed as threatened; it is not listed by the state. It is a medium-sized (0.8 inch long) beetle with dark metallic-green forewings with red margins in the female and red forewings with dark green spots in the male. The beetle's entire life cycle is associated with elderberry shrubs in California's Central Valley and the surrounding foothills. The larvae live in the pith of the elderberry stem. The adults emerge through distinctive oval exit holes. The presence of these exit holes is an indication of previous valley elderberry longhorn beetle use. The species may have always been rare; however, the substantial reduction in Central Valley riparian vegetation in the past 150 years probably has further reduced the beetle's range and isolated the remaining populations.

Valley elderberry longhorn beetle is not known to occur in the Restoration Project area; however, old exit holes have been found in elderberry shrubs 0.7 mile east of Paynes Creek, approximately 5 miles away from the Restoration Project area (CNDDB 2003). Biologists found numerous elderberry shrubs with stems greater than 1 inch in diameter that could provide habitat for the beetle (Table 4.2-8). A few stems with possible exit holes were found in two separate large clusters of elderberry shrubs located on the South Powerhouse alternative access road. However, the holes were old, and it is uncertain whether they were made by emerging valley elderberry longhorn beetles; other wood-boring insects and woodpeckers could make similar-sized holes.

Foothill Yellow-Legged Frog

Foothill yellow-legged frog has been designated as a federal species of concern and a California species of special concern. This frog is easily distinguished from the rare, federally listed red-legged frog by the color of its legs. Yellow-legged frogs breed after the winter river levels have dropped in mid-March to May throughout the Coast Ranges, along the western side of the Sierra Nevada, and in most of northern California west of the Cascades. Habitat requirements for foothill yellow-legged frog include shallow, flowing streams with at least a cobble-sized substrate. Introduced predatory aquatic species such as fish and bullfrogs and poorly timed water releases from reservoirs have contributed to the decline of this species.

Larvae, juveniles, and one adult yellow-legged frog were observed near the South Powerhouse during field surveys. Adult and/or juvenile foothill yellow-legged frogs were also found near the Lower Ripley Creek Feeder Dam, South Diversion Dam, and Soap Creek Feeder (Jones & Stokes 2001b, 2001c).

Northwestern Pond Turtle

Northwestern pond turtle is a federal species of concern and a state species of special concern. It is endemic to the Pacific Northwest and, as the only native turtle in northern California, is unlikely to be misidentified. It is found north of the American River in a wide range of fresh or brackish rivers, streams, lakes, ponds, and wetlands. Basking sites, such as rocks, logs, or vegetation, are usually present. Northwestern pond turtles may be either largely inactive during the winter or active throughout the year, depending on location and environmental conditions. Habitat destruction is the primary cause of population decline (Jennings et al. 1992). Introduced exotic fish and bullfrogs that prey on young turtles may also be causing decreases in recruitment.

One adult was found in Ripley Creek just upstream from Lower Ripley Creek Feeder Dam. The turtles are likely to occur elsewhere in the Restoration Project area; however, no individuals were found during field surveys.

Bald Eagle

Bald eagle is federally listed as threatened, state listed as endangered, and protected under the Bald and Golden Eagle Protection Act (16 USC 668–668d). The adult's distinctive white-feathered head and tail contrast sharply with its dark brown body and wings. Fish constitute most of the species' diet. Bald eagles winter throughout most of California at lakes, reservoirs, river systems, and some rangelands and coastal wetlands. They breed in forested habitats near reservoirs, lakes, and rivers in the northern half of the state. The nest is usually in a large tree near a large body of water with low human disturbance. Bald eagle populations declined as a result of eggshell-thinning from ingestion of dichlorodiphenyltrichloroethane (DDT), shooting, and disturbance of nest sites. However, because of protection under the federal Endangered Species Act (16 USC 1531–1544) and the Bald and Golden Eagle Protection Act, bald eagle populations have recovered across most of North America, and the species may soon be delisted.

Bald eagles hunt for fish within the Restoration Project area; however, no active or inactive nest sites were identified. Bald eagles likely nest outside the Restoration Project area, but near enough that the Restoration Project Area would lie within the daily range of foraging eagles. Adults were seen flying high over both forks of Battle Creek on several occasions during the spring field surveys.

Golden Eagle

Golden eagle, designated as a species of special concern by DFG, is a fully protected species under the California Fish and Game Code and is protected under the Federal Bald and Golden Eagle Protection Act (16 USC 668–668d). One of the largest raptors in the world, golden eagle is named for the golden crown and nape found on the adults. Golden eagle is a permanent resident throughout California, except in the center of the Central Valley, although it winters in this area (Zeiner et al. 1990). Golden eagles are closely associated with open range, including blue oak savanna, and avoid dense coastal and montane coniferous forests. Golden eagles, prey mostly on rabbits and rodents, need these open areas for hunting. They breed from late January through August, usually nesting on cliff ledges and less frequently in large trees.

Golden eagles were seen flying over the Restoration Project site at North Battle Creek Feeder Dam and the South Powerhouse, and two birds were observed in courtship display over the crags at South Diversion Dam. Old, unoccupied nests were found at the headwaters of Soap Creek Feeder and at the South Powerhouse. The eagles sighted may have nested in the region, but because their home range is very large, observations of pairs of golden eagles at a site do not necessarily indicate local nesting (Jones & Stokes 2001b, 2001c).

Osprey

Osprey is a California species of special concern. Ospreys are widely distributed throughout most of the world. Currently, ospreys breed in northern California from the Cascade Ranges south to Lake Tahoe and along the coast south to Marin County. Although most ospreys migrate, small numbers are present in winter along the entire California coast and near large inland bodies of water. Ospreys prey mainly on fish and, therefore, require open waters for foraging. They nest in large trees, on cliffs, or on human-made structures in open forest habitats. Pesticide contamination, nest-tree removal, alteration of the environmental quality of rivers and lakes, boating and other human disturbances in nesting areas, and illegal shooting have all led to the decline of osprey populations.

In April 2000, an adult osprey was observed perched on an active nest approximately 0.7 mile north of the access road to the South Diversion Dam. In June 2000, an adult osprey was observed hunting for fish along South Fork Battle Creek near Inskip Diversion Dam/South Powerhouse.

Cooper's Hawk

Cooper's hawk has been designated as a species of special concern by DFG. This medium-sized *Accipiter* is larger than sharp-shinned hawk; adults are easily identified by the reddish barring on their underparts and their lack of a white eyestripe. Prey is varied and includes small birds, small mammals, reptiles, and amphibians. Cooper's hawks can be found in a variety of habitats and elevations. They breed throughout most of California in a variety of woodland habitats but are not common. They will also nest in urban areas and seem to tolerate human disturbance near the nest. The highest densities probably occur in the foothill oak woodlands of the Sierra Nevada and Transverse Ranges. Cooper's hawks are found in greater numbers during migration and winter, when they can be found in all habitats throughout California. The decline of western United States populations is not well documented but has been attributed in California to habitat destruction, particularly that of lowland riparian habitat.

An immature Cooper's hawk observed during field surveys conducted in July 2000 was probably dispersing from its natal territory. An adult Cooper's hawk was seen in April 2001 on the road to South Diversion Dam and may have been a migrating bird not breeding locally. No other individuals were observed during the breeding season (late April through August); therefore, they are considered not likely to have nested in the Restoration Project area during the 2000–2002 survey period.

Sharp-Shinned Hawk

Sharp-shinned hawk has been designated as a species of special concern by DFG. It is the smallest of the three North American species of the genus *Accipiter*, a group of forest-dwelling hawks. Skilled at maneuvering, sharp-shinned hawks feed largely on other birds. Found throughout North America, sharp-shinned hawks nest primarily in heavily forested locations with little human disturbance. In California, breeding birds are rare and are found primarily in dense, undisturbed conifer forests in the Sierra Nevada and northern Coast Ranges. During migration and winter, however, they are common in all habitats. Sharp-shinned hawks may never have been abundant in California during the breeding season; however, the population status in California is unknown.

Several individuals were seen during spring and fall migration (April and September) at various locations along access roads and Restoration Project sites. No individuals were observed during the breeding season (late April through August); therefore, they are not likely to nest in the Restoration Project area.

American Peregrine Falcon

American peregrine falcon is listed as endangered under the California Endangered Species Act (California Fish and Game Code §§2050–2068) and is currently fully protected under the California Fish and Game Code. The species was formerly federally listed as endangered but was delisted in 1999. USFWS has designated peregrine falcon as a species of concern for purposes of a 5-year monitoring period.

A large and powerful predator, peregrine falcon is the fastest bird in North America. The bird has a distinctive helmeted appearance formed by its black crown and nape and a black wedge extending below the eyes. Historically, resident American peregrine falcons nested throughout most of California. The population increased during winter, when migrating birds arrived from the north (Grinnell and Miller 1944). Currently, peregrine falcons breed in the mountains of the central and northern Coast Ranges and Cascade Range, where they nest on cliff ledges in woodland, forest, and coastal habitats. Peregrine falcons prefer to nest near marshes, lakes, and rivers that support an abundance of birds, but they may fly several miles to forage. Medium-sized birds, such as pigeons, shorebirds, and waterfowl, are the main prey. Marsh habitats are especially important in fall and winter, when they attract large concentrations of water birds. Pesticide use, especially DDT, was a primary cause of the decline in peregrine falcon populations. Other causes of decline include illegal shooting, illegal falconry activities, and habitat destruction.

One adult peregrine falcon was observed circling high over the road at South Diversion Dam during raptor surveys on April 13, 2001 (Jones & Stokes 2001b, 2001c).

California Spotted Owl

California spotted owl is a federal species of concern and a California species of special concern. Spotted owl is a large nocturnal bird, generally brown in color with irregular white spots on the back, head, and underparts. California spotted owl is paler in color with larger spots than the conspecific northern spotted owl, which is federally listed as endangered. Spotted owls frequently utter a distinctive four-note call during the breeding season. California spotted owls occur on the western side of the Sierra Nevada from the southern Cascade Range south to Kern County, in the southern part of the Coast Ranges, and in the mountain ranges of southern California south to Baja California. California spotted owls occupy coniferous, hardwood, and mixed forests that have complex, multilayered structure; large-diameter trees; and high canopy closure. They nest in tree cavities or in the abandoned nests of other animals in dense, old-growth forest. Roosting sites have similar characteristics. California spotted owls forage in a wider variety of forest types, including more open forests. The Sierra Nevada spotted owls prey largely on northern flying squirrels and dusky-footed woodrats. The status of the Sierra Nevada population of California spotted owl is uncertain, and long-term population trends are unknown.

Suitable nesting and roosting habitat occurs in dense forest with large trees on lower canyon slopes, and suitable foraging habitat occurs more widely throughout the Restoration Project area. California spotted owl is not known to breed within the Restoration Project area. A 2-year survey was completed in 2002. To date, no California spotted owls have been observed within the Restoration Project area (Jones & Stokes pers. comm. 2002b).

Vaux's Swift

Vaux's swift has been designated as a species of special concern by DFG. It is a migratory, insectivorous bird that forages in the air over forests, grasslands, and water. Vaux's swift is distinguished from the many species of swallows by its overall dark brown plumage, cigar-shaped body, and twittering wing beats. In California, the species breeds primarily in the narrow coastal redwood forest zone as far south as Santa Cruz County; it also occurs at lower densities across the northern end of the state and in the Sierra Nevada. Vaux's swifts breed in old-growth redwood and Douglas-fir forest types, nesting in large hollow trees and snags. Populations of Vaux's swift declined in Oregon and Washington during the 1980s, but data for California are lacking. The removal of large snags and hollow trees in late-seral stage forests has probably contributed to population declines.

An individual was sighted flying over blue oak savanna just outside the Restoration Project area on June 13, 2000, and a pair was observed at the Lower Ripley Creek Feeder on July 25, 2000 (Jones & Stokes 2001b, 2001c). Although the nest location is unknown, these birds are probably nesting in a large snag somewhere in the canyon of either South Fork or North Fork Battle Creek at a higher elevation outside the Restoration Project area.

Little Willow Flycatcher

Willow flycatcher is listed as endangered under the California Endangered Species Act. This listing includes all three subspecies that occur in California. Two of these subspecies could occur at the Restoration Project area. USFWS has listed one subspecies, southwestern willow flycatcher, as endangered; however, this subspecies does not occur at the Restoration Project area.

Little willow flycatcher belongs to a group of dull-plumaged, secretive, small flycatchers. It can be distinguished from other members of its genus by its loud song, "fitz-bew," and by its lack of a white eye ring. Of the two subspecies that could occur at the Restoration Project area, mountain willow flycatcher, is possibly present during migration, and little willow flycatcher could occur as both a migrant and breeding bird. Historically, little willow flycatcher was a common nesting species in the Sierra Nevada, Central Valley, and Coast Ranges, but now only isolated populations remain in the Sierra Nevada and the Cascade Range. Little willow flycatchers breed and forage almost exclusively in wet mountain meadow systems with willow-dominated scrub. They arrive on the breeding grounds in May and June and depart for South America in August. This species has declined for a variety of reasons, including nest parasitism by brown-headed cowbirds, loss and alteration of riparian and meadow habitats, and cattle grazing.

Willow flycatchers were seen at Eagle Canyon Diversion Dam in mid-June 2000. They were not identified to the subspecific level. Although these flycatchers were observed singing in appropriate nesting habitat, they are presumed to have been migrants because July searches of this area did not detect nesting willow flycatchers (Jones & Stokes 2001b, 2001c).

Yellow-Breasted Chat

Yellow-breasted chat has been designated as a species of special concern by DFG. It is the largest warbler in the United States, with a very large head, bright white "spectacles," bright-yellow breast, and white belly. Yellow-breasted chats feed on insects, spiders, berries, and other fruits. They breed from early May to early August, leave for wintering grounds in September, and return in April.

Although once common throughout riparian woodland and scrub habitats in California, the species is now an uncommon breeder in coastal California, in the central and southern Sierra Nevada foothills, and in southern California, and is uncommon to rare in the Central Valley. The mid-elevation western slope of the northern Sierra Nevada is one of the strongholds for this species in California, and yellow-breasted chats are common throughout the riparian habitats in the Restoration Project region. Found in riparian habitats, chats in the Sierra Nevada foothills are very closely associated with blackberry brambles for cover and for foraging; they nest in dense vegetation. The loss and fragmentation of riparian habitats are major causes of the decline of yellow-breasted chat. Brood parasitism by brown-headed cowbird also has caused declines, even in areas with intact riparian habitat.

Yellow-breasted chats were found at three riparian sites with blackberry brambles and riparian scrub: Darrah Springs Feeder, Coleman Diversion Dam/Inskip Powerhouse, and Lower Ripley Creek Feeder. Suitable breeding habitat was found at Darrah Springs Feeder and Coleman Diversion Dam/Inskip Powerhouse, where the birds likely breed. The chats seen at the Lower Ripley Creek Feeder and Inskip Diversion Dam/South Powerhouse were migrants and do not nest in the area (Jones & Stokes 2001b, 2001c).

Special-Status Bats

Numerous bats were observed foraging over the Restoration Project area, and roosting bats were observed in abandoned tunnels near the South Powerhouse and at Inskip Diversion Dam. The bats were not identified to the specific level, but the following species could occur in the Restoration Project area based on their habitats and geographic range: spotted bat, western red bat, fringed myotis, long-eared myotis, small-footed myotis, long-legged myotis, Yuma myotis, pallid bat, and Townsend’s big-eared bat. All these species have been designated as federal species of concern or California species of special concern, and/or are recognized by the Western Bat Working Group (and DFG) as high priority species.

On January 28 and 29, 2002, Jones & Stokes (pers. comm. 2002a) conducted field surveys for bats at water diversion tunnels at Inskip and Eagle Canyon Diversion Dams and along the South Canal. The purpose was to determine the presence of hibernating bats and to assess the potential suitability of these tunnels for use by bats. The field survey identified one hibernating bat inside Inskip Tunnel 3, approximately 100 feet from the entrance portal. The bat appeared to be a big brown bat. Additional bats were observed during other site visits; however, none of the bats were identified as special-status bats.

Other Sensitive Resources

Nesting Raptors

Nesting raptors and their nests are protected under Sections 3503 and 3503.5 of the California Fish and Game Code. In addition to the active osprey nest mentioned earlier, an active red-tailed hawk nest was found in a large cottonwood tree at the Coleman Diversion Dam site on April 13, 2001.

Migratory Birds

Under the Migratory Bird Treaty Act, migratory birds are protected from pursuing, hunting, taking, capturing, or killing. Nests and their contents are also protected. Many of the birds observed in the project area (listed in Appendix F) could potentially nest in vegetation and structures that could be affected during project construction.

Regulatory Setting

The following laws, regulations, or policies are relevant to the biological resources occurring within the Restoration Project area. Descriptions of these, if not described below, can be found in Chapter 5, “Consultation and Coordination:”

- Federal Clean Water Act, Section 404 (33 USC 1251–1376).
- Federal Endangered Species Act(16 USC 1531–1544).
- Fish and Wildlife Coordination Act (16 USC 661–667e)
- Migratory Bird Treaty Act (16 USC 703–712). The Migratory Bird Treaty Act states that, without a permit issued by the U.S. Department of the Interior, pursuing, hunting, taking, capturing, or killing any migratory bird is unlawful.
- USFWS Mitigation Policy (46 FR 7644, January 23, 1981). USFWS mitigation policy provides guidance for the protection and conservation of fish and wildlife resources. The intent is to protect and conserve the most important and valuable fish and wildlife resources, while allowing reasonable and balanced use of the nation’s natural resources. The mitigation policy defines mitigation to include avoiding impacts, minimizing impacts, rectifying impacts, reducing or eliminating impacts over time, and compensating for impacts. USFWS considers the stated order of mitigation elements to represent the most desirable sequence of steps in the mitigation planning process.
- USFWS Region 1 Policy on Wetlands. USFWS Region 1 policy applies, but is not limited, to USFWS involvement in federal projects. The policy is to

view wetland degradation or losses as an unacceptable change to an important national resource. It is the goal of USFWS Region 1 to ensure that no net loss (acreage or value, whichever is greater) of wetland habitats occurs. For the purposes of this policy, wetlands are defined according to Cowardin et al. (1979).

- California Endangered Species Act (Fish and Game Code §§2050–2068, 2126).
- California Native Plant Protection Act (Fish and Game Code §1900 *et seq.*). This act affords protection to plants listed as endangered or rare in California.
- Protection of Wetlands (Executive Order 11990; DFG Commission 1993).
- Streambed Alteration Agreement.
- Senate Concurrent Resolution No. 17, January 18, 1989. The loss of oak woodlands in California, especially valley oak woodlands, has led the California Department of Forestry and Fire Protection, CNPS, and The Nature Conservancy to identify the conservation and management of oak woodlands as a major concern. The California State Senate passed a resolution identifying the conservation of oak woodland as a priority of state agencies when authorizing actions and projects.
- The Carlson-Foley Act of 1968 (43 USC 12241–1243); Federal Noxious Weed Act of 1974 (7 USC 2814 *et seq.*); Executive Order 13112 (64 FR 6183, February 8, 1999). The Carlson-Foley Act deals with the identification, prevention, and control of invasive pest species, including noxious weeds.

Environmental Consequences

Summary

All the Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal) include activities that could adversely affect botanical, wetland, and wildlife resources. Those activities having the greatest potential to affect these resources are construction in the stream channel, access roads in the steep canyon sections, excavations, and discharges during and after dam removal. Feasible mitigation measures are provided for each significant impact to reduce it to a less-than-significant level.

Impact Significance Criteria

Based on Section 15065 and Appendix I of the CEQA Guidelines, with additional consideration given to specific Restoration Project concerns, impacts on biological resources would be considered significant if the Restoration Project would result in any of the following conditions.

- Long-term loss or degradation of a sensitive plant community because of substantial alteration of landform or site conditions (e.g., alteration of wetland hydrology).
- Substantial loss or degradation of a plant community and associated wildlife habitat.
- Fragmentation or isolation of wildlife habitats, especially riparian and wetland communities.
- Substantial disturbance or displacement of wildlife resulting from human activities.
- Avoidance by animals of biologically important habitat for substantial periods; such avoidance may increase mortality or reduce reproductive success.
- Disruption of natural wildlife movement corridors.
- Reduction in local population size attributable to direct mortality or habitat loss, lowered reproductive success, or habitat fragmentation of species that are state- or federally listed or proposed for listing as threatened or endangered; of portions of local populations that are candidates for state or federal listing and federal and state species of concern; or of species that qualify as rare and endangered under CEQA.
- Substantial reduction or elimination of species diversity or abundance.

Impact Assessment

This impact assessment for biological resources is based on draft engineering design drawings provided by Reclamation and site-specific information gathered during field surveys. This impact analysis qualitatively evaluates potential impacts on biological resources. A detailed quantitative analysis was not performed because the level of information that is currently available is not adequate for determining exact acreages of permanent and temporary disturbance of plant communities (particularly riparian and wetland communities). Acreages will be calculated when more detailed design specifications are available or, in some cases, as part of the postconstruction evaluation.

Figures 4.2-1 through 4.2-19, at the end of this section, graphically depict areas of potential disturbance to waters of the United States and biological resources resulting from construction activities at each of eight construction sites, as well as along South Canal. Figure 4.2-1 is an index map showing the boundaries of the nine site maps. Figures 4.2-2 through 4.2-19 show those areas where waters of the United States and biological resources may be affected.

The General Environmental Protection Measures listed in the introduction to this chapter will be implemented as part of the project to minimize and avoid impacts to resources. For potentially significant impacts that are not adequately avoided or minimized with these environmental protection measures, specific mitigation measures have been identified. To the extent possible, the mitigation measures described for potential impacts on sensitive biological resources were developed through coordination with resource agencies. Additional compensatory mitigation for impacts on waters of the United States (including wetlands), riparian habitats, and valley elderberry longhorn beetle may also be identified as conditions of project permits (e.g., the Section 404 Clean Water Act permit issued by the Corps, the Section 1601 streambed alteration agreement with DFG, and the federal Endangered Species Act Section 7 authorization process administered by USFWS); any such conditions will be implemented as part of the Restoration Project.

No Action Alternative

The No Action Alternative would not affect botanical, wetland, or wildlife resources. Under the No Action Alternative, the Hydroelectric Project would continue to operate in accordance with the current FERC license. The Hydroelectric Project canal system would continue to convey and discharge substantial amounts of cooler waters from North Fork Battle Creek and major springs in the watershed to the lower-elevation reaches of South Fork Battle Creek.

Five Dam Removal Alternative (Proposed Action)

The Five Dam Removal Alternative would remove Wildcat, South, Coleman, Soap Creek Feeder, and Lower Ripley Creek Feeder Diversion Dams. Wildcat Canal and South Battle Creek Canal would also be removed. Fish screens and fish ladders would be constructed at the North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams. Those dams that are not removed would increase flow releases to levels identified in the 1999 MOU (Appendix D). The Five Dam Removal Alternative would also construct a bypass facility at the Inskip Powerhouse, and would construct tailrace connectors between South Powerhouse and Inskip Canal and between Inskip Powerhouse and Coleman Canal to prevent North Battle Creek water from mixing with South Battle Creek water. The Asbury Diversion Dam spill gates would be reoperated and a new gaging system installed to ensure an instream flow release of 5 cfs.

Specific impacts associated with the No Dam Removal Alternative are described below. Total acreage of biological communities and waters of the United States potentially affected for the Five Dam Removal Alternative are summarized in Table 4.2-2.

Impact 4.2-1 Significant—Potential disturbance or loss of 7.2 acres of woody riparian vegetation and associated wildlife habitat.

The Restoration Project could result in the temporary disturbance or permanent removal of woody riparian vegetation and associated wildlife habitat during construction of access roads and restoration activities along Battle Creek (Table

4.2-2). The most substantial removal of woody riparian habitat would occur at the North Battle Creek Feeder Diversion Dam, where a new 30-foot by 22-foot landing area for the new access road would be constructed along the creek's edge. This new landing area and foot access bridge would require the removal of approximately 7.2 acres of woody riparian vegetation.

The actual acreage of riparian forest that is removed or disturbed during construction of the access roads and Restoration Project activities will be determined as part of the environmental compliance program. The habitat removal will be assessed and measured by a qualified plant ecologist after construction activities are complete at each site. The impact acreage will be used to determine the exact acreage of compensatory mitigation and will be described in the Implementation Plan.

Riparian forest provides important shelter, foraging, and roosting habitat for a variety of wildlife species, including bats, and nesting habitat for raptors and migratory birds. Substantial statewide declines of riparian communities in recent years have increased concerns about dependent plant and wildlife species, leading state and federal agencies to adopt policies to arrest further loss. Riparian vegetation serves a variety of functions, such as providing bank stabilization, erosion control, and wildlife habitat. For these reasons, DFG has adopted a no-net-loss policy for riparian habitat value. USFWS mitigation policy identifies California's riparian habitats as Resource Category 2, for which no net loss of existing habitat value is recommended (46 FR 7644, January 23, 1981).

Although the exact acreage of impact is unknown at this time, construction of the new access road could result in potential long-term impacts on the riparian forest community at the site. In this analysis, the long-term loss or degradation of a sensitive plant community because of substantial alteration of landform or site conditions is considered a significant impact. In addition to the General Environmental Protection Measures that will be implemented before and during project construction, implementing the following mitigation measures would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.2-1. Reclamation will implement the following measures to avoid, minimize, and compensate for the potential loss of woody riparian vegetation and associated wildlife habitat.

Minimize Removal and Disturbance of Riparian Habitat. Reclamation will ensure that the unnecessary removal or disturbance of riparian habitat adjacent to the construction area will be avoided by installing orange construction barrier fencing (and sedimentation fencing in some cases) between the construction site and the riparian/creek area. The removal of woody riparian vegetation will be avoided by creating an exclusion zone (buffer) around woody riparian vegetation near the construction zone, educating construction crews about the importance of avoiding the sensitive habitat, and monitoring construction to ensure avoidance. The exclusion zone will be demarcated by orange construction fencing placed 20 feet beyond the drip line of the vegetation. The protected area will be designated as an "environmentally sensitive area."

The fencing will be installed prior to the initiation of construction activities and will be maintained throughout the construction period. The following paragraph will be included in the construction specifications for environmentally sensitive areas:

> *The Contractor's attention is directed to the areas designated as "Environmentally Sensitive Areas." These areas are protected, and no entry by the Contractor for any purpose will be allowed unless specifically authorized in writing by the Bureau of Reclamation. The Contractor shall take measures to ensure that Contractor's employees do not enter or disturb these areas, including giving written notice to his employees and subcontractors.*

Temporary fences around the environmentally sensitive areas shall be installed as the first order of work. Temporary fences shall be furnished and constructed, maintained, and later removed as shown on the plans, as specified in the special provisions, and as directed by Reclamation. Fabric for temporary fences shall be commercial-quality polypropylene, orange in color, a minimum of 48 inches high, and approved by Reclamation for the purpose of temporary fencing.

Avoid Long-Term Impacts on Woody Riparian Vegetation and Associated Habitat. Reclamation will avoid long-term impacts on woody riparian vegetation by trimming trees and shrubs rather than removing entire woody plants. Where possible, shrubs and trees should be cut at least 1 foot above ground level to leave the root systems intact and allow for more rapid regeneration following construction. To avoid the take of eggs or nestlings of migratory birds and avoid violating the Migratory Bird Treaty Act (see Regulatory Setting), riparian vegetation should be removed during the nonbreeding season (October–December) prior to construction. If such timing is not feasible, riparian vegetation should not be removed until it can be demonstrated that it is not supporting nesting birds.

Compensate for the Loss of Woody Riparian Habitat. Reclamation will compensate for permanent impacts on woody riparian habitat to ensure no net loss of habitat functions and values. The compensation shall be provided at a minimum ratio of 1:1 (1 acre restored or created for every 1 acre affected) and may be a combination of onsite restoration/creation, offsite restoration, or mitigation credits. Compensation ratios shall be based on site-specific information and determined through coordination with state and federal agencies as part of the permitting process for the project. Compensation options are presented below.

1. Purchase mitigation bank credits at an agency-approved bank in the project region. This mitigation credit may be used to mitigate the disturbance or temporary loss of riparian vegetation. Reclamation shall provide written evidence to the resource agencies that mitigation credits have been purchased to compensate for the direct loss of woody riparian habitat.

or

2. Contribute funds, equal to the amount needed to purchase mitigation bank credits, to restore riparian habitat located within the Battle Creek watershed or other nearby lands that are publicly managed and will be protected in perpetuity. Reclamation will coordinate with appropriate individuals to determine whether there is a potential to create, restore, or enhance riparian habitat in the Battle Creek watershed.

or

3. Develop and implement a Riparian Restoration Plan. As part of the Implementation Plan (described as a General Environmental Protection Measure in the introduction to this chapter), Reclamation will retain a qualified ecologist to prepare a Riparian Restoration Plan to compensate for the removal of riparian vegetation along Battle Creek. This measure would apply to trees and shrubs that are removed entirely (including root systems) for construction of the Restoration Project. The plan will focus on replanting or enhancing riparian habitat on a suitable site within the creek's watershed. Woody riparian vegetation should be replaced at a minimum ratio of 1:1 (1 acre planted or enhanced for every 1 acre removed). Enhancement of riparian habitat could be accomplished along Battle Creek through the removal of invasive species and replacement with native riparian species. The feasibility of removing nonnative species and replanting native species will be evaluated as part of the Riparian Restoration Plan.

The Riparian Restoration Plan will be developed through coordination with USFWS, DFG, and the Corps, and described in detail as part of the Implementation Plan. The restoration plan will include design specifications, an implementation plan, maintenance requirements, and a monitoring program. Monitoring will be conducted for a minimum 5-year period to document the degree to which success criteria are achieved and to identify remedial actions that may be needed. Annual monitoring reports will be submitted to the appropriate resource agencies. The report will summarize the data collected during monitoring periods and describe how the habitats are progressing in terms of the success criteria (to be determined as part of the restoration plan). Success criteria will be determined through coordination with the resource agencies. A brief letter report summarizing the results of monitoring and recommending additional needed actions will be submitted to the appropriate resource agencies.

Impact 4.2-2 Significant—Potential introduction of noxious weeds or spread of existing noxious weeds.

Activities associated with implementation of the Restoration Project could introduce or spread noxious weeds into currently uninfested areas, possibly resulting in displacement of special-status plants, alteration of habitat for special-status wildlife, or substantial reduction of species diversity or abundance. Plants or seeds of noxious weeds may be dispersed on construction equipment if appropriate measures are not implemented. This impact could result in a substantial reduction or elimination of species diversity or abundance and is therefore considered significant. Implementing General Environmental Protection Measures; Mitigation Measures for Impact 4.7-1 in Section 4.7, Geology and Soils; and the following mitigation measures would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.2-2. To avoid the introduction or spread of noxious weeds into previously uninfested areas, Reclamation will implement the following measures as part of the Restoration Project.

- Construction supervisors and managers will be educated on weed identification and the importance of controlling and preventing the spread of noxious weeds.
- Small, isolated infestations will be treated with approved eradication methods at an appropriate time to prevent and/or destroy viable plant parts or seed (treatment areas will be identified in the Implementation Plan).
- All equipment will be washed before entering Restoration Project sites. Because of the remoteness of the project area, equipment washing will be done off site at a paved facility (located away from sensitive biological resource areas). The contract inspectors and resource monitors will routinely inspect construction activities to verify that construction equipment is being washed.
- Implement measures set forth in the SWPPP to revegetate and restore disturbed areas immediately after construction is complete. The revegetation portion of the SWPPP will contain specifications for using certified weed-free native and nonnative mixes. The SWPPP will also specify that all disturbed areas will be weeded (if necessary) and reseeded in the following years if the postconstruction inventory (see following discussion) indicates that noxious weed species are colonizing the area.

A qualified plant ecologist will conduct a postconstruction inventory at years 1 and 2 after construction. The inventory will focus on areas disturbed during Restoration Project activities and will verify that ongoing activities have not resulted in the introduction of new noxious weed infestations. The plant ecologist will also prepare and submit an inventory letter to the resource agencies after each visit. Items addressed in the letter will include any new infestations of noxious weeds and the actions that have been taken to control noxious weed infestations. The Implementation Plan will contain guidelines for monitoring, documenting, and controlling noxious weed infestations located during the postconstruction inventory.

Impact 4.2-3 Significant—Potential loss or disturbance of 12.1 acres of waters of the United States (including wetlands).

Construction activities associated with the Restoration Project could result in the loss or disturbance of approximately 12.1 acres of waters of the United States (including wetlands), resulting in short-term (temporary) and/or long-term (permanent) impacts on wetland communities (Table 4.2-2). Some additional acreage of waters of the United States may be incidentally filled or disturbed during construction of access roads and establishment of staging areas. The estimated acreage of disturbance or fill material that would be placed into waters of the United States will be determined after detailed design specifications are provided by Reclamation and before obtaining Section 404 Clean Water Act permits. An additional assessment of impacts will be conducted by a wetland ecologist after construction activities are complete. This postconstruction assessment will be used to quantify unanticipated impacts on waters of the United States.

Reclamation will implement measures as part of the project to avoid and minimize impacts on waters of the United States. Although these measures would minimize the extent of potential impacts, some disturbance or loss of waters of the United States would be necessary in order to construct the Restoration Project.

Because the proposed project could result in the placement of fill material into waters of the United States, this impact would be considered significant.

Implementing the General Environmental Protection Measures; Mitigation Measures for Impact 4.4-1 in Section 4.4, Water Quality; Mitigation Measures for Impact 4.7-1 in Section 4.7, Geology and Soils; and the following mitigation measures would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.2-3. Reclamation will implement the following measures to avoid, minimize, and compensate for the potential disturbance or loss of waters of the United States (including wetlands) along potential access roads and staging areas.

Avoid and Minimize Disturbance of Waters of the United States, Including Wetlands. To the extent possible, Reclamation will avoid and minimize impacts on waters of the United States (including wetlands) by implementing the following measures.

- Redesign or modify the project to avoid direct and indirect impacts on wetlands and streams, if feasible.
- Avoid construction activities in saturated or ponded wetlands and streams during the wet season (spring and winter) to the maximum extent possible. Where such activities are unavoidable, protective practices, such as use of padding or vehicles with balloon tires, shall be employed.
- Where determined necessary by resource specialists, use geotextile cushions and other materials (e.g., timber pads, prefabricated equipment pads, geotextile fabric) in saturated conditions to minimize damage to the substrate and vegetation.
- Stabilize exposed slopes and streambanks immediately upon completion of construction activities. Other waters of the United States shall be restored in a manner that encourages vegetation to reestablish to its preproject condition and reduces the effects of erosion on the drainage system.
- In highly erodible stream systems, stabilize banks using a nonvegetative material that will bind the soil initially and break down within a few years. If

Reclamation determines that more aggressive erosion control treatments are needed, the contractor will be directed to use geotextile mats, excelsior blankets, or other soil stabilization products.

- During construction, remove trees, shrubs, debris, or soils that are inadvertently deposited below the ordinary high water mark of streams in a manner that minimizes disturbance of the drainage bed and bank.
- In-stream construction within the ordinary high water mark will be restricted to the low-flow period of April through October.
- All activities shall be completed promptly to minimize their duration and resultant impacts.
- All staging areas for the Restoration Project will be subject to approval by Reclamation.
- To the extent possible, Reclamation will prohibit equipment access or staging in and near wetlands and other waters of the United States located along existing access roads. To the extent possible, access will be confined to existing roads.
- Resource monitors and contract compliance inspectors will routinely inspect protected areas to ensure that protective measures are in place and effective.
- All protective measures will remain in place until all construction activities have been completed near the resource and will be removed immediately following construction and reclamation activities.

Compensate for the Loss of Waters of the United States. Reclamation will compensate for permanent impacts to ensure no net loss of habitat functions and values. The compensation shall be provided at a minimum ratio of 1:1 (1 acre restored or created for every 1 acre filled) and may be a combination of onsite restoration/creation, offsite restoration, or mitigation credits. Compensation ratios shall be based on site-specific information and determined through coordination with state and federal agencies as part of the permitting process for the project. Compensation options are presented below.

1. Purchase mitigation bank credits at an agency-approved bank in the project region.

or

2. Contribute funds, equal to the amount needed to purchase mitigation bank credits, to restoration of wetlands and other waters in the Battle Creek watershed or other nearby lands that are publicly managed and will be protected in perpetuity. Reclamation will coordinate with appropriate individuals to determine whether there is a potential to create, restore, or enhance waters of the United States in the Battle Creek watershed.

or

3. Develop a wetland restoration plan that involves creating or enhancing wetland habitat on site or within the Battle Creek watershed. Potential

creation and enhancement sites shall be evaluated by Reclamation to determine whether this is a feasible option. If Reclamation determines that onsite or offsite restoration is possible, a restoration plan will be developed that describes where and when restoration will occur and who will be responsible for developing, implementing, and monitoring the restoration plan. When this option is selected, restoration will be conducted within the Battle Creek watershed.

Impact 4.2-4 Significant—Potential loss or disturbance of common upland woodland and forest communities and associated wildlife habitat.

The Restoration Project could result in the loss or disturbance of common woodland and forest communities, including gray pine/oak, blue oak, and/or live oak woodland, and westside ponderosa forest (Table 4.2-2). The most substantial impacts on a common plant community would occur along the South Battle Creek Canal and the Coleman Diversion Dam/Inskip Powerhouse sites. Along the South Battle Creek Canal, approximately 35.9 acres of woodland would be removed or disturbed during construction activities. Approximately, 19.8 acres of woodland would be removed or disturbed during construction activities at the Coleman Diversion Dam/Inskip Powerhouse site.

Most of the common woodland communities contain native oaks that could be removed during construction of access roads, staging areas, and other project features. These activities could result in short-term or long-term impacts on the oak woodlands and other common plant communities in the Restoration Project area. The estimated acreage of disturbance or loss of these communities will be determined after detailed design specifications are provided by Reclamation. An additional assessment of impacts will be performed by a plant ecologist after construction activities are complete. This postconstruction assessment will be used to quantify unanticipated impacts on the plant communities.

Oak woodland provides important foraging habitat for several species of wildlife, including mammals, birds, and reptiles. A variety of raptors use oak woodland habitat for nesting. The removal of these woodland habitats could result in the substantial loss or degradation of a plant community and associated wildlife habitat and the disruption of natural wildlife movement corridors. Therefore, this impact is considered significant. In addition to the General Environmental Protection Measures that will be implemented before and during project construction, implementation of the following mitigation measures would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.2-4. Reclamation will implement the following measures to avoid, minimize, and compensate for this impact.

- Retain an arborist to identify the species and numbers of native trees that will be removed or indirectly affected within the construction zone.
- Protect oaks that will not to be removed but that are within 61 meters (200 feet) of the grading activity by fencing them 1.5 meters (5 feet) beyond the

dripline and root zone (as determined by a certified arborist). This fence, intended to prevent activities that result in soil compaction beneath the canopy or over the root zone, will be maintained until all construction activities are complete. No grading, trenching, or movement of construction equipment will be allowed within fenced areas. Protection for oak trees on slopes will include installation of silt fences. A silt fence will be installed at the upslope base of the protective fence to prevent any soil drifting down over the root zone.

- Develop and implement an oak planting plan. The plan will specify collecting acorns from the local region, planting the acorns on site at a predetermined ratio based on the diameter at breast height of the removed trees, developing success criteria, and monitoring for a predetermined time period (e.g., 5 years) to evaluate the success criteria. In addition, the plan will contain adaptive management measures to ensure that the desired goals are achieved.
- Plantings shall be monitored annually by a qualified biologist for 5 years after construction is complete. The monitoring methods will be described in the Implementation Plan. Results of the monitoring shall be submitted to the appropriate agencies. Success will be achieved if there is a minimum of 50% survival by the end of the fifth year and a stable viable population for the duration of the monitoring period. If the performance standards are not met, remedial measures, such as replanting, will be implemented. During monitoring, the following information will be evaluated: average tree height, percent of tree cover, tree density, percent of woody shrub cover, seedling recruitment, and invasion by nonnative species. During the revegetation process, tree survival will be maximized by using deer screens or other maintenance measures as recommended by a certified arborist.
- Inspect the areas that have vegetative pruning and tree removal immediately prior to construction, following construction, and 1 year following construction to determine the amount of existing vegetative cover, cover that is removed, and cover that resprouts. If these areas have not resprouted sufficiently to return the cover to the level of cover existing prior to project construction, these areas will be replanted with the same species to reestablish the cover to the preproject condition.

Implementation of these measures would reduce the potential loss or disturbance of gray pine/oak, blue oak, and/or live oak woodland habitat impact to a less-than-significant level.

Impact 4.2-5 Significant—Potential disturbance to valley elderberry longhorn beetle habitat.

Seventeen elderberry shrubs occur in the project area that are capable of providing habitat for valley elderberry longhorn beetle. Most of these shrubs are along roadsides and would be subject to either direct or indirect disturbance from road improvement activities. Some of the shrubs, such as those near the Eagle Canyon Diversion Dam, are in the immediate vicinity of project features. USFWS considers any ground-disturbing activity within 100 feet of an elderberry shrub within the range of valley elderberry longhorn beetle to be a potential take of the species (as defined under the federal Endangered Species Act). Because valley elderberry longhorn beetle is federally listed and because construction activities could directly or indirectly affect elderberry shrubs potentially resulting in take of this species, this impact is considered significant. Implementing the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.2-5. Impacts on valley elderberry longhorn beetle will be mitigated according to standard valley elderberry longhorn beetle compensation guidelines (USFWS 1999) through Section 7 consultation with USFWS. In general, the guidelines require compensation for direct and indirect impacts in the form of transplanting shrubs and planting seedling elderberry shrubs at a secure mitigation site. Avoidance of impacts requires a 100-foot no-disturbance buffer between the shrub and construction activities. Some activities are permitted within the 20–100 foot range through consultation with USFWS. A biological assessment under Section 7 of the federal Endangered Species Act has been prepared for this species. The actual compensation requirement will be provided in USFWS's biological opinion. A preconstruction assessment is currently underway to assess the extent of disturbance to potential valley elderberry longhorn beetle habitat. Compensation will be provided on the basis of those results.

According to 2003 field survey results, 17 elderberry shrubs are located within 100 feet of the proposed project features and may be affected by construction activities. Impacts on valley elderberry longhorn beetle will be minimized by the following measures:

- A qualified biologist will identify and mark all elderberry shrubs with stems 1.0 inch or more in diameter within 100 feet of the impact area. A 100-foot buffer will be established around all elderberry shrubs, and no construction activities will be permitted within the buffer zone without consultation with USFWS. In areas where encroachment on the 100-foot buffer has been approved by USFWS, no ground-disturbing activities will be permitted within 20 feet of the dripline of each elderberry shrub unless the activity is necessary to complete the project. No riparian vegetation within 100 feet of elderberry shrubs will be removed by construction activities.
- Orange fencing will be placed around all shrubs to avoid inadvertent effects.
- Signs will be erected every 50 feet along the edge of the avoidance area with the following information: "This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment." The signs will be clearly readable from a distance of 20 feet, and must be maintained for the duration of construction.
- An environmental education program will be presented to all construction personnel to brief them on the need to avoid impacts on valley elderberry

longhorn beetle and its habitat and the penalty for not complying with these requirements.

- If the proposed project cannot avoid elderberry shrubs by 100 feet (or 20 feet with USFWS consultation), the following mitigation measures will be implemented:
  - All elderberry shrubs with one or more stems measuring 1.0 inch or more in diameter that will be directly affected by construction activities (i.e., that will be destroyed) will be transplanted to a conservation area in accordance with USFWS's *Conservation Guidelines for Valley Elderberry Longhorn Beetle* (USFWS1999).
  - Each elderberry stem measuring 1.0 inch or more at ground level that is within 100 feet of construction activities will be replaced in a conservation area with elderberry seedlings or cuttings at a ratio between 1:1 and 8:1 depending on the diameter of the stem at ground level, whether the shrub is located in riparian habitat, and whether the shrub has evidence of exit holes.
  - A mix of native tree/plant species associated with the elderberry shrubs at the project site will be planted in the conservation area at ratios of 1:1 for elderberry shrubs without exit holes or 2:1 for elderberry shrubs with exit holes (native tree/plant species to each elderberry seedling or cutting) (Table 4.2-8). A mixture of native grasses and forbs should also be planted in the conservation area.
  - Each transplanted elderberry shrub should have at least 1,800 square feet of area. As many as five additional elderberry seedlings or cuttings and up to five associated natives may also be planted within the 1,800-square-foot transplant area.
- Adequate dust control measures are to be used during construction activities. Final measures will be set forth in USFWS' Biological Opinion, which will supercede the measures described here.

Impact 4.2-6 Significant—Potential disturbance of foothill yellow-legged frog habitat.

Surveys conducted for the Restoration Project indicate that foothill yellow-legged frog occurs in the project area. Construction activities could temporarily degrade foothill yellow-legged frog habitat at the Lower Ripley Creek Feeder Diversion Dam, Inskip Diversion Dam/South Powerhouse, Soap Creek Feeder, and South Diversion Dam sites. Restoration activities in these areas could disturb the shallow, rocky substrate required by foothill yellow-legged frogs and increase flows in areas that have been constrained by dam operations for many years. In addition, individual frogs could be killed during construction. The overall effects of the project, however, are considered beneficial to this species because the process of restoring the affected drainages will ultimately return them to an approximation of their former natural conditions. Nonetheless, because this species has declined throughout its range, and in particular throughout the Sierra Nevada, the short-term effects of the project are considered significant. Accordingly, mitigation will focus on avoiding killing or injuring frogs in construction areas. In addition to the General Environmental Protection Measures that will be implemented before and during project construction, implementing Mitigation Measures for Impact 4.2-3 and the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measure for Impact 4.2-6. Within 2 weeks prior to construction activities at Lower Ripley Creek Feeder Diversion Dam, Inskip Diversion Dam/South Powerhouse, Soap Creek Feeder, and South Diversion Dam, protocol-level surveys for foothill yellow-legged frog will be conducted by qualified biologists. If frogs, tadpoles, or egg masses are detected, barrier fencing will be constructed in the work area in a manner that will exclude frogs from entering the work area. For 3 days prior to construction activities (one survey each day), qualified biologists will survey each work site for foothill yellow-legged frogs and relocate any frog found within the exclusion area. If frogs are found within previously unoccupied sites, exclusion areas will be established at those sites. Frogs will be relocated to the nearest suitable habitat outside the exclusion area. After construction has been completed, the barrier fencing will be removed and the habitat will be restored.

In the event that all or part of this mitigation measure is considered unfeasible during implementation of the project, DFG and USFWS will be consulted to develop alternative measures.

Impact 4.2-7 Significant—Potential disturbance of northwestern pond turtle habitat.

Surveys conducted for the Restoration Project indicate that northwestern pond turtle occurs in the project area. Construction activities could temporarily degrade habitat for this species at Lower Ripley Creek Feeder Diversion Dam, Inskip Diversion Dam/South Powerhouse, Soap Creek Feeder, and South Diversion Dam. Restoration activities in these areas could disturb the pond and other open water habitats and basking sites required by northwestern pond turtle, as well as increasing flows in areas that have been constrained by dam operations for many years. In addition, individual turtles could be killed during construction. The overall effects of the project, however, are considered beneficial to this species because the process of restoring the affected drainages will ultimately return them to an approximation of their former natural conditions. Nonetheless, because this species has declined throughout its range, the short-term potential for mortality is considered significant. Accordingly, mitigation will focus on avoiding killing or injuring turtles in construction areas. In addition to the General Environmental Protection Measures that will be used before and during project construction, implementing Mitigation Measures for Impact 4.2-3 and the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measure for Impact 4.2-7. Within 2 weeks prior to construction activities at Lower Ripley Creek Feeder Diversion Dam, Inskip Diversion Dam/South Powerhouse, Soap Creek Feeder, and South Diversion Dam, protocol-level surveys for northwestern pond turtle will be conducted by qualified biologists. If turtles are detected, barrier fencing will be constructed in the work area in a manner that will exclude turtles from entering the work area. For 3 days prior to construction activities (one survey each day), qualified biologists will survey each of these work sites for turtles and will relocate any turtle found within the exclusion area. If turtles are found within previously unoccupied sites, exclusion areas will be established at those sites. Turtles will be relocated to the nearest suitable habitat outside the exclusion area. After construction has been completed, the barrier fencing will be removed and the habitat will be restored.

In the event that all or part of this mitigation measure is considered unfeasible during implementation of the project, DFG and USFWS will be consulted to develop alternative measures.

Impact 4.2-8 Significant—Potential disturbance of breeding habitat for yellow-breasted chat.

During surveys for the Restoration Project, yellow-breasted chats were detected and are considered to be breeding at two sites in the project area: Darrah Springs Feeder and Coleman Diversion Dam/Inskip Powerhouse. No construction is proposed at Darrah Springs under this alternative; however, construction at the Coleman Diversion Dam/Inskip Powerhouse could remove riparian scrub habitat required by this species for breeding and cover. Impacts on this habitat during the breeding season could also result in destruction of active nests and mortality of individual chats or their eggs. Yellow-breasted chat is an uncommon species in California; it is restricted to a habitat type (riparian scrub) that has declined substantially over past decades, and local breeding populations are considered to be declining. For these reasons, impacts resulting from removal of or disturbance to occupied breeding habitat and the potential for mortality of individuals or nests are considered significant. In addition to the General Environmental Protection Measures that will be implemented before and during project construction, implementing Mitigation Measures for Impact 4.2-1 and the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measure for Impact 4.2-8. Yellow-breasted chats are known to breed at two sites in the project area: Darrah Springs Feeder and Coleman Diversion Dam/Inskip Powerhouse. In addition, although no breeding was detected during surveys, potential breeding habitat exists at the Lower Ripley Creek Feeder and Inskip Diversion Dam/South Powerhouse project sites. Prior to construction during the breeding season of the construction year, a qualified biologist will survey all project sites to determine chat occupancy. If no breeding chats are detected, then no further mitigation is required. Surveys will be conducted between April 25 and May 25. If breeding chats are detected, a qualified biologist will install orange barrier fencing around the riparian vegetation to protect it from incidental damage. To minimize the potential for mortality or nest abandonment, the construction contractor will establish a 500-foot no-disturbance buffer around all active nesting sites during the breeding season (mid-April to mid-July).

In the event that all or part of this mitigation measure is considered unfeasible during implementation of the project, DFG and USFWS will be consulted to develop alternative measures.

Impact 4.2-9 Significant—Potential disturbance to nesting raptors. Two nonlisted special-status raptors, osprey and golden eagle, are known or have potential to nest in the Restoration Project area. One active osprey nest was found during surveys; moreover, although no active golden eagle nests were found, suitable golden eagle nesting habitat exists throughout the project area. Construction activities occurring in the immediate vicinity of active nests could cause abandonment of nests and potentially result in death of young or eggs. Osprey and golden eagle are locally and regionally uncommon species, and the abandonment of active nests could affect local and regional breeding populations. Therefore, this impact is considered significant. In addition to the General Environmental Protection Measures that will be implemented before and during project construction, implementing the following mitigation measure will reduce this impact to a less-than-significant level.

Mitigation Measure for Impact 4.2-9. Prior to construction activities during the breeding season (generally February through July) of each construction year, a qualified biologist will survey the project sites to locate active osprey and golden eagle nests. If a nest is occupied, Reclamation will limit construction activities near the nest to the nonbreeding season (mid-July to February). Reclamation will establish a 0.5-mile-radius direct line-of-sight buffer for active golden eagle nests and a 500-foot-radius direct line-of-sight buffer for active osprey nests. In addition, Reclamation will maintain a 0.5-mile direct line-of-sight helicopter exclusion zone around any active nests.

In the event that all or part of this mitigation measure is considered unfeasible during implementation of the project, DFG and USFWS will be consulted to develop alternative measures.

Impact 4.2-10 Significant—Potential disturbance of bats in canal tunnels and on rocky cliffs and outcrops along canyon walls. Construction activities may disturb special-status bats using tunnels near the South and Inskip Diversion Dams for roosting, breeding, migration, and hibernation habitat. In addition, construction activities may disturb bats that use the rocky cliffs and outcrops along canyon walls at Eagle Canyon and Wildcat Diversion Dams and other areas with potential bat habitat. Although bats were not identified to the specific level during surveys, several species of bats that could be using the tunnels for roosting, breeding, migration, and hibernation habitat are state species of special concern, federal species of concern, and Western Bat Working Group species of high priority. Construction disturbances could affect reproductive success, result in the abandonment of maternity sites, or disturb hibernating colonies. Disturbance at sites that support colonies or large concentrations of roosting bats could result in local population declines. This impact, therefore, is considered significant. In addition to the General Environmental Protection Measures that will be implemented before and during project construction, implementing the following mitigation measure would reduce the impact to a less-than-significant level.

Mitigation Measure for Impact 4.2-10. Prior to all construction activities, a qualified biologist will survey construction sites, nearby tunnels, rocky cliffs and outcrops, and other potential bat habitats that could be adversely affected by construction to determine the presence or absence of bats. Bat surveys will be conducted to determine the presence of bats in tunnels during the spring (March through mid-May) for maternity colonies, summer (June through August) for roosting sites, fall (mid-August through October) for migrant stopover sites, and winter (November through February) for hibernating sites. At sites that support maternity colonies or large concentrations of roosting bats, Reclamation will restrict construction activities where practical to non-use periods or outside the breeding and hibernation periods. If impacts are unavoidable during any season, Reclamation will implement selected minimizing actions, including temporary closure and soundproofing of tunnel entrances during the day, to reduce disturbance of roosting bats. Survey and construction scheduling, buffer zones, and other mitigation measures will be developed in consultation with bat specialists, USFWS, and DFG.

Impact 4.2-11 Less than Significant—Possible loss of woody riparian vegetation along the South and Wildcat Canals from cessation of flows.

The Restoration Project could cause the loss of scattered woody riparian trees and shrubs along the South Canal (Figure 4.2-14) and the Wildcat Canal (Figure 4.2-6) as a result of cessation of flows. Canal leakage has supported the establishment of these riparian species in scattered locations along the canals. This impact is considered less than significant because the scattered riparian trees and shrubs along the canals provide minimal habitat functions and values for wildlife species. Additionally, as part of the Five Dam Removal Alternative, the South and Wildcat Diversion Dams would be removed, and flows to the canals would be restored to the original Battle Creek channel. The overall impacts on the riparian community downstream are expected to be beneficial because of increases in streamflows. No mitigation is required.

Impact 4.2-12 Less than Significant—Potential disturbance of foraging bald eagles along Battle Creek.

No bald eagle nests were found or are known to occur in the immediate vicinity of the project area. However, bald eagles may forage along North Fork and South Fork Battle Creek during the winter nonbreeding season (October through February). Breeding bald eagles that nest in the surrounding area, but outside the project area, may also use Battle Creek as foraging habitat during the breeding season (March through September). Overall use of the project by bald eagles appears to be low; during all field surveys only two bald eagles were detected flying over the project area, and none were found foraging or roosting in the project area.

The long-term impacts of the project are considered beneficial to bald eagles because the area will be restored to its pre-dam condition, allowing greater movement of fish and creating natural pools. In the short term, construction noise disturbance and helicopter flights associated with restoration activities could temporarily displace roosting or foraging bald eagles. However, because of the low number of bald eagles apparently using the project area and the extent of available habitat throughout the project region, this level of possible displacement is not expected to disrupt overall bald eagle use of the area, affect individual eagles' ability to forage successfully, or affect reproductive efforts during any construction year. This impact is therefore considered less than significant.

Impact 4.2-13 Beneficial—Reduction of artificial flow fluctuations and increased survival of amphibians.

Powerhouses, canals, and reliable fish screens are all subject to planned and unplanned outages as part of preventative maintenance and in response to malfunctions. Such outages are typically infrequent and of short duration; during outages, water intended to go to the power canals is instead released to Battle Creek below the dam. At the end of outages, the water is again diverted into canals, thereby reducing the flow in the stream channel.

Amphibians typically found in streams like Battle Creek are capable of colonizing areas that are wetted for relatively short periods of time (e.g., several weeks). When the stream below the diversion dams receives all the canal flow during an outage, transitory habitat is created along edges of the stream channel that may remain wet long enough to be colonized by amphibians. When outages end and diversion of flows from the creek resume, the ramping rate may not be slow enough to allow the early amphibian life stages (i.e., eggs and tadpoles) to follow the receding water back to the normally wetted part of the stream.

To some extent the natural hydrograph creates seasonally transitory habitat, but habitat use patterns by amphibians have evolved with the relatively predictable seasonal changes in hydrology, and the rate at which these types of flows recede is generally slower than the ramping rate controlled by the dams. Removal of diversion dams would eliminate potential for unseasonal changes in transitory habitat in North Fork and South Fork Battle Creek and their tributaries. This change to flow regimes would benefit the early life stages of amphibians that may inhabit transitory aquatic habitat.

Under the No Action Alternative, flow reductions below the dams could be abrupt and have the potential to cause stranding or isolation of juvenile fish in the stream channel as the stream margin is dewatered (DFG pers. comm. 2001) and, by extension, could also cause stranding or isolation of early amphibian life stages. Such stranding may cause mortality to amphibians. Under the present FERC license there is no requirement governing the rate of flow changes.

The ramping rate specified in the Five Dam Removal Alternative for dams that would remain in place should improve the survival of early amphibian life stages occupying transient habitat during flow reductions by slowly ramping down the water surface elevation in the stream when returning power canals to service following outages. Improved survival of early amphibian life stages should benefit amphibian populations downstream from dams, as well as populations of species that prey on amphibians.

Impact 4.1-14 Beneficial—Increase in quantity of amphibian habitat resulting from increased minimum instream flows.

The prescribed minimum instream flow releases are generally 5–20 times greater under the Five Dam Removal Alternative than under the FERC license. As discussed in the preceding section (4.1, Fish), these increases in minimum instream flows would significantly affect the amount of wetted habitat available[1] (Thomas R. Payne and Associates 1998a). Such increases would benefit animal species using aquatic habitat for foraging or reproduction, such as northwestern pond turtle, foothill yellow-legged frog, and salamanders. In general, aquatic habitat would increase within the mainstem and forks of Battle Creek under the Five Dam Removal Alternative. In no case does the Five Dam Removal Alternative provide less habitat for these organisms. Although not modeled by T.R. Payne and Associates (1998a), the wetted areas of the section of Soap, Lower Ripley, and Baldwin Creeks would also increase dramatically, as the required minimum instream flows would increase from 0 cfs at each of these sites.

Increased wetted habitat would likely lead to corresponding increases in the production of periphyton and aquatic macroinvertebrates, which form the basis of the food chain in stream ecosystems. These organisms provide a primary food source for animal species inhabiting aquatic habitats, such as northwestern pond turtle, foothill yellow-legged frog, and salamanders. Aquatic insects that metamorphose into aerial and terrestrial insects would contribute to the food supply of certain insectivorous wildlife, such as willow flycatcher and several bat species. Furthermore, wildlife species that prey on amphibians, such as green heron and common merganser, would also benefit from increased wetted habitat.

Impact 4.1-15 Beneficial—Substantial increase in quantity of bat roosting habitat in the South Canal tunnels due to termination of water flow through the tunnels.

Removal of the South Diversion Dam and associated facilities would result in termination of water flow through the South Canal tunnels. The resultant dry tunnels would potentially provide substantially increased roosting habitat for cave-dwelling bats. The actual use of the tunnels would depend on the new microclimate conditions established after the water flow is stopped.

No Dam Removal Alternative

For the No Dam Removal Alternative, none of the Battle Creek diversion dams would be removed. Instead, fish screens and fish ladders would be constructed at the North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and

[1] Habitat changes of greater than or equal to 10% of maximum weighted usable area were considered significant in this analysis.

Coleman Diversion Dams. The dams that are not removed would increase flow releases to levels required by AFRP.

Impacts on the botanical, wetland, and wildlife resources resulting from the construction of fish screens and ladders would be similar to those described for the Five Dam Removal Alternative (Proposed Action). The proposed construction areas are anticipated to be the same for the North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dam sites as under the Five Dam Removal Alternative. However, under the No Dam Removal Alternative, no construction is anticipated at Soap Creek Feeder, Lower Ripley Creek Feeder, or along the Wildcat and South Canals because these facilities would not be removed but would remain in their current condition. In addition, no bypass facilities or tailrace connectors would be constructed under the No Dam Removal Alternative.

The Restoration Project area would experience substantially less long-term benefit to riparian habitat under the No Dam Removal Alternative than under the Five Dam Removal Alternative because of continued streamflow diversion. Moreover, flow reductions below the diversion dams could be abrupt and have the potential to cause stranding or isolation of early amphibian life stages. Such stranding may cause mortality to amphibians.

Specific impacts associated with the No Dam Removal Alternative are described below. Total acreage of biological communities and waters of the United States potentially affected for the No Dam Removal Alternative are summarized in Table 4.2-3.

Impact 4.2-16 Significant—Potential disturbance or loss of 4.1 acres of woody riparian vegetation and associated wildlife habitat.
Like the Five Dam Removal Alternative, construction activities associated with the No Dam Removal Alternative could result in the temporary disturbance or permanent removal of woody riparian vegetation and associated wildlife habitat (Table 4.2-3). This impact is similar to Impact 4.2-1 described for the Five Dam Removal Alternative and is considered significant. Implementing the General Environmental Protection Measures and Mitigation Measures for Impact 4.2-1 would reduce this impact to a less-than-significant level.

Impact 4.2-17 Significant—Potential introduction of noxious weeds or spread of existing noxious weeds.
Activities associated with implementation of the Restoration Project could introduce or spread noxious weeds into currently uninfested areas, possibly resulting in the displacement of special-status plants, alteration of habitat for special-status wildlife, or substantial reduction of species diversity or abundance. Plants or seeds of noxious weeds may be dispersed on construction equipment if appropriate measures are not implemented. This impact is similar to Impact 4.2-2 described for the Five Dam Removal Alternative and could result in a substantial reduction or elimination of species diversity or abundance; it is therefore considered significant. Implementing the General Protection Measures

and the Mitigation Measures for Impact 4.2-2 would reduce this impact to a less-than-significant level.

Impact 4.2-18 Significant—Potential loss or disturbance of 11.6 acres of waters of the United States (including wetlands).
Under the No Dam Removal Alternative, construction activities could result in the loss or disturbance of approximately 11.6 acres of waters of the United States, resulting in short-term (temporary) and/or long-term (permanent) impacts on wetland communities (Table 4.2-3). As described for the Five Dam Removal Alternative, some additional acreage of waters of the United States may be incidentally filled or disturbed during construction of access roads and establishment of staging areas. The estimated acreage of disturbance or fill material that would be placed into waters of the United States will be determined after detailed design specifications are provided by Reclamation and before obtaining Section 404 Clean Water Act permits. An additional assessment of impacts will be conducted by a wetland ecologist after construction activities are complete. This postconstruction assessment will be used to quantify unanticipated impacts on waters of the United States.

Reclamation will implement measures as part of the project to avoid and minimize impacts on waters of the United States. Although these measures would minimize the extent of potential impacts, some disturbance or loss of waters of the United States would be necessary in order to construct the Restoration Project.

Because the proposed project could result in the placement of fill material into waters of the United States, this impact would be considered significant. This impact is similar to Impact 4.2-3 described for the Five Dam Removal Alternative and is considered significant. Implementing the General Environmental Protection Measures; Mitigation Measures for Impact 4.4-1 in Section 4.4, Water Quality; Mitigation Measures for Impact 4.7-1 in Section 4.7, Geology and Soils; and the Mitigation Measure for Impact 4.2-3 (described above) would reduce this impact to a less-than-significant level.

Impact 4.2-19 Significant—Potential loss or disturbance of common upland woodland and forest communities and associated wildlife habitat.
The No Dam Removal Alternative could result in the loss or disturbance of common woodland and forest communities, including gray pine/oak, blue oak, and/or live oak woodland, and westside ponderosa forest (Table 4.2-3). As described for the Five Dam Removal Alternative, most of the plant communities contain native oaks that could be removed during construction of access roads, staging areas, and other project features. These activities could result in short-term or long-term impacts on the oak woodlands and other common plant communities in the Restoration Project area. The estimated acreage of disturbance or loss of these communities will be determined after detailed design specifications are provided by Reclamation. An additional assessment of impacts will be performed by a plant ecologist after construction activities are complete.

This postconstruction assessment will be used to quantify unanticipated impacts on the plant communities.

Oak woodland provides important foraging habitat for several species of wildlife, including mammals, birds, and reptiles. A variety of raptors use oak woodland habitat for nesting. The removal of these woodland habitats could result in the substantial loss or degradation of a plant community and associated wildlife habitat and the disruption of natural wildlife movement corridors. Therefore, this impact is considered significant. This impact is similar to Impact 4.2-4 described for the Five Dam Removal Alternative and is considered significant. Implementing the General Environmental Protection Measures and the Mitigation Measure for Impact 4.2-4 would reduce this impact to a less-than-significant level.

Impact 4.2-20 Significant—Potential disturbance to valley elderberry longhorn beetle habitat.

Seventeen elderberry shrubs capable of providing habitat for valley elderberry longhorn beetle occur in the project area. Most of these shrubs are along roadsides and would be subject to either direct or indirect disturbance from road improvement activities. Some of the shrubs, such as those near the Eagle Canyon Diversion Dam, are in the immediate vicinity of project features. USFWS considers any ground-disturbing activity within 100 feet of an elderberry shrub within the range of valley elderberry longhorn beetle to be a potential take of the species (as defined under the federal Endangered Species Act). Because valley elderberry longhorn beetle is federally listed and because construction activities could directly or indirectly affect elderberry shrubs, potentially resulting in take of this species, this impact is considered significant. This impact is similar to Impact 4.2-5 described for the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-5 would reduce this impact to a less-than-significant level.

Impact 4.2-21 Significant—Potential disturbance of foothill yellow-legged frog habitat.

Surveys conducted for the Restoration Project indicate that foothill yellow-legged frog occurs in the project area. Construction activities could temporarily degrade foothill yellow-legged frog habitat at the Inskip Diversion Dam/South Powerhouse and South Diversion Dam sites. Restoration activities in these areas could disturb the shallow, rocky substrate required by foothill yellow-legged frogs and increase flows in areas that have been constrained by dam operations for many years. In addition, individual frogs could be killed during construction. Because this species has declined throughout its range, and in particular throughout the Sierra Nevada, the short-term effects of the project are considered significant. Accordingly, mitigation will focus on avoiding killing or injuring frogs in construction areas. This impact is similar to Impact 4.2-6 described for the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-6 would reduce this impact to a less-than-significant level.

Impact 4.2-22 Significant—Potential disturbance of northwestern pond turtle habitat.

Surveys conducted for the Restoration Project indicate that northwestern pond turtle occurs in the project area. Construction activities could temporarily degrade habitat for this species at Inskip Diversion Dam/South Powerhouse and South Diversion Dam sites. Restoration activities in these areas could disturb pond and other open water habitats and basking sites required by northwestern pond turtles. In addition, during construction, individual turtles could be killed. Because this species has declined throughout its range, the short-term potential for mortality is considered significant. Accordingly, mitigation will focus on avoiding killing or injuring turtles in construction areas. This impact is similar to Impact 4.2-7 described for the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-7 would reduce this impact to a less-than-significant level.

Impact 4.2-23 Significant—Potential disturbance of breeding habitat for yellow-breasted chat.

During surveys for the Restoration Project, yellow-breasted chats were detected and are considered to be breeding at two sites in the project area: Darrah Springs Feeder and Coleman Diversion Dam/Inskip Powerhouse. No construction is proposed at Darrah Springs under this alternative; however, construction at the Coleman Diversion Dam/Inskip Powerhouse could potentially remove riparian scrub habitat required by this species for breeding and cover. Impacts on this habitat during the breeding season could also result in destruction of active nests and mortality of individual chats or their eggs. Yellow-breasted chat is an uncommon species in California; it is restricted to a habitat type (riparian scrub) that has declined substantially over past decades; and local breeding populations are considered to be declining. For these reasons, impacts resulting from removal or disturbance of occupied breeding habitat and the potential for mortality of individuals or nests are considered significant. This impact is similar to Impact 4.2-8 described for the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impacts 4.2-1 and 4.2-8 would reduce this impact to a less-than-significant level.

Impact 4.2-24 Significant—Potential disturbance to nesting raptors.

Two nonlisted special-status raptors, osprey and golden eagle, are known or have potential to nest in the Restoration Project area. One active osprey nest was found during surveys; moreover, although no active golden eagle nests were found, suitable golden eagle nesting habitat exists throughout the project area. Construction activities occurring in the immediate vicinity of active nests could cause abandonment of nests and potentially result in death of young or eggs. Osprey and golden eagle are locally and regionally uncommon species, and the abandonment of active nests could affect local and regional breeding populations. Therefore, this impact is considered significant. This impact is similar to Impact 4.2-9 described for the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-9 would reduce this impact to a less-than-significant level.

Impact 4.2-25 Significant—Potential disturbance of bats in canal tunnels and on rocky cliffs and outcrops along canyon walls.

Construction activities may disturb special-status bats using tunnels near the South and Inskip Diversion Dams for roosting, breeding, migration, and hibernation habitat. In addition, construction activities may disturb bats that use the rocky cliffs and outcrops along canyon walls at Eagle Canyon and Wildcat Diversion Dams and other areas with potential bat habitat. Although bats were not identified to the specific level during surveys, several species of bats that could be using the tunnels for roosting, breeding, migration, and hibernation habitat are state species of special concern, federal species of concern, and Western Bat Working Group species of high priority. Construction disturbances could affect reproductive success, result in the abandonment of maternity sites, or disturb hibernating colonies. Disturbance at sites that support colonies or large concentrations of roosting bats could result in local population declines. This impact, therefore, is considered significant. This impact is similar to Impact 4.2-10 described for the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-10 would reduce this impact to a less-than-significant level.

Impact 4.2-26 Less than Significant—Potential disturbance of foraging bald eagles along Battle Creek.

No bald eagle nests were found or are known to occur in the immediate vicinity of the project area. However, bald eagles may forage along North Fork and South Fork Battle Creek during the winter nonbreeding season (October through February). Breeding bald eagles that nest in the surrounding area, but outside the project area, may also use Battle Creek as foraging habitat during the breeding season (March through September). Overall use of the project area by bald eagles appears to be low; during all field surveys only two bald eagles were detected flying over the project area, and none were found foraging or roosting in the project area.

In the short term, construction noise disturbance and helicopter flights associated with restoration activities could temporarily displace roosting or foraging bald eagles. However, because of the low number of bald eagles apparently using the project area and the extent of available habitat throughout the project region, this level of possible displacement is not expected to disrupt overall bald eagle use of the area, affect individual eagles' ability to forage successfully, or affect reproductive effort during any construction year. This impact is therefore considered less than significant.

Impact 4.1-27 Beneficial—Increase in quantity of amphibian habitat resulting from increased minimum instream flows.

The prescribed minimum instream flow releases are generally 5–20 times greater under the No Dam Removal Alternative than under the FERC license. As discussed in the preceding section (Section 4.1, Fish), these increases in minimum instream flows would significantly affect the amount of wetted habitat available[2] (Thomas R. Payne and Associates 1998a). Such increases would benefit animal species using aquatic habitat for foraging or reproduction, such as northwestern pond turtle, foothill yellow-legged frog, and salamanders. In general, aquatic habitat would increase within the mainstem and forks of Battle Creek under the No Dam Removal Alternative. In no case does the No Dam Removal Alternative provide less habitat for these organisms.

Increased wetted habitat would likely lead to corresponding increases in the production of periphyton and aquatic macroinvertebrates, which form the basis of the food chain in stream ecosystems. These organisms provide a primary food source for animal species inhabiting aquatic habitats, such as northwestern pond turtle, foothill yellow-legged frog, and salamanders. Aquatic insects that metamorphose into aerial and terrestrial insects would contribute to the food supply of certain insectivorous wildlife, such as willow flycatcher and several bat species. Furthermore, wildlife species that prey on amphibians, such as green heron and common merganser, would also benefit from increased wetted habitat.

Six Dam Removal Alternative

The Six Dam Removal Alternative would remove Eagle, Wildcat, South, Coleman, Soap Creek Feeder, and Lower Ripley Creek Feeder Diversion Dams. Wildcat Canal and South Canal would also be removed. Fish screens and fish ladders would be constructed at the North Battle Creek Feeder and Inskip Diversion Dams. Those dams that are not removed would increase flow releases to levels identified in the 1999 MOU (Appendix D). The Six Dam Removal Alternative would also construct a bypass facility at the Inskip Powerhouse, and would construct tailrace connectors between South Powerhouse and Inskip Canal and between Inskip Powerhouse and Coleman Canal to prevent North Battle Creek water from mixing with South Battle Creek water. The Asbury Diversion Dam spill gates would be reoperated and a new gaging system installed to ensure an instream flow release of 5 cfs.

Impacts on the botanical, wetland, and wildlife resources resulting from the construction of fish screens and ladders at North Battle Creek Feeder and Inskip Diversion Dams and the removal of Eagle Canyon, Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams would be similar to those described for the Five Dam Removal Alternative (Proposed Action). The proposed construction areas are assumed to be the same for each site as under the Five Dam Removal Alternative. The following impacts are associated with the Six Dam Removal Alternative. Total acreage of biological communities and waters of the United States potentially affected for the Six Dam Removal Alternative are summarized in Table 4.2-4.

[2] Habitat changes of greater than or equal to 10% of maximum weighted usable area were considered significant in this analysis.

Impact 4.2-28 Significant—Potential disturbance or loss of 7.2 acres of woody riparian vegetation and associated wildlife habitat.
Like the Five Dam Removal Alternative, the Six Dam Removal Alternative could result in the temporary disturbance or permanent removal of woody riparian vegetation and associated wildlife habitat (Table 4.2-4). This impact is similar to Impact 4.2-1 described for the Five Dam Removal Alternative and is considered significant. Implementing the General Environmental Protection Measures and Mitigation Measures for Impact 4.2-1 would reduce this impact to a less-than-significant level.

Impact 4.2-29 Significant—Potential introduction of noxious weeds or spread of existing noxious weeds.
Construction activities associated with the Six Dam Removal Alternative could introduce or spread noxious weeds into currently uninfested areas, possibly resulting in displacement of special-status plants, alteration of habitat for special-status wildlife, or substantial reduction of species diversity or abundance. Plants or seeds of noxious weeds may be dispersed on construction equipment if appropriate measures are not implemented. This impact is similar to Impact 4.2-2 described for the Five Dam Removal Alternative and could result in a substantial reduction or elimination of species diversity or abundance and is therefore considered significant. Implementing the General Environmental Protection Measures and Mitigation Measures for Impact 4.2-2 would reduce this impact to a less-than-significant level.

Impact 4.2-30 Significant—Potential loss or disturbance of 12.1 acres of waters of the United States (including wetlands).
Under the Six Dam Removal Alternative, construction activities could result in disturbing 12.1 acres of waters of the United States, resulting in short-term (temporary) and/or long-term (permanent) impacts on wetland communities (Table 4.2-4). As described for the Five Dam Removal Alternative, some additional acreage of waters of the United States may be incidentally filled or disturbed during construction of access roads and establishment of staging areas. The estimated acreage of disturbance or fill material that would be placed into waters of the United States will be determined after detailed design specifications are provided by Reclamation and before obtaining Section 404 Clean Water Act permits. An additional assessment of impacts will be conducted by a wetland ecologist after construction activities are complete. This postconstruction assessment will be used to quantify unanticipated impacts on waters of the United States.

Reclamation will implement measures as part of the project to avoid and minimize impacts on waters of the United States. Although these measures would minimize the extent of potential impacts, some disturbance or loss of waters of the United States would be necessary in order to construct the Restoration Project.

Because the proposed project could result in the placement of fill material into waters of the United States, this impact would be considered significant. Implementing the General Environmental Protection Measures; Mitigation

Measures for Impact 4.4-1 in Section 4.4, Water Quality; Mitigation Measures for Impact 4.7-1 in Section 4.7, Geology and Soils; and the Mitigation Measure for Impact 4.2-3 would reduce this impact to a less-than-significant level.

Impact 4.2-31 Significant—Potential loss or disturbance of common upland woodland and forest communities and associated wildlife habitat.

The Six Dam Removal Alternative could result in the loss or disturbance of common woodland and forest communities, including gray pine/oak, blue oak, and/or live oak woodland, and westside ponderosa forest (Table 4.2-4). As described for the Five Dam Removal Alternative, most of the plant communities contain native oaks that could be removed during construction of access roads, staging areas, and other project features. These activities could result in short-term or long-term impacts on the oak woodlands and other common plant communities in the Restoration Project area. The estimated acreage of disturbance or loss of these communities will be determined after detailed design specifications are provided by Reclamation. An additional assessment of impacts will be performed by a plant ecologist after construction activities are complete. This postconstruction assessment will be used to quantify unanticipated impacts on the plant communities.

Oak woodland provides important foraging habitat for several species of wildlife, including mammals, birds, and reptiles. A variety of raptors use oak woodland habitat for nesting. The removal of these woodland habitats could result in the substantial loss or degradation of a plant community and associated wildlife habitat and the disruption of natural wildlife movement corridors. Therefore, this impact is considered significant. This impact is similar to Impact 4.2-4 described under the Five Dam Removal Alternative and is considered significant. Implementing the General Environmental Protection Measures and the Mitigation Measures for Impact 4.2-4 would reduce this impact to a less-than-significant level.

Impact 4.2-32 Significant—Potential disturbance to valley elderberry longhorn beetle habitat.

Seventeen elderberry shrubs capable of providing habitat for valley elderberry longhorn beetle occur in the project area. Most of these shrubs are along roadsides and would be subject to either direct or indirect disturbance from road improvement activities. Some of the shrubs, such as those near the Eagle Canyon Diversion Dam, are in the immediate vicinity of project features. USFWS considers any ground-disturbing activity within 100 feet of an elderberry shrub within the range of valley elderberry longhorn beetle to be a potential take of the species (as defined under the federal Endangered Species Act). Because valley elderberry longhorn beetle is federally listed and because construction activities could directly or indirectly affect elderberry shrubs potentially resulting in take of this species, this impact is considered significant. This impact is similar to Impact 4.2-5. Implementing the Mitigation Measures for Impact 4.2-5 would reduce this impact to a less-than-significant level.

Impact 4.2-33 Significant—Potential disturbance of foothill yellow-legged frog habitat.

Surveys conducted for the Restoration Project indicate that foothill yellow-legged frog occurs in the project area. Construction activities could temporarily degrade foothill yellow-legged frog habitat at Lower Ripley Creek Feeder Diversion Dam, Inskip Diversion Dam/South Powerhouse, Soap Creek Feeder, and South Diversion Dam. Restoration activities in these areas could disturb the shallow, rocky substrate required by foothill yellow-legged frogs and increase flows in areas that have been constrained by dam operations for many years. In addition, during construction, individual frogs could be killed. The overall effects of the project, however, are considered beneficial to this species because the process of restoring the affected drainages will ultimately return them to an approximation of their former natural conditions. Nonetheless, because this species has declined throughout its range, and in particular throughout the Sierra Nevada, the short-term effects of the project are considered significant. Accordingly, mitigation will focus on avoiding killing or injuring frogs in construction areas. This impact is similar to Impact 4.2-6 described under the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-6 would reduce this impact to a less-than-significant level.

Impact 4.2-34 Significant—Potential disturbance of northwestern pond turtle habitat.

Surveys conducted for the Restoration Project indicate that northwestern pond turtle occurs in the project area. Construction activities could temporarily degrade habitat for this species at Lower Ripley Creek Feeder Diversion Dam, Inskip Diversion Dam/South Powerhouse, Soap Creek Feeder, and South Diversion Dam. Restoration activities in these areas could disturb the pond and other open water habitats and basking sites required by northwestern pond turtles as well as increasing flows in areas that have been constrained by dam operations for many years. In addition, individual turtles could be killed during construction. The overall effects of the project, however, are considered beneficial to this species because the process of restoring the affected drainages will ultimately return them to an approximation of their former natural conditions. Nonetheless, because this species has declined throughout its range, the short-term potential for mortality is considered significant. Accordingly, mitigation will focus on avoiding killing or injuring turtles in construction areas. This impact is similar to Impact 4.2-7 described for the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-7 would reduce this impact to a less-than-significant level.

Impact 4.2-35 Significant—Potential disturbance of breeding habitat for yellow-breasted chat.

During surveys for the Restoration Project, yellow-breasted chats were detected and are considered to be breeding at two sites in the project area: Darrah Springs Feeder and Coleman Diversion Dam/Inskip Powerhouse. No construction is proposed at Darrah Springs under this alternative; however, construction at the Coleman Diversion Dam/Inskip Powerhouse could potentially remove riparian scrub habitat required by this species for breeding and cover. Impacts on this habitat during the breeding season could also result in destruction of active nests and mortality of individual chats or their eggs. Yellow-breasted chat is an uncommon species in California; it is restricted to a habitat type (riparian scrub) that has declined substantially over past decades; and local breeding populations are considered to be declining. For these reasons, impacts resulting from removal or disturbance of occupied breeding habitat and the potential for mortality of individuals or nests are considered significant. This impact is similar to Impact 4.2-8 described under the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impacts 4.2-1 and 4.2-8 would reduce this impact to a less-than-significant level.

Impact 4.2-36 Significant—Potential disturbance to nesting raptors.
Two nonlisted special-status raptors, osprey and golden eagle, are known or have potential to nest in the Restoration Project area. One active osprey nest was found during surveys; moreover, although no active golden eagle nests were found, suitable golden eagle nesting habitat exists throughout the project area. Construction activities occurring in the immediate vicinity of active nests could cause abandonment of nests and potentially result in death of young or eggs. Osprey and golden eagle are locally and regionally uncommon species, and the abandonment of active nests could affect local and regional breeding populations. Therefore, this impact is considered significant. This impact is similar to Impact 4.2-9. Implementing the Mitigation Measures for Impact 4.2-9 would reduce this impact to a less-than-significant level.

Impact 4.2-37 Significant—Potential disturbance of bats in canal tunnels and on rocky cliffs and outcrops along canyon walls.
Construction activities may disturb special-status bats using tunnels near the South and Inskip Diversion Dams for roosting, breeding, migration, and hibernation habitat. In addition, construction activities may disturb bats that use the rocky cliffs and outcrops along canyon walls at Eagle Canyon and Wildcat Diversion Dams and other areas with potential bat habitat. Although bats were not identified to the specific level during surveys, several species of bats that could be using the tunnels for roosting, breeding, migration, and hibernation habitat are state species of special concern, federal species of concern, and Western Bat Working Group species of high priority. Construction disturbances could affect reproductive success, result in the abandonment of maternity sites, or disturb hibernating colonies. Disturbance at sites that support colonies or large concentrations of roosting bats could result in local population declines. This impact, therefore, is considered significant. This impact is similar to Impact 4.2-10 described under the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-10 would reduce this impact to a less-than-significant level.

Impact 4.2-38 Less than Significant—Possible loss of woody riparian vegetation along the South and Wildcat Canals from cessation of flows.
Under the Six Dam Removal Alternative, the South and Wildcat Diversion Dams would be removed, and flows to the canals would be restored to the original Battle Creek channel. This impact is similar to Impact 4.2-11 described for the

Five Dam Removal Alternative and is considered less than significant. No mitigation is required.

Impact 4.2-39 Less than Significant—Potential disturbance of foraging bald eagles along Battle Creek.

No bald eagle nests were found or are known to occur in the immediate vicinity of the project area. However, bald eagles may forage along North Fork and South Fork Battle Creek during the winter nonbreeding season (October through February). Breeding bald eagles that nest in the surrounding area, but outside the project area, may also use Battle Creek as foraging habitat during the breeding season (March through September). Overall use of the project by bald eagles appears to be low; during all field surveys only two bald eagles were detected flying over the project area, and none were found foraging or roosting in the project area.

The long-term impacts of the project are considered beneficial to bald eagles because the area will be restored to its pre-dam condition, allowing greater movement of fish and creating natural pools. In the short term, construction noise disturbance and helicopter flights associated with restoration activities could temporarily displace roosting or foraging bald eagles. However, because of the low number of bald eagles apparently using the project area and the extent of available habitat throughout the project region, this level of possible displacement is not expected to disrupt overall bald eagle use of the area, affect individual eagles' ability to forage successfully, or affect reproductive effort during any construction year. This impact is therefore considered less than significant.

Impact 4.2-40 Beneficial—Reduction of artificial flow fluctuations and increased survival of amphibians.

Powerhouses, canals, and reliable fish screens are all subject to planned and unplanned outages as part of preventative maintenance and in response to malfunctions. The outages are typically infrequent and of short duration; during outages, water intended to go to the power canals is instead released to Battle Creek below the dam. At the end of outages, the water is again diverted into canals, thereby reducing the flow in the stream channel.

Amphibians typically found in streams like Battle Creek are capable of colonizing areas that are wetted for relatively short periods of time (e.g., several weeks). When the stream below the diversion dams receives all the canal flow during an outage, transitory habitat is created along edges of the stream channel that may remain wet long enough to be colonized by amphibians. When outages end and diversion of flows from the creek resume, the ramping rate may not be slow enough to allow the early amphibian life stages (i.e., eggs and tadpoles) to follow the receding water back to the normally wetted part of the stream.

To some extent the natural hydrograph creates seasonally transitory habitat, but habitat use patterns by amphibians have evolved with the relatively predictable seasonal changes in hydrology, and the rate at which these types of flows recede is generally slower than the ramping rate controlled by the dams. Removal of diversion dams would eliminate potential for unseasonal changes in transitory habitat in North Fork and South Fork Battle Creek and its tributaries. This would benefit the early life stages of amphibians that may inhabit transitory aquatic habitat.

Under the No Action Alternative, flow reductions below the dams could be abrupt and have the potential to cause stranding or isolation of juvenile fish in the stream channel as the stream margin is dewatered (DFG pers. comm. 2001) and, by extension, the stranding or isolation of early amphibian life stages. Such stranding may cause mortality to amphibians. Under the present FERC license there is no requirement governing the rate of flow changes.

The ramping rate specified in the Six Dam Removal Alternative for dams that would remain in place should improve the survival of early amphibian life stages occupying transient habitat during flow reductions by slowly ramping down the water surface elevation in the stream when returning power canals to service following outages. Improved survival of early amphibian life stages should benefit amphibian populations downstream from dams, as well as populations of species that prey on amphibians.

Impact 4.1-41 Beneficial—Increase in quantity of amphibian habitat resulting from increased minimum instream flows.

The prescribed minimum instream flow releases are generally 5–20 times greater under the Six Dam Removal Alternative than under the FERC license. As discussed in the preceding section (Section 4.1, Fish), these increases in minimum instream flows would significantly affect the amount of wetted habitat available[3] (Thomas R. Payne and Associates 1998a). Such increases would benefit animal species using aquatic habitat for foraging or reproduction, such as northwestern pond turtle, foothill yellow-legged frog, and salamanders. In general, aquatic habitat would increase within the mainstem and forks of Battle Creek under the Six Dam Removal Alternative. In no case does the Six Dam Removal Alternative provide less habitat for these organisms. Although not modeled by T. R. Payne and Associates (1998a), the wetted areas of the section of Soap, Lower Ripley, and Baldwin Creeks would also increase dramatically, as the required minimum instream flows would increase from 0 cfs at each of these sites.

Increased wetted habitat would likely lead to corresponding increases in the production of periphyton and aquatic macroinvertebrates, which form the basis of the food chain in stream ecosystems. These organisms provide a primary food source for animal species inhabiting aquatic habitats, such as northwestern pond turtle, foothill yellow-legged frog, and salamanders. Aquatic insects that metamorphose into aerial and terrestrial insects would contribute to the food supply of certain insectivorous wildlife, such as willow flycatcher and several bat species. Furthermore, wildlife species that prey on amphibians, such as green heron and common merganser, would also benefit from increased wetted habitat.

[3] Habitat changes of greater than or equal to 10% of maximum weighted usable area were considered significant in this analysis.

Impact 4.1-42 Beneficial—Substantial increase in quantity of bat roosting habitat in the South Canal tunnels due to termination of water flow through the tunnels.

Removal of the South Diversion Dam and associated facilities would result in termination of water flow through the South Canal tunnels. The resultant dry tunnels would potentially provide substantially increased roosting habitat for cave-dwelling bats. The actual use of the tunnels would depend on the new microclimate conditions established after the water flow is stopped.

Three Dam Removal Alternative

The Three Dam Removal Alternative would remove Eagle, Wildcat, and Coleman Diversion Dams. Wildcat Canal would also be removed. Fish screens and fish ladders would be constructed at the North Battle Creek Feeder, South, and Inskip Diversion Dams. Those dams that are not removed would increase flow releases to levels required by AFRP. The Three Dam Removal Alternative would not include construction of a bypass facility at the Inskip Powerhouse; however, this alternative would construct tailrace connectors between South Powerhouse and Inskip Canal, and between Inskip Powerhouse and Coleman Canal to prevent North Battle Creek water from mixing with South Battle Creek water. The Asbury Diversion Dam spill gates would be reoperated and a new gaging system installed to ensure an instream flow release of 5 cfs.

Impacts on the botanical, wetland, and wildlife resources resulting from the construction of fish screens and ladders and the removal of Wildcat, South, and Coleman Diversion Dams would be similar to those described for the Five Dam Removal Alternative (Proposed Action). The proposed construction areas are assumed to be the same for the North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dam sites as under the Five Dam Removal Alternative. However, under the Three Dam Removal Alternative, no construction is anticipated at Soap Creek Feeder, Lower Ripley Creek Feeder, or along the South Canal because these facilities would not be removed but would remain in their current conditions.

The Restoration Project area would experience somewhat lesser long-term benefits to riparian habitat under the Three Dam Removal Alternative than under the Five Dam Removal Alternative because flows would continue to be diverted along South Canal rather than returned to the main stream channel in South Fork Battle Creek. In addition, flow reductions below the remaining diversion dams could be abrupt and have the potential to cause stranding or isolation of early amphibian life stages. Such stranding may cause mortality to amphibians.

The following impacts are associated with the Three Dam Removal Alternative. Total acreage of biological communities and waters of the United States potentially affected for the Three Dam Removal Alternative are summarized in Table 4.2-5.

Impact 4.2-43 Significant—Potential disturbance or loss of 6.0 acres of woody riparian vegetation and associated wildlife habitat.
Like the Five Dam Removal Alternative, the Three Dam Removal Alternative could result in the temporary disturbance or permanent removal of woody riparian vegetation and associated wildlife habitat (Table 4.2-5). This impact is similar to Impact 4.2-1 described for the Five Dam Removal Alternative and is considered significant. Implementing the General Environmental Protection Measures and Mitigation Measures for Impact 4.2-1 would reduce this impact to a less-than-significant level.

Impact 4.2-44 Significant—Potential introduction of noxious weeds or spread of existing noxious weeds.
Construction activities associated with the Three Dam Removal Alternative could introduce or spread noxious weeds into currently uninfested areas, possibly resulting in displacement of special-status plants, alteration of habitat for special-status wildlife, or substantial reduction of species diversity or abundance. Plants or seeds of noxious weeds may be dispersed on construction equipment if appropriate measures are not implemented. This impact is similar to Impact 4.2-2 described under the Five Dam Removal Alternative and could result in a substantial reduction or elimination of species diversity or abundance. This impact is therefore considered significant. Implementing the General Environmental Protection Measures and the Mitigation Measures for Impact 4.2-2 would reduce this impact to a less-than-significant level.

Impact 4.2-45 Significant—Potential loss or disturbance of 11.6 acres of waters of the United States (including wetlands) during construction.
Under the Three Dam Removal Alternative, construction activities could result in the loss or disturbance of approximately 11.6 acres of waters of the United States (including wetlands), resulting in short-term (temporary) and/or long-term (permanent) impacts on wetland communities (Table 4.2-5). As described for the Five Dam Removal Alternative, some additional acreage of waters of the United States may be incidentally filled or disturbed during construction of access roads and establishment of staging areas. The estimated acreage of disturbance or fill material that would be placed into waters of the United States will be determined after detailed design specifications are provided by Reclamation and before obtaining Section 404 Clean Water Act permits. An additional assessment of impacts will be conducted by a wetland ecologist after construction activities are complete. This postconstruction assessment will be used to quantify unanticipated impacts on waters of the United States.

Reclamation will implement measures as part of the project to avoid and minimize impacts on waters of the United States. Although these measures would minimize the extent of potential impacts, some disturbance or loss of waters of the United States would be necessary in order to construct the Restoration Project.

Because the proposed project could result in the placement of fill material into waters of the United States, this impact would be considered significant. This impact is similar to Impact 4.2-3 described under the Five Dam Removal Alternative and is considered significant. Implementing the General Environmental Protection Measures; Mitigation Measures for Impact 4.4-1 in Section 4.4, Water Quality; Mitigation Measures for Impact 4.7-1 in Section 4.7, Geology and Soils; and the Mitigation Measure for Impact 4.2-3 would reduce this impact to a less-than-significant level.

Impact 4.2-46 Significant—Potential loss or disturbance of common upland woodland and forest communities and associated wildlife habitat.

The Three Dam Removal Alternative could result in the loss or disturbance of common woodland and forest communities, including gray pine/oak, blue oak, and/or live oak woodland, and westside ponderosa forest (Table 4.2-5). As described for the Five Dam Removal Alternative, most of the plant communities contain native oaks that could be removed during construction of access roads, staging areas, and other project features. These activities could result in short-term or long-term impacts on the oak woodlands and other common plant communities in the Restoration Project area. The estimated acreage of disturbance or loss of these communities will be determined after detailed design specifications are provided by Reclamation. An additional assessment of impacts will be performed by a plant ecologist after construction activities are complete. This postconstruction assessment will be used to quantify unanticipated impacts on the plant communities.

Oak woodland provides important foraging habitat for several species of wildlife, including mammals, birds, and reptiles. A variety of raptors use oak woodland habitat for nesting. The removal of these woodland habitats could result in the substantial loss or degradation of a plant community and associated wildlife habitat and the disruption of natural wildlife movement corridors. Therefore, this impact is considered significant. This impact is similar to Impact 4.2-4 described under the Five Dam Removal Alternative and is considered significant. Implementing the General Environmental Protection Measures and the Mitigation Measure for Impact 4.2-4 would reduce this impact to a less-than-significant level.

Impact 4.2-47 Significant—Potential disturbance to valley elderberry longhorn beetle habitat.

Seventeen elderberry shrubs capable of providing habitat for valley elderberry longhorn beetle occur in the project area. Most of these shrubs are along roadsides and would be subject to either direct or indirect disturbance from road improvement activities. Some, such as those near the Eagle Canyon Diversion Dam, are in the immediate vicinity of project features. USFWS considers any ground-disturbing activity within 100 feet of an elderberry shrub within the range of valley elderberry longhorn beetle to be a potential take of the species (as defined under the federal Endangered Species Act). Because valley elderberry longhorn beetle is federally listed and because construction activities could directly or indirectly affect elderberry shrubs potentially resulting in take of this species, this impact is considered significant. This impact is similar to Impact

4.2-5. Implementing the Mitigation Measures for Impact 4.2-5 would reduce this impact to a less-than-significant level.

Impact 4.2-48 Significant—Potential disturbance of foothill yellow-legged frog habitat.
Surveys conducted for the Restoration Project indicate that foothill yellow-legged frog occurs in the project area. Construction activities could temporarily degrade foothill yellow-legged frog habitat at the Inskip Diversion Dam/South Powerhouse and South Diversion Dam sites. Restoration activities in these areas could disturb the shallow, rocky substrate required by foothill yellow-legged frogs and increase flows in areas that have been constrained by dam operations for many years. In addition, individual frogs could be killed during construction. The overall effects of the project, however, are considered beneficial to this species because the process of restoring the affected drainages will ultimately return them to an approximation of their former natural conditions. Nonetheless, because this species has declined throughout its range, and in particular throughout the Sierra Nevada, the short-term effects of the project are considered significant. Accordingly, mitigation will focus on avoiding killing or injuring frogs in construction areas. This impact is similar to Impact 4.2-6 described for the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-6 would reduce this impact to a less-than-significant level.

Impact 4.2-49 Significant—Potential disturbance of northwestern pond turtle habitat.
Surveys conducted for the Restoration Project indicate that northwestern pond turtle occurs in the project area. Construction activities could temporarily degrade habitat for this species at the Inskip Diversion Dam/South Powerhouse and South Diversion Dam sites. Restoration activities in these areas could disturb the pond and other open water habitats and basking sites required by northwestern pond turtles, and increase flows in areas that have been constrained by dam operations for many years. In addition, individual turtles could be killed during construction. The overall effects of the project, however, are considered beneficial to this species because the process of restoring the affected drainages will ultimately return them to an approximation of their former natural conditions. Nonetheless, because this species has declined throughout its range, the short-term potential for mortality is considered significant. Accordingly, mitigation will focus on avoiding killing or injuring turtles in construction areas. This impact is similar to Impact 4.2-7 described under the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-7 would reduce this impact to a less-than-significant level.

Impact 4.2-50 Significant—Potential disturbance of breeding habitat for yellow-breasted chat.
During surveys for the Restoration Project, yellow-breasted chats were detected and are considered to be breeding at two sites in the project area: Darrah Springs Feeder and Coleman Diversion Dam/Inskip Powerhouse. No construction is proposed at Darrah Springs under this alternative; however, construction at the Coleman Diversion Dam/Inskip Powerhouse could potentially remove riparian scrub habitat required by this species for breeding and cover. Impacts on this

habitat during the breeding season could also result in destruction of active nests and mortality of individual chats or their eggs. Yellow-breasted chat is an uncommon species in California; it is restricted to a habitat type (riparian scrub) that has declined substantially over past decades; and local breeding populations are considered to be declining. For these reasons, impacts resulting from removal or disturbance of occupied breeding habitat and the potential for mortality of individuals or nests are considered significant. This impact is similar to Impact 4.2-8 described for the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impacts 4.2-1 and 4.2-8 would reduce this impact to a less-than-significant level.

Impact 4.2-51 Significant—Potential disturbance to nesting raptors. Two nonlisted special-status raptors, osprey and golden eagle, are known or have potential to nest in the Restoration Project area. One active osprey nest was found during surveys; moreover, although no active golden eagle nests were found, suitable golden eagle nesting habitat exists throughout the project area. Construction activities occurring in the immediate vicinity of active nests could cause abandonment of nests and potentially result in death of young or eggs. Osprey and golden eagle are locally and regionally uncommon species, and the abandonment of active nests could affect local and regional breeding populations. Therefore, this impact is considered significant. This impact is similar to Impact 4.2-9. Implementing the Mitigation Measures for Impact 4.2-9 would reduce this impact to a less-than-significant level.

Impact 4.2-52 Significant—Potential disturbance of bats in canal tunnels and on rocky cliffs and outcrops along canyon walls. Construction activities may disturb special-status bats using tunnels near the South and Inskip Diversion Dams for roosting, breeding, migration, and hibernation habitat. In addition, construction activities may disturb bats that use the rocky cliffs and outcrops along canyon walls at Eagle Canyon and Wildcat Diversion Dams and other areas with potential bat habitat. Although bats were not identified to the specific level during surveys, several species of bats that could be using the tunnels for roosting, breeding, migration, and hibernation habitat are state species of special concern, federal species of concern, and Western Bat Working Group species of high priority. Construction disturbances could affect reproductive success, result in the abandonment of maternity sites, or disturb hibernating colonies. Disturbance at sites that support colonies or large concentrations of roosting bats could result in local population declines. This impact, therefore, is considered significant. This impact is similar to Impact 4.2-10 described under the Five Dam Removal Alternative. Implementing the Mitigation Measures for Impact 4.2-10 would reduce this impact to a less-than-significant level.

Impact 4.2-53 Less than Significant—Possible loss of woody riparian vegetation along the Wildcat Canal from cessation of flows. Under the Three Dam Removal Alternative, the Wildcat Diversion Dam would be removed, and flows to the Wildcat Canal would be restored to the original channel along North Fork Battle Creek. This impact is similar to Impact 4.2-11 described under the Five Dam Removal Alternative and is considered less than significant. No mitigation is required.

Impact 4.2-54 Less than Significant—Potential disturbance of foraging bald eagles along Battle Creek.

No bald eagle nests were found or are known to occur in the immediate vicinity of the project area. However, bald eagles may forage along North Fork and South Fork Battle Creek during the winter nonbreeding season (October through February). Breeding bald eagles that nest in the surrounding area, but outside the project area, may also use Battle Creek as foraging habitat during the breeding season (March through September). Overall use of the project by bald eagles appears to be low; during all field surveys only two bald eagles were detected flying over the project area, and none were found foraging or roosting in the project area.

The long-term impacts of the project are considered beneficial to bald eagles because the area will be restored to its pre-dam condition, allowing greater movement of fish and creating natural pools. In the short term, construction noise disturbance and helicopter flights associated with restoration activities could temporarily displace roosting or foraging bald eagles. However, because of the low number of bald eagles apparently using the project area and the extent of available habitat throughout the project region, this level of possible displacement is not expected to disrupt overall bald eagle use of the area, affect individual eagles' ability to forage successfully, or affect reproductive effort during any construction year. This impact is therefore considered less than significant.

Impact 4.2-55 Beneficial—Reduction of artificial flow fluctuations and increased survival of amphibians.

Powerhouses, canals, and reliable fish screens are all subject to planned and unplanned outages as part of preventative maintenance and in response to malfunctions. The outages are typically infrequent and of short duration; during outages, water intended to go to the power canals is instead released to Battle Creek below the dam. At the end of outages, the water is again diverted into canals, thereby reducing the flow in the stream channel.

Amphibians typically found in streams like Battle Creek are capable of colonizing areas that are wetted for relatively short periods of time (e.g., several weeks). When the stream below the diversion dams receives all the canal flow during an outage, transitory habitat is created along edges of the stream channel that may remain wet long enough to be colonized by amphibians. When outages end and diversion of flows from the creek resume, the ramping rate may not be slow enough to allow the early amphibian life stages (i.e., eggs and tadpoles) to follow the receding water back to the normally wetted part of the stream.

To some extent the natural hydrograph creates seasonally transitory habitat, but habitat use patterns by amphibians have evolved with the relatively predictable seasonal changes in hydrology, and the rate at which these types of flows recede is generally slower than the ramping rate controlled by the dams. Removal of diversion dams would eliminate potential for unseasonal changes in transitory habitat in North Fork and South Fork Battle Creek and its tributaries. This would benefit the early life stages of amphibians that may inhabit transitory aquatic habitat.

Under the No Action Alternative, flow reductions below the dams could be abrupt and have the potential to cause stranding or isolation of juvenile fish in the stream channel as the stream margin is dewatered (DFG pers. comm. 2001) and, by extension, causing stranding or isolation of early amphibian life stages. Such stranding may cause mortality to amphibians. Under the present FERC license there is no requirement governing the rate of flow changes.

The ramping rate specified in the Three Dam Removal Alternative for dams that would remain in place should improve the survival of early amphibian life stages occupying transient habitat during flow reductions by slowly ramping down the water surface elevation in the stream when returning power canals to service following outages. Improved survival of early amphibian life stages should benefit amphibian populations downstream from dams, as well as populations of species that prey on amphibians.

Impact 4.1-56 Beneficial— Substantial increase in quantity of amphibian habitat resulting from increased minimum instream flows.

The prescribed minimum instream flow releases are generally 5–20 times greater under the Three Dam Removal Alternative than under the FERC license. As discussed in the preceding fisheries section, these increases in minimum instream flows would significantly affect the amount of wetted habitat available[4] (Thomas R. Payne and Associates 1998a). Such increases would benefit animal species using aquatic habitat for foraging or reproduction, such as northwestern pond turtle, foothill yellow-legged frog, and salamanders. In general, aquatic habitat would increase within the mainstem and forks of Battle Creek under the Three Dam Removal Alternative. In no case does the Three Dam Removal Alternative provide less habitat for these organisms.

Increased wetted habitat would likely lead to corresponding increases in the production of periphyton and aquatic macroinvertebrates, which form the basis of the food chain in stream ecosystems. These organisms provide a primary food source for animal species inhabiting aquatic habitats, such as northwestern pond turtle, foothill yellow-legged frog, and salamanders. Aquatic insects that metamorphose into aerial and terrestrial insects would contribute to the food supply of certain insectivorous wildlife, such as willow flycatcher and several bat species. Furthermore, wildlife species that prey on amphibians, such as green heron and common merganser, would also benefit from increased wetted habitat.

[4] Habitat changes of greater than or equal to 10% of maximum weighted usable area were considered significant in this analysis.

Cumulative Impacts

The area for analyzing cumulative impacts on botanical, wetland, and wildlife resources (collectively referred to as biological resources in this cumulative impact analysis) was determined to be Tehama and Shasta Counties and the surrounding watershed of Battle Creek. The area within these counties and the Battle Creek watershed represent the probable area in which project effects on biological resources could interact with other development and have significant cumulative effects on sensitive biological resources.

This cumulative impacts analysis considered the following factors to determine if the Restoration Project would result in significant cumulative impacts on biological resources:

- historical and current known distribution of special-status species and sensitive biological communities within Tehama and Shasta Counties and statewide;
- extent of sensitive biological resources protected on public lands and current known threats to these resources on private lands (e.g., proposed development, current agricultural practices, and land management practices); and
- documented impacts associated with approved or pending future projects within the counties and Battle Creek watershed (including proposed modifications at the Coleman National Fish Hatchery).

Based on these evaluation criteria, the Restoration Project would not have a cumulatively significant impact on biological resources that are known to occur in Shasta and Tehama Counties and the surrounding watershed. No additional mitigation is required beyond that proposed for each potential impact described above.

Table 4.2-1. Plant Communities and Associated Wildlife Habitats Observed at the Restoration Project Sites[1]

Restoration Project Site	Annual Grassland	Mixed Chaparral	Live Oak Woodland	Blue Oak Woodland/ Savanna	Gray Pine/Oak Woodland	Westside Ponderosa Pine Forest	Emergent Wetland	Seasonal Wetland	Emergent Scrub Wetland	Groundwater Seep	Riparian Forest/ Riparian Scrub
North Battle Creek Feeder Diversion Dam			X		X	X					X
Eagle Canyon Diversion Dam			X							X	X
Wildcat Diversion Dam/Wildcat Pipeline	X	X		X							X
Coleman Diversion Dam/Inskip Powerhouse[2]	X		X	X	X		X	X	X		X
Lower Ripley Creek Feeder	X			X							X
Inskip Diversion Dam/ South Powerhouse	X		X				X	X			X
Soap Creek Feeder Diversion Dam	X	X	X	X	X						X
South Diversion Dam/ South Battle Creek Canal		X			X						X

Notes:

[1] This table does not include plant communities and associated wildlife habitats observed in existing access roads or potential staging areas.

[2] The Coleman Diversion Dam/Inskip Powerhouse site includes plant community and associated wildlife habitat observations at the Penstock Junction Box.

Table 4.2-2. Biological Communities and Waters of the United States Potentially Affected by the Five Dam Removal Alternative

	Biological Communities (acres)						Waters of the United States (acres)				
Restoration Project Site	Annual Grassland	Blue Oak Woodland/ Savanna	Grey Pine/ Oak Woodland	Live Oak Woodland	Mixed Chaparral	Riparian Forest/ Riparian Scrub	Emergent Wetland	Seasonal Wetland	Perennial Drainage	Seasonal Drainage	Groundwater Seep
North Battle Creek Diversion Dam	1.8	0.0	0.0	1.5	1.5	0.4	0.0	0.0	0.7	0.0	0.0
Eagle Canyon Diversion Dam	0.0	0.3	0.7	1.4	0.4	1.3	0.0	0.0	1.1[a]	0.0	0.5
Wildcat Diversion Dam	0.0	0.0	0.2	0.0	0.0	0.7	0.0	0.0	0.2[b]	0.0	0.0
Wildcat Canal	0.2	2.5	1.7	0.0	1.3	1.9	0.0	0.0	0.0	0.0	0.0
South Diversion Dam	0.0	0.0	0.2	3.5	0.2	0.4	0.0	0.0	4.4[c]	0.0	0.0
South Battle Creek Canal	0.1	24.8	0.0	11.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Soap Creek Feeder	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inskip Diversion Dam-South Powerhouse	4.5	2.9	0.3	7.8	0.0	0.1	0.0	0.6	1.8[a]	0.0	0.0
Lower Ripley Creek Feeder	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.3[d]	0.0	0.0
Coleman Diversion Dam-Inskip Powerhouse	4.6	19.1	0.3	0.4	0.0	1.2	0.1	0.0	2.1[a]	0.1	0.0
Total Acres Affected	**11.2**	**49.6**	**3.4**	**25.9**	**3.4**	**7.2**	**0.1**	**0.6**	**10.7**	**0.2**	**0.5**

[a] Partially refers to South Fork of Battle Creek; total acres extend beyond detail area.

[b] Partially refers to North Fork of Battle Creek; total acres extend beyond detail area.

[c] Partially refers to South Fork of Battle Creek, or Soap Creek; total acres extend beyond detail area.

[d] Partially refers to Ripley Creek; total acres extend beyond detail area.

Table 4.2-3. Biological Communities and Waters of the United States Potentially Affected by the No Dam Removal Alternative

	Biological Communities (acres)						Waters of the United States (acres)				
Restoration Project Site	Annual Grassland	Blue Oak Woodland/ Savanna	Grey Pine/ Oak Woodland	Live Oak Woodland	Mixed Chaparral	Riparian Forest/ Riparian Scrub	Emergent Wetland	Seasonal Wetland	Perennial Drainage	Seasonal Drainage	Groundwater Seep
North Battle Creek Diversion Dam	1.8	0.0	0.0	1.5	1.5	0.4	0.0	0.0	0.7	0.0	0.0
Eagle Canyon Diversion Dam	0.0	0.3	0.7	1.4	0.4	1.3	0.0	0.0	1.1[a]	0.0	0.5
Wildcat Diversion Dam	0.0	0.0	0.2	0.0	0.0	0.7	0.0	0.0	0.2[b]	0.0	0.0
Wildcat Canal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
South Diversion Dam	0.0	0.0	0.2	3.5	0.2	0.4	0.0	0.0	4.4[c]	0.0	0.0
South Battle Creek Canal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soap Creek Feeder	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inskip Diversion Dam-South Powerhouse	4.5	2.9	0.3	7.8	0.0	0.1	0.0	0.6	1.8[A]	0.0	0.0
Lower Ripley Creek Feeder	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Coleman Diversion Dam-Inskip Powerhouse	4.6	19.1	0.3	0.4	0.0	1.2	0.1	0.0	2.1[A]	0.1	0.0
Total Acres Affected	**10.9**	**22.3**	**1.7**	**14.6**	**2.1**	**4.1**	**0.1**	**0.6**	**10.3**	**0.1**	**0.5**

[a] Partially refers to South Fork of Battle Creek; total acres extend beyond detail area.

[b] Partially refers to North Fork of Battle Creek; total acres extend beyond detail area.

[c] Partially refers to South Fork of Battle Creek, or Soap Creek; total acres extend beyond detail area.

Table 4.2-4. Biological Communities and Waters of the United States Potentially Affected by the Six Dam Removal Alternative

	Biological Communities (acres)						Waters of the United States (acres)				
Restoration Project Site	Annual Grassland	Blue Oak Woodland/ Savanna	Grey Pine/ Oak Woodland	Live Oak Woodland	Mixed Chaparral	Riparian Forest/ Riparian Scrub	Emergent Wetland	Seasonal Wetland	Perennial Drainage	Seasonal Drainage	Groundwater Seep
North Battle Creek Diversion Dam	1.8	0.0	0.0	1.5	1.5	0.4	0.0	0.0	0.7	0.0	0.0
Eagle Canyon Diversion Dam	0.0	0.3	0.7	1.4	0.4	1.3	0.0	0.0	1.1[a]	0.0	0.5
Wildcat Diversion Dam	0.0	0.0	0.2	0.0	0.0	0.7	0.0	0.0	0.2[b]	0.0	0.0
Wildcat Canal	0.2	2.5	1.7	0.0	1.3	1.9	0.0	0.0	0.0	0.0	0.0
South Diversion Dam	0.0	0.0	0.2	3.5	0.2	0.4	0.0	0.0	4.4[c]	0.0	0.0
South Battle Creek Canal	0.1	24.8	0.0	11.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Soap Creek Feeder	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inskip Diversion Dam-South Powerhouse	4.5	2.9	0.3	7.8	0.0	0.1	0.0	0.6	1.8[a]	0.0	0.0
Lower Ripley Creek Feeder	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.3[d]	0.0	0.0
Coleman Diversion Dam-Inskip Powerhouse	4.6	19.1	0.3	0.4	0.0	1.2	0.1	0.0	2.1[a]	0.1	0.0
Total Acres Affected	**11.2**	**49.6**	**3.4**	**25.9**	**3.4**	**7.2**	**0.1**	**0.6**	**10.7**	**0.2**	**0.5**

[a] Partially refers to South Fork of Battle Creek; total acres extend beyond detail area.

[b] Partially refers to North Fork of Battle Creek; total acres extend beyond detail area.

[c] Partially refers to South Fork of Battle Creek, or Soap Creek; total acres extend beyond detail area.

[d] Partially refers to Ripley Creek; total acres extend beyond detail area.

Table 4.2-5. Biological Communities and Waters of the United States Potentially Affected by the Three Dam Removal Alternative

	Biological Communities (acres)						Waters of the United States (acres)				
Restoration Project Site	Annual Grassland	Blue Oak Woodland/ Savanna	Grey Pine/ Oak Woodland	Live Oak Woodland	Mixed Chaparral	Riparian Forest/ Riparian Scrub	Emergent Wetland	Seasonal Wetland	Perennial Drainage	Seasonal Drainage	Groundwater Seep
North Battle Creek Diversion Dam	1.8	0.0	0.0	1.5	1.5	0.4	0.0	0.0	0.7	0.0	0.0
Eagle Canyon Diversion Dam	0.0	0.3	0.7	1.4	0.4	1.3	0.0	0.0	1.1[a]	0.0	0.5
Wildcat Diversion Dam	0.0	0.0	0.2	0.0	0.0	0.7	0.0	0.0	0.2[b]	0.0	0.0
Wildcat Canal	0.2	2.5	1.7	0.0	1.3	1.9	0.0	0.0	0.0	0.0	0.0
South Diversion Dam	0.0	0.0	0.2	3.5	0.2	0.4	0.0	0.0	4.4[c]	0.0	0.0
South Battle Creek Canal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soap Creek Feeder	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inskip Diversion Dam-South Powerhouse	4.5	2.9	0.3	7.8	0.0	0.1	0.0	0.6	1.8[a]	0.0	0.0
Lower Ripley Creek Feeder	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Coleman Diversion Dam-Inskip Powerhouse	4.6	19.1	0.3	0.4	0.0	1.2	0.1	0.0	2.1[a]	0.1	0.0
Total Acres Affected	**11.1**	**24.8**	**3.4**	**14.6**	**3.4**	**6.0**	**0.1**	**0.6**	**10.3**	**0.1**	**0.5**

[a] Partially refers to South Fork of Battle Creek; total acres extend beyond detail area.

[b] Partially refers to North Fork of Battle Creek; total acres extend beyond detail area.

[c] Partially refers to South Fork of Battle Creek, or Soap Creek; total acres extend beyond detail area.

Table 4.2-6. Special-Status Plants Documented as Potentially Occurring and/or Observed during the 2000 Survey in the Restoration Project Area

Common Name *Scientific Name*	Legal Status[1] Federal	State	CNPS	Distribution	Habitat Association	Occurrence in Restoration Project area	Period of Identification[2]
State- and Federally Listed Plants							
Boggs Lake hedge-hyssop[3] *Gratiola heterosepala*	–	E	1B	Fresno, Lake, Lassen, Madera, Modoc, Placer, Sacramento, Shasta, San Joaquin, Solano, and Tehama Counties; also in Oregon	Shallow water, vernal pools, marshes, and lake margins (below 3,940 feet elevation)	Not observed during surveys	April–June
Slender Orcutt grass[3] *Orcuttia tenuis*	T	E	1B	Lake, Lassen, Plumas, Sacramento, Shasta, Siskiyou, and Tehama Counties	Vernal pools (660 to 5,760 feet elevation)	Not observed during surveys	May–July
CNPS List 2 and 1B Plants							
Dimorphic snapdragon *Antirrhinum subcordatum*	–	–	1B	Colusa, Glenn, Lake, and Tehama Counties	Chaparral, lower conifer forest, and sometimes on serpentine (980 to 2,600 feet elevation)	Not observed during surveys	April–July
Big-scale balsamroot *Balsamorhiza macrolepis* var. *macrolepis*	–	–	1B	Alameda, Butte, Mariposa, Napa, Placer, Santa Clara, and Tehama Counties	Cismontane woodland, valley and foothill grassland, and sometimes serpentine (below 4,600 feet elevation)	Not observed during surveys	March–June
Silky cryptantha[3] *Cryptantha crinita*	SC	–	1B	Shasta and Tehama Counties	Cismontane woodland, lower conifer forest, riparian forests, riparian woodland, and gravelly areas with valley foothill grasslands (490 to 990 feet elevation)	Known from several occurrences along the edge of Battle Creek; no populations documented during 2000 field surveys	April–May
Dwarf downingia *Downingia pusilla*	–	–	2	Merced, Mariposa, Napa, Placer, Sacramento, Solano, Sonora, Stanislaus, and Tehama Counties	Vernal pools and other seasonally wet places in valley and foothill annual grasslands (490 feet elevation)	Not observed during surveys	March–May
Four-angled spikerush *Eleocharis quadrangularis*	–	–	2	Butte, Merced, and Tehama Counties	Marshes and swamps with seasonally or permanently saturated soils (below 1,600 feet elevation)	Not observed during surveys	July–September
Brandegee’s eriastrum *Eriastrum brandegeae*	SC	–	1B	Colusa, Glenn, Lake, Santa Clara, Tehama, and Trinity Counties	Chaparral, and cismontane woodland on volcanic soil (2,600 to 3,300 feet elevation)	Not observed during surveys	May–August

Common Name *Scientific Name*	Legal Status[1] Federal	State	CNPS	Distribution	Habitat Association	Occurrence in Restoration Project area	Period of Identification[2]
Adobe-lily *Fritillaria puriflora*	SC	–	1B	Butte, Colusa, Glenn, Lake, Napa, Plumas, Solano, and Tehama Counties	Chaparral, cismontane woodland, and clayey foothill valley grasslands (below 1,640 feet elevation)	Not observed during surveys	February–April
Red Bluff dwarf rush[3] *Juncus leiospermus* var. *leiospermus*	–	–	1B	Butte, Shasta, and Tehama Counties	Vernal pools and other seasonally wet sites in chaparral, oak woodland, and annual grassland (900 to 1,620 feet elevation)	Not observed during surveys	March–May
Legenere *Legenere limosa*	SC	–	1B	Lake, Napa, Placer, Sacramento, San Mateo, Solano, Sonoma, Stanislaus, and Tehama Counties	Vernal pools (below 490 feet elevation)	Not observed during surveys	May–June
Red-flowered lotus *Lotus rubriflorus*	SC	–	1B	Colusa, Stanislaus, and Tehama Counties	Cismontane woodland and foothill valley grassland (±660 feet elevation)	Not observed during surveys	April–June
Ahart's paronychia[3] *Paronychia ahartii*	SC	–	1B	Butte, Shasta, and Tehama Counties	Well-drained rocky outcrops, often vernal pool edges, volcanic uplands (below 1,650 feet elevation)	Not observed during surveys	April–June
White-stemmed pondweed* *Potamogeton praelongus*	–	–	2	Lassen, Plumas, Shasta, and Sierra Counties; also in Washington and Oregon	Marshes and swamps with deep water (lakes) (5,900 to 9,800 feet elevation)	Not observed during surveys	July–August
Eel-grass pondweed *Potamogeton zosteriformis*	–	–	2	Contra Costa, Lake, Lassen, Modoc, and Shasta Counties; also in Washington and Oregon	Marshes and swamps (below 4,300 feet elevation)	Not observed during surveys	June–July
Sanford's arrowhead *Sagittaria sanfordii*	SC	–	1B	Butte, Del Norte, Fresno, Kern, Merced, Marin, Orange, Sacramento, Shasta, San Joaquin, Tehama, and Ventura Counties	Slow-moving water often within saltwater and freshwater marshes (above 990 feet elevation)	Not observed during surveys	May–August
Water bulrush *Scirpus subterminalis*	–	–	2	Butte, Plumas, Tehama, El Dorado, Del Norte, and Humboldt Counties; also in Oregon	Lake margins, ponds, and marshes (2,460 to 7,385 feet elevation)	Not observed during surveys	July–August
Marsh skullcap *Scutellaria galericulata*	–	–	2	Plumas, Placer, Nevada, El Dorado, and Shasta Counties	Wet meadows, marshes, and stream banks in montane conifer forest (3,275 to 6,895 feet elevation)	Not observed during surveys	June–September

Common Name *Scientific Name*	Legal Status[1] Federal	State	CNPS	Distribution	Habitat Association	Occurrence in Restoration Project area	Period of Identification[2]
Canyon Creek stonecrop *Sedum paradisum*	SC	–	1B	Shasta and Trinity Counties	Broad-leaved upland forest, chaparral, lower montane conifer forest, and subalpine conifer forest on granitic outcrops (980 to 4,600 feet elevation)	Not observed during surveys	May–June
Obtuse starwort[3] *Stellaria obtusa*	–	–	2	Butte, Glenn, Humboldt, and Tuolumne Counties; also in Idaho, Oregon, and Washington	Mesic areas in upper montane conifer forest (5,250 to 6,500 feet elevation)	Not observed during surveys	July
Western compion *Silene occidentalis* ssp. *longistipitata*	–	–	1B	Butte, Plumas, Shasta, and Tehama Counties	Chaparral and lower montane conifer forest (3,280 to 6,565 feet elevation)	Not observed during surveys	July–August
CNPS List 3 and 4 Plants							
Henderson's bent grass[3] *Agrostis hendersonii*	–	–	3	Butte, Calaveras, Merced, and Shasta Counties; also in Oregon	Valley and foothill grasslands and vernal pools (3,000 to 3,500 feet elevation)	Not observed during surveys	April–May
Sanborn's onion *Allium sanbornii* var. *sanbornii*	–	–	4	Butte, Calaveras, El Dorado, Nevada, Placer, Tehama, and Yuba Counties; also in Oregon	Gravelly areas on serpentinite substrates in chaparral, oak woodland, and lower montane coniferous forest (980 to 4,495 feet elevation)	Not observed during surveys	May–September
Depauperate milk-vetch[4] *Astragalus pauperculus*	–	–	4	Butte, Placer, Shasta, Tehama, and Yuba Counties	Open, vernally moist, volcanic clay soils in oak woodland and annual grassland (490 to 1,970 feet elevation)	27 occurrences documented at 6 Restoration Project sites	March–May
Marsh claytonia *Claytonia palustris*	–	–	4	Butte, Fresno, Plumas, Siskiyou, Tehama, and Tulare Counties	Montane marshes, meadows, springs, and stream banks (3,280 to 8,205 feet elevation)	Not observed during surveys	June–August
Hot rock daisy *Erigeron inornatus* var. *calidipetris*	–	–	4	Butte, Modoc, Plumas, Shasta, and Tehama Counties	Sandy, volcanic soils in lower montane conifer forest (3,600 to 4,600 feet elevation)	Not observed during surveys	June–September
Butte County fritillary[3] *Fritillaria eastwoodiae*	–	–	3[5]	Butte, Shasta, Tehama, and Yuba Counties	Chaparral, cismontane woodland, and lower montane conifer forest (1,640 to 4,900 feet elevation)	Not observed during surveys	March–May
Woolly meadowfoam[4] *Limnanthes floccosa* ssp. *floccose*	–	–	4	Butte, Lake, Shasta, Tehama, and Trinity Counties; also in Oregon	Vernal pools, moist meadows, and other seasonally wet habitats in oak woodland and valley and foothill annual grassland (33 to 1,320 feet elevation)	14 occurrences documented at 3 Restoration Project sites	March–June

Common Name *Scientific Name*	Legal Status[1] Federal	State	CNPS	Distribution	Habitat Association	Occurrence in Restoration Project area	Period of Identification[2]
Shield-bracted monkeyflower[4] *Mimulus glaucescens*	–	–	4	Butte, Colusa, Lake, and Tehama Counties	Seeps and other wet places in foothill woodland and foothill annual grassland (below 1,970 feet elevation)	19 occurrences documented at 4 Restoration Project sites	March–May
Bidwell's knotweed[4] *Polygonum bidwelliae*	–	–	4	Butte, Shasta, and Tehama Counties	Thin volcanic soils of openings in chaparral, oak woodland, and valley and foothill grasslands (195 to 3,940 feet elevation)	One occurrence documented in the Restoration Project	April–June
Pale yellow stonecrop *Sedum laxum* ssp. *flavidum*	–	–	4	Glenn, Humboldt, Shasta, Siskiyou, Tehama, and Trinity Counties	Serpentine or volcanic outcrops in broad-leaved upland forest, chaparral, cismontane woodland, and lower montane conifer forest (2,600 to 6,500 feet elevation)	Not observed during surveys	May–July

[1] Status explanation:

Federal

T = Listed as threatened under the Federal Endangered Species Act

SC = Species of concern; species for which existing information indicates it may warrant listing but for which substantial biological information to support a proposed rule is lacking

– = No listing

State

E = Listed as endangered under the California Endangered Species Act

– = No listing

CNPS

1B = List 1B species: rare, threatened, or endangered in California and elsewhere

2 = List 2 species: rare, threatened, or endangered in California but more common elsewhere

3 = List 3 species: plants about which more information is needed to determine their status

4 = List 4 species: plants of limited distribution

[2] Period of Identification refers to the expected flowering period for the species. This period is considered a guide for the best time to survey for the species.

[3] Species identified in the CNDDB search (DFG 2000)

[4] Species was located during spring and summer 2000 field surveys

[5] Fritillaria eastwoodiae was recently listed as a CNPS List 3 species because of taxonomic problems; however, it could possibly be relisted as a CNPS List 1B species.

Table 4.2-7. Special-Status Wildlife Documented or Identified as Potentially Occurring in the Restoration Project Area

Common Name *Scientific Name*	Legal Status[1] Federal	State, WBWG	Distribution	Habitat Association	Occurrence in the Restoration Project area
Insects					
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	FT, FS	–	Streamside habitats below 3,000 feet throughout the Central Valley	Riparian and oak savanna habitats with elderberry shrubs (the host plant)	Not observed during surveys; no CNDDB record
Amphibians					
California red-legged frog *Rana aurora draytonii*	FT	SSC	Along the coast and coastal mountain ranges of California from Marin to San Diego County and in the Sierra Nevada from Tehama to Fresno County	Permanent and semipermanent aquatic habitats, such as creeks and coldwater ponds, with emergent and submergent vegetation; may estivate in rodent burrows or cracks during dry periods	Not observed during surveys; no CNDDB record
Foothill yellow-legged frog *Rana boylii*	SC, FS	SSC	In the Klamath, Cascade, north Coast, south Coast, Transverse, and Sierra Nevada Ranges up to approximately 6,000 feet elevation	Creeks or rivers in woodlands or forests with rock and gravel substrate and low overhanging vegetation along the edge; usually found near riffles with rocks and sunny banks nearby	7 occurrences documented at 3 Restoration Project sites.
Cascades frog *Rana cascadae*	SC, FS	SSC	In the Shasta-Trinity region east to the Modoc Plateau and south to the Lassen area and the upper Feather River system	Seasonal and permanent ponds and streams; oviposition habitat is open, shallow water in unshaded areas	Not observed during surveys; no CNDDB record
Reptiles					
Northwestern pond turtle *Clemmys marmorata marmorata*	SC, FS	SSC	From the Oregon border of Del Norte and Siskiyou Counties south along the coast to San Francisco Bay, inland through the Sacramento Valley, and on the western slope of the Sierra Nevada	Occupies ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation in woodlands, grasslands, and open forests	1 occurrence documented in the Restoration Project area
Birds					
White-tailed kite *Elanus leucurus*	–	FP	Lowland areas west of the Sierra Nevada from the head of the Sacramento Valley south, including coastal valleys and foothills, to western San Diego County	Low foothills or valley areas with valley or live oaks, riparian areas, and marshes near open grasslands	Not observed during surveys; no CNDDB record

Common Name *Scientific Name*	Legal Status[1] Federal	State, WBWG	Distribution	Habitat Association	Occurrence in the Restoration Project area
Bald eagle *Haliaeetus leucocephalus*	FT	SE, FP	Nests in Siskiyou, Modoc, Trinity, Shasta, Lassen, Plumas, Butte, Tehama, Lake, and Mendocino Counties and in the Lake Tahoe Basin; reintroduced into central coast; winter range includes the rest of California, except the southeastern deserts, very high altitudes in the Sierra Nevada, and east of the Sierra Nevada south of Mono County	In western North America, nests and roosts in coniferous forests within one mile of a lake, reservoir, stream, or the ocean	2 occurrences documented at Restoration Project area
Osprey[2] *Pandion haliaetus*	–	SSC	Nests along the north coast from Marin to Del Norte County, east through the Klamath and Cascade Ranges, and in the upper Sacramento Valley; important inland breeding populations at Shasta Lake, Eagle Lake, and Lake Almanor, and small numbers elsewhere south through the Sierra Nevada; winters along the coast from San Mateo to San Diego County	Nests in snags, trees, or utility poles near the ocean, large lakes, or rivers with abundant fish populations	1 occurrence documented at Restoration Project area; several seen flying overhead.
Sharp-shinned hawk[2] *Accipiter striatus*	–	SSC	Permanent resident in the Sierra Nevada, Cascade, Klamath, and north Coast Ranges at mid-elevations and along the coast in Marin, San Francisco, San Mateo, Santa Cruz, and Monterey Counties; winters over the rest of the state except at very high elevations	Dense-canopy ponderosa pine or mixed conifer forest and riparian habitats	Observed during spring and fall migrations at various locations along access roads and Restoration Project sites.
Cooper's hawk[2] *Accipiter cooperii*	–	SSC	Throughout California except high altitudes in the Sierra Nevada; winters in the Central Valley, southeastern desert regions, and plains east of the Cascade Range	Nests in a wide variety of habitat types, from riparian woodlands and digger pine-oak woodlands through mixed conifer forests	1 occurrence documented at Restoration Project area
Northern goshawk *Accipiter gentilis*	SC, FS	SSC	Permanent resident in the Klamath and Cascade Ranges, in the north Coast Ranges from Del Norte to Mendocino County, and in the Sierra Nevada south to Kern County; winters in Modoc, Lassen, Mono, and northern Inyo Counties	Nests and roosts in older stands of red fir, Jeffrey pine, ponderosa pine, lodgepole pine, Douglas fir, and mixed conifer forests	Not observed during surveys; one CNDDB record
Golden eagle *Aquila chrysaetos*	–	SSC, FP	Foothills and mountains throughout California; uncommon non-breeding visitor to lowlands such as the Central Valley	Nest on cliffs and escarpments or in tall trees overlooking open country; forages in annual grasslands, chaparral, and oak woodlands with plentiful medium- and large-sized mammals	Several occurrences documented at Restoration Project area

Common Name *Scientific Name*	Legal Status[1] Federal	State, WBWG	Distribution	Habitat Association	Occurrence in the Restoration Project area
American peregrine falcon *Falco peregrinus anatum*	D-SC/FS	SE, FP	Permanent resident along the north and south Coast Ranges; may summer in the Cascade and Klamath Ranges and through the Sierra Nevada to Madera County; winters in the Central Valley south through the Transverse and Peninsular Ranges and the plains east of the Cascade Range	Nests and roosts on protected ledges of high cliffs, usually adjacent to lakes, rivers, or marshes that support large prey populations	One adult was observed circling high over the road at South Diversion Dam during raptor surveys; no CNDDB record
Prairie falcon *Falco mexicanus*		SSC	Permanent resident in the south Coast, Transverse, Peninsular, and northern Cascade Ranges, the southeastern deserts, Inyo-White Mountains, foothills surrounding the Central Valley, and in the Sierra Nevada in Modoc, Lassen, and Plumas Counties; winters in the Central Valley, along the coast from Santa Barbara to San Diego County, and in Marin, Sonoma, Humboldt, Del Norte, and Inyo Counties	Nests on cliffs or escarpments, usually overlooking dry, open terrain or uplands	Not observed during surveys; no CNDDB record
Western burrowing owl *Athene cunicularia hypugea*	SC	SSC	Lowlands throughout California, including the Central Valley, northeastern plateau, southeastern deserts, and coastal areas; rare along south coast	Level, open, dry, heavily grazed or low-stature grassland or desert vegetation with available burrows	Not observed during surveys; no CNDDB record
California spotted owl *Strix occidentalis occidentalis*	SC, FS	SSC	Sierra Nevada from Lassen County south to northern Kern County, and in the Transverse, Peninsular, and southern coastal mountains	Mature forest with suitable nesting trees; in southern California, occurs in oak and oak-conifer habitats in addition to mature conifer forest	Not observed during surveys; no CNDDB record
Long-eared owl *Asio otus*	–	SSC	Permanent resident east of the Cascade Range from Placer County north to the Oregon border, east of the Sierra Nevada from Alpine to Inyo County; scattered breeding populations along the coast and in southeastern California; winters throughout the Central Valley and southeastern California	Nests in abandoned crow, hawk, or magpie nests, usually in dense riparian stands of willows, cottonwoods, live oaks, or conifers	Not observed during surveys; no CNDDB record
Black swift *Cypseloides niger*	–	SSC	Breeds locally in the Sierra Nevada and Cascade Range, the San Gabriel, San Bernardino, and San Jacinto Mountains; and in coastal bluffs from San Mateo County south to near San Luis Obispo County	Nests in moist crevices or caves on sea cliffs above the surf or on cliffs behind or adjacent to waterfalls in deep canyons	Not observed during surveys; no CNDDB record
Vaux's swift *Chaetura vauxi*	–	SSC	Coastal belt from Del Norte County south to Santa Cruz County and in mid-elevation forests of the Sierra Nevada and Cascade Range	Nests in hollow, burned-out tree trunks in large conifers	1 occurrence documented at Restoration Project area

Common Name *Scientific Name*	Legal Status[1] Federal	State, WBWG	Distribution	Habitat Association	Occurrence in the Restoration Project area
Little willow flycatcher *Empidonax traillii brewsteri* (*E. t. adustus* could occur as a rare migrant)	SC, FS	SE	Summers along the western Sierra Nevada from El Dorado to Madera County, in the Cascade and northern Sierra Nevada in Trinity, Shasta, Tehama, Butte, and Plumas Counties, and along the eastern Sierra Nevada from Lassen to Inyo County	Riparian areas and large wet meadows with abundant willows; usually found in riparian habitats during migration	3 occurrences at 3 Restoration Project sites
Purple martin *Progne subis*	–	SSC	Coastal mountains south to San Luis Obispo County, west slope of the Sierra Nevada, and northern Sierra and Cascade Ranges; absent from the Central Valley except in Sacramento; isolated, local populations in southern California	Nests in abandoned woodpecker holes in oaks, cottonwoods, and other deciduous trees in a variety of wooded and riparian habitats; also nests in vertical drainage holes under elevated freeways and highway bridges	Not observed during surveys; no CNDDB record
Loggerhead shrike *Lanius ludovicianus*	SC	SSC	Resident and winter visitor in lowlands and foothills throughout California; rare on coastal slope north of Mendocino County, occurring only in winter	Prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches	Not observed during surveys; no CNDDB record
California yellow warbler *Dendroica petechia brewsteri*		SSC	Nests in all of California except the Central Valley, the Mojave Desert region, and high altitudes in the Sierra Nevada; winters along the Colorado River and in parts of Imperial and Riverside Counties	Nests in riparian areas dominated by willows, cottonwoods, sycamores, or alders or in mature chaparral; may also use oaks, conifers, and urban areas near stream courses	Not observed during surveys; no CNDDB record
Yellow-breasted chat *Icteria virens*	–	SSC	Nests locally in coastal mountains and Sierra Nevada foothills, east of the Cascades in northern California, along the Colorado River, and very locally inland in southern California	Nests in dense riparian habitats dominated by willows, alders, Oregon ash, tall weeds, blackberry vines, and grapevines	4 occurrences documented at Restoration Project sites
Mammals					
Spotted bat *Euderma maculatum*	SC	HP	Throughout California; mostly in foothills and mountains and desert regions of southern California	Found in arid deserts and grasslands through mixed conifer forests; roosts in rock crevices	Not observed during surveys; no CNDDB record
Western red bat *Lasiurus blossevillii*	–	HP	Scattered throughout California's lower elevations	Found in riparian and wooded habitats; day roosts in trees, within the foliage.	Not observed during surveys; no CNDDB record
Fringed myotis *Myotis thysanodes*	SC	HP	Throughout California, except the southeastern deserts and the Central Valley	Found in a wide variety of habitats from low desert scrub to high-elevation coniferous forests; day and night roosts in caves, mines, trees, buildings, and rock crevices	Not observed during surveys; no CNDDB record

Common Name *Scientific Name*	Legal Status[1] Federal	State, WBWG	Distribution	Habitat Association	Occurrence in the Restoration Project area
Long-eared myotis *Myotis evotis*	SC	–	Throughout California, except the southeastern deserts and the Central Valley	Occurs primarily in high-elevation coniferous forests, but also found in mixed hardwood/conifer, high desert, and humid coastal conifer habitats	Not observed during surveys; no CNDDB record
Small-footed myotis *Myotis ciliolabrum*	SC	–	Sierra Nevada; south Coast, Transverse, and Peninsular Ranges; and the Great Basin	Open stands in forests and woodlands, as well as shrublands and desert scrub; uses caves, crevices, trees, and abandoned buildings	Not observed during surveys; no CNDDB record
Long-legged myotis *Myotis volans*	SC	HP	Mountains throughout California, including ranges in the Mojave Desert	Most common in woodlands and forests above 4,000 feet, but occurs from sea level to 11,000 feet	Not observed during surveys; no CNDDB record
Yuma myotis *Myotis yumanensis*	SC	–	Common and widespread throughout most of California, except the Colorado and Mojave Deserts	Found in a wide variety of habitats from sea level to 11,000 feet, but uncommon above 8,000 feet; optimal habitat is open forests and woodlands near water bodies	Not observed during surveys; no CNDDB record
Pallid bat *Antrozous pallidus*	–	SSC, HP	Throughout California, primarily at lower elevations and mid-elevations	Occurs in a variety of habitats from desert to coniferous forest; most closely associated with oak, yellow pine, redwood, and giant sequoia habitats in northern California; relies heavily on trees for roosts	Not observed during surveys; no CNDDB record
Townsend's big-eared bat *Plecotus townsendii*	SC	SSC, HP	Throughout California, from low desert to mid-elevation montane habitats	Roosts in caves, tunnels, mines, and dark attics of abandoned buildings; buildings must offer cavelike spaces to be suitable; highly sensitive to disturbance at roost sites	Not observed during surveys; no CNDDB record
Sierra Nevada Mountain beaver *Aplodontia rufa*	–	SSC	Throughout the Klamath, Cascade, and Sierra Nevada mountains and the north Coast Ranges in Del Norte and Humboldt Counties; Sierra Nevada populations scattered and local	Slopes of ridges or gullies with abundant moisture, thick undergrowth, and soft soil for burrowing	Not observed during surveys; no CNDDB record
Ringtail *Basariscus astutas*	–	FP	Little information on distribution and abundance; apparently occurs throughout the state except for the southern Central Valley and the Modoc Plateau	Occurs primarily in riparian habitats, but also known to occur in most forest and shrub habitats from lower elevations to mid-elevations	1 occurrence observed near North Battle Creek Feeder (2002 surveys); no CNDDB record
Pacific fisher *Martes pennanti pacifica*	SC, FS	SSC	Coastal mountains from Del Norte to Sonoma County, east through the Cascades to Lassen County, and south in the Sierra Nevada to Kern County	Late-successional coniferous forests and montane riparian habitats	Not observed during surveys; no CNDDB record

Common Name *Scientific Name*	Legal Status[1] Federal	State, WBWG	Distribution	Habitat Association	Occurrence in the Restoration Project area
American badger *Taxidea taxus*	–	–	Statewide except for the northwestern corner in Del Norte County and parts of Humboldt and Siskiyou Counties	Typically found in open areas with scattered shrubs and trees; also found in open forests, particularly ponderosa pine	1 occurrence observed near the town of Manton (2002 surveys); no CNDDB record

[1] Status explanation:

Federal:	FE	=	Federally listed as endangered	State:	FP	=	State fully protected
	FS	=	U.S. Forest Service sensitive species		SE	=	State-listed as endangered
	FT	=	Federally listed as threatened		SSC	=	Species of special concern
	SC	=	Species of concern		ST	=	State-listed as threatened
	D	=	Delisted, monitor for 5 years		–	=	No listing
	–	=	No listing		HP	=	Western Bat Working Group (WBWG) High Priority

[2] This species is not considered to be a state species of special concern in the Draft List of California Bird Species of Special Concern (DFG and PRBO 2001). This list is currently under review by the DFG and Point Reyes Bird Observatory Advisory Committee.

Table 4.2-8. Elderberry Shrub Survey Results at the Restoration Project Sites, April 17, 2003

Shrub #	Stems 1–3 inches	Stems 3–5 inches	Stems >5 inches	Exit Holes Present
1	0	0	1	No
2	4	1	3	No
3	0	0	1	No
4*	0	0	1	No
5	5	3	0	No
6	2	0	0	No
7	1	2	0	No
8	0	1	0	No
9	3	4	0	No
10	3	0	1	No
11**	1	0	0	No
12	3	0	2	No
13	3	0	1	No
14	1	0	2	No
15, 16, 17***				
Total	**26**	**11**	**12**	

* Could not see base shrub; however, shrub appeared to have two large trunks coming from one base.

** Many small stems sprouting from larger dead shrub.

*** Three elderberry shrubs could not be surveyed because they were in the middle of large blackberry shrubs and could not be accessed.

4.3 Hydrology

Affected Environment

Battle Creek drains a watershed of approximately 357 square miles in the southern Cascade Range of the northern Central Valley and flows into the Sacramento River at RM 272, approximately 5 miles east of the town of Cottonwood, California. Battle Creek and its tributaries drain the western volcanic slopes of Mount Lassen, which is located at the eastern edge of the watershed. The large snowfields on this 10,000-foot peak maintain streamflow until late in the summer. The volcanic formations and alluvial stream channels buried by lava flows store most of the wet season rainfall and convey it to the streams and numerous springs as base flow.

Average annual rainfall is approximately 36 inches. The highest amounts of rainfall occur from December through March. There is very little rain from June to September. However, because streamflow is supplied by snowmelt and a large contribution from spring flow, Battle Creek has a relatively high base flow throughout the summer and fall. Representative wet, normal, and dry water years are indicated on Figure 4.3-1. The average flow in Battle Creek is approximately 500 cfs. Battle Creek flow remained above 200 cfs even in the dry year of 1994.

Battle Creek is composed of two main branches: North Fork Battle Creek and South Fork Battle Creek. North Fork Battle Creek, which is approximately 29.5 miles long from its headwaters to the confluence, drains a basin of approximately 213 square miles. South Fork Battle Creek, which is approximately 28 miles long from its headwaters to the confluence, drains a basin of approximately 124 square miles (Reclamation 2001a). The upper portion of North Fork Battle Creek and the upper portion of South Fork Battle Creek are inaccessible to anadromous salmon and steelhead because natural barriers impede fish migration (Figure 4.3-2).

The North Fork Battle Creek natural fish barrier is a waterfall located at North Fork Battle Creek RM 13.5, above the confluence of Rock Creek and Bailey Creek, and about 4 miles above North Fork Battle Creek Feeder Diversion Dam at NFBC RM 9.4. The watershed upstream of the natural fish barrier provides about 20% of the Battle Creek flow, but the majority is diverted at the Al Smith and Keswick Diversion Dams. Rock Creek and Bailey Creek provide a substantial flow at the North Battle Creek Feeder Diversion Dam, which is about 15% of the total Battle Creek flow.

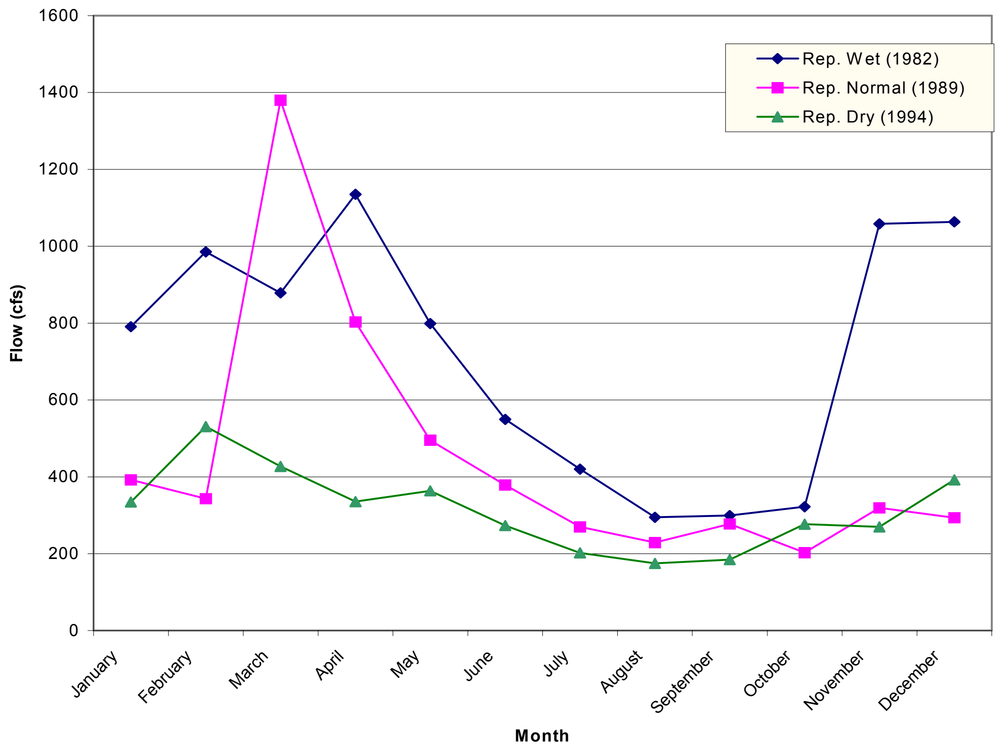


Figure 4.3-1
Representative Wet, Normal, and Dry Water Years

The South Fork Battle Creek absolute fish barrier is Angel Falls, located at South Fork Battle Creek RM 18.9, about 4.5 miles above the South Diversion Dam. The watershed upstream of Angel Falls provides about 15% of Battle Creek flow.

The mainstem valley reach of Battle Creek flows approximately 17 miles from the confluence of its forks to the Sacramento River. The Coleman National Fish Hatchery is located at Battle Creek RM 7.5. The U.S. Geological Survey Battle Creek flow gage is located just downstream of the hatchery.

Within the Eagle Canyon reach, North Fork Battle Creek receives significant spring flow from basalt formations. Figures 4.3-3 and 4.3-4 illustrate the spring flow entering North Fork Battle Creek at the Eagle Canyon Diversion Dam. The spring flow at Eagle Canyon Diversion Dam enters the Eagle Canyon Canal that runs along the southern canyon wall and contributes to the Inskip Powerhouse flow.

Figure 4.3-3
Spring Flow at Eagle Canyon Diversion Dam Flowing out of a Basalt Formation on the Southern Canyon Wall

Figure 4.3-4
Spring Flow Entering Eagle Canyon Canal at Eagle Canyon Diversion Dam, Looking Downstream

Soap Creek, which is entirely diverted by Soap Creek Feeder to South Canal, enters South Fork Battle Creek between South Diversion Dam and Inskip Diversion Dam. Ripley Creek, which is entirely diverted by Lower Ripley Creek Feeder to Inskip and South Canals, enters South Fork Battle Creek between Inskip Diversion Dam and Coleman Diversion Dam. Baldwin Creek, which is partially diverted by Asbury Diversion Dam to Coleman Canal, enters Battle Creek downstream of the confluence of North Fork and South Fork Battle Creek.

Battle Creek has the largest base flow or dry-season flow of any of the tributaries to the Sacramento River between the Feather River and Keswick Dam. The spring-fed nature of Battle Creek results in an average September flow of 255 cfs reaching the Sacramento River from the Battle Creek drainage area (USGS 1995).

Flow measurements have been performed at the Coleman National Fish Hatchery since 1940. The relative contributions of North Fork and South Fork Battle Creek were taken from DWR, PG&E, and Resource Management Inc. estimates published previously. Reclamation has approximated the flow in the upper reaches of the North and South Forks Battle Creek by using the square root of the ratio of the contributing watershed area to the entire watershed area of the corresponding creek (Reclamation 2001a). During heavy rainfall, local runoff may be higher than expected from the watershed fraction. However, during the base flow periods, the watershed fraction provides a good estimate of flow.

Based on recent stream gage records from two gages installed by DWR near the confluence of North Fork and South Fork Battle Creek, the South Fork Battle Creek drainage basin (124 square miles) is more likely to experience runoff from intense rainfall. Therefore, of the two forks, South Fork Battle Creek can experience larger peak flows. The North Fork Battle Creek drainage basin is larger (213 square miles) and includes more area at high elevations. North Fork Battle Creek receives a greater portion of its water from snowmelt and spring-fed streams and, therefore, exhibits less variability. Generally, during peak flows, South Fork Battle Creek may contribute more flow than North Fork Battle Creek, but during most of the remainder of the year, North Fork Battle Creek contributes a larger portion of the flow.

Hydraulic Gradients and Sediment Movement

The overall hydraulic gradient of North Fork Battle Creek is high (3%); the creek falls more than 5,000 feet in less than 40 miles. South Fork Battle Creek has a slightly lower gradient (2%) (Figure 4.3-5). Gradients upstream of Eagle Canyon Diversion Dam in North Fork Battle Creek and upstream of Inskip Diversion Dam in South Fork Battle Creek are similar to portions of Deer and Mill Creeks between 2,000 and 4,300 feet in elevation.

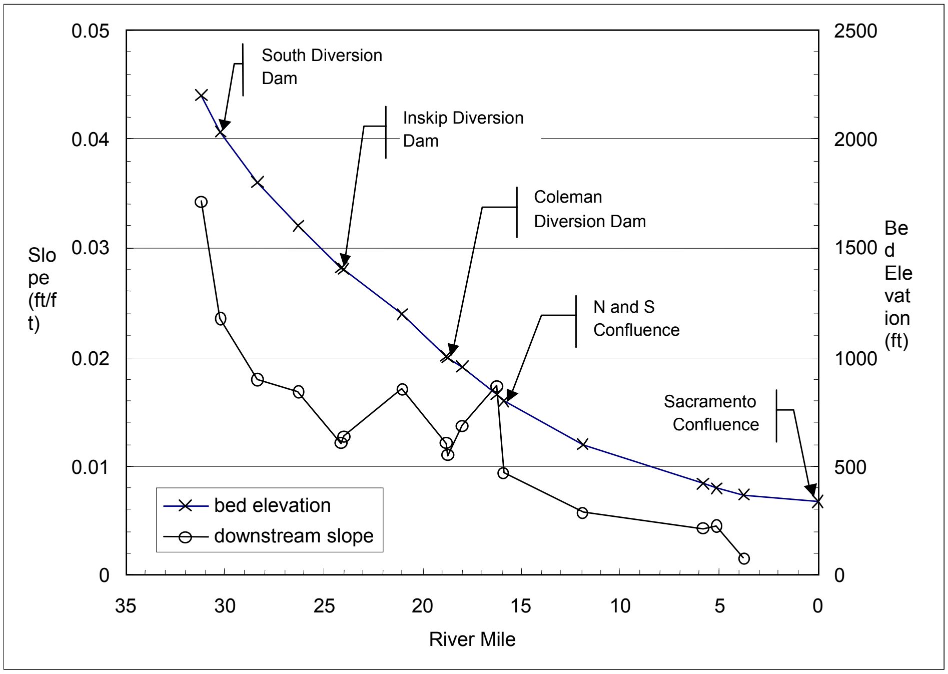
Throughout most of its length, Battle Creek is characterized by alternating pools and riffles with rocky cascades. The pools are deep, slow-moving stretches of river with fine bed material. The riffles are shallow, swiftly moving stretches of river with relatively coarse bed material. Only large cobbles are retained in the cascades.

Battle Creek has a large range of sediment sizes available for transport. These sediment sizes range from fine sand to large boulders, with the greatest portion in the gravel and cobble size ranges. Very little silt or clay is present in the bed of Battle Creek until near its confluence with the Sacramento River. Throughout the system, the many gravel bars hold a significant amount of sediment. These bars provide a reservoir of stored sediment that may be mobilized by high flows, resulting in downstream movement to another pool or riffle.

There are several different flow gradients along South Fork Battle Creek. These flow gradients are important because they may control the amount of sediment movement in the stream. A background study of sediment in Battle Creek was conducted by Reclamation (Reclamation 2001b). Because the gradient upstream of South Diversion Dam is steep (3%), South Fork Battle Creek can transport large material and has a large average bed material.

Between South and Inskip Diversion Dams, South Fork Battle Creek's slope gradually decreases, and the average bed material size decreases slightly. Near Inskip Diversion Dam, the average bed material size is approximately half the size of material upstream of South Diversion Dam. Downstream of Inskip Diversion Dam, the slope (averages 1.5%) continues to decrease. The stream then enters a relatively steep canyon where the slope is high. Near Coleman Diversion Dam, the canyon opens up and the slope flattens somewhat, such that the slope near the dam is similar to the slope at Inskip Diversion Dam (1%). Because of their similar slopes, the average bed material size near Coleman Diversion Dam is similar to that at Inskip Diversion Dam (Figure 4.3-6).

Downstream of the County Road Bridge to its confluence with North Fork Battle Creek, South Fork Battle Creek enters a canyon, and the slope increases again. After the confluence, the slope flattens substantially to about 0.5%. However, because of the contribution of flow from North Fork Battle Creek, the sediment-carrying capacity of mainstem Battle Creek probably does not decrease below the confluence. The stream travels through several miles of canyon, until the terrain opens up just upstream of Coleman Powerhouse. Downstream of the Coleman National Fish Hatchery, the slope is significantly flatter (0.2%), and the bed material becomes substantially finer.



Source: Bureau of Reclamation 2001b

Figure 4.3-6
Bed Profile of South Fork and Mainstem Battle Creek

Based on estimates developed by Reclamation, the sediment transported past Coleman Diversion Dam on South Fork Battle Creek is approximately 100,000 cubic yards per year. Of this load, approximately 8,000 cubic yards is gravel-sized or larger (Reclamation 2001b). The volume and maximum depth of trapped sediment behind Eagle Canyon, Wildcat, South, and Coleman Diversion Dams, assuming a trapezoidal channel with an average width equal to the present channel width, are presented in Table 4.3-1. Bed load material mobilized during high storm events is allowed to pass over the dams.

Table 4.3-1. Estimated Sediment Volume and Depth Behind Potentially Removed Dams

	Eagle Canyon Diversion Dam	Wildcat Diversion Dam	South Diversion Dam	Coleman Diversion Dam
Sediment volume behind dams (cubic yards)	3,200	5,000	30,000	28,000
Maximum depth of sediment (feet)	10	10	23	13

Hydroelectric Developments in Battle Creek

Battle Creek has been extensively developed for PG&E's Hydroelectric Project. The Hydroelectric Project consists of five powerhouses (Volta, Volta 2, South, Inskip, and Coleman), two small upstream storage reservoirs (North Battle Creek and Macumber), three forebays (Grace, Nora, and Coleman), five diversions on North Fork Battle Creek , including the North Battle Creek Feeder, Eagle Canyon, and Wildcat, three diversions on South Fork Battle Creek (South, Inskip, and Coleman), numerous tributary and spring diversions, and a network of some 20 canals, ditches, flumes, tunnels and pipelines (Figure 4.3-7).

Each of the eight diversion dams diverts a portion of the streamflow from North Fork and South Fork Battle Creek into canals leading to Hydroelectric Project facilities. These facilities use the diverted water for generating hydropower and then release it to Battle Creek. Some of the water is rediverted below South Powerhouse at Inskip Diversion Dam and below Inskip Powerhouse at Coleman Diversion Dam. In addition, a few tributaries to South Fork Battle Creek (Soap Creek and Ripley Creek) have small dams to divert flow into the canals leading to the South and Inskip Powerhouses, respectively. A full description of the Project hydroelectric facilities is provided in Chapter 2, "Purpose and Need, Project Description, and Project Background."

The range of streamflows at each Battle Creek diversion dam, the diversions for hydroelectric power, and remaining habitat flows below each diversion dam are evaluated with the monthly flow and power generation model (Appendix L) for the No Action Alternative and each restoration alternative.

Regulatory Setting

The following federal regulations apply to the Restoration Project.

Federal Flood Insurance Program

Congress, alarmed by increasing costs of disaster relief, passed the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The intent of these acts is to reduce the need for large publicly funded flood control structures and disaster relief by restricting development on the floodplain.

The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP) to provide subsidized flood insurance to communities that comply with FEMA regulations that limit development in floodplain. FEMA issues Flood Insurance Rate Maps (FIRMs) for communities participating in the NFIP. These maps delineate flood hazard zones in the community.

Executive Order 11988

Executive Order 11988 (Floodplain Management) addresses floodplain issues related to public safety, conservation, and economics. It generally requires federal agencies constructing, permitting, or funding projects within floodplains to:

1. avoid incompatible floodplain development,
2. be consistent with the standards and criteria of NFIP, and
3. restore and preserve the natural and beneficial floodplain values.

Environmental Consequences

Summary

All of the action alternatives include activities that could impact the Battle Creek streamflow by changing the pattern of diversions and providing higher streamflow below the diversion dams. Dam removals would have the greatest potential to impact streamflow because the diversions at these removed dams would cease. These changes in streamflow are considered to be potential impacts only in the context of fish habitat and are indirectly evaluated in the fish impact assessment (Section 4.1, “Fish”). Because the minimum required flows established by FERC as part of the Hydroelectric Project regulations would increase under each alternative, the actual changes in streamflow are considered less than significant because they may approach more natural flow conditions but would not increase the risk, duration, or frequency of flooding.

Dam removal may also impact the downstream movement of sediment now trapped behind the dams. However, the bulk of the sediment behind the dams would be gradually redistributed downstream during high flow events from winter storms. Within 2–3 years after dam removal, high winter flows are expected to provide sufficient energy to redistribute most of these sediments to downstream reaches. During this time, this redistribution of trapped sediment could lead to temporary increases in the amount of fine sediments deposited in downstream pools. These temporary sediment impacts are expected to be minor and less than significant, with little long-term effect on streambed elevations, gradation, or composition. Reclamation would mitigate for some of these potential impacts by constructing pilot channels to facilitate the downstream redistribution of sediment now trapped behind dams. Monitoring of postremoval sediment would be conducted, and sediment reworking would be used, if necessary, to assist in the restoration of an equilibrium sediment transport condition that would be achieved largely through the natural redistribution of these materials during high-flow events.

Impact Significance Criteria

For this analysis, the impact significance criteria were taken from section 15065 and Appendix G of the CEQA guidelines. Hydrology or sediment impacts for the Restoration Project would be significant if implementation would:

- substantially alter the existing drainage pattern of the site or area, including alteration of the bed elevation or the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in on-site or off-site flooding, or
- expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam.

Impact Assessment

As applicable, the General Environmental Protection Measures listed in the introduction to this chapter will be used for this resource. In addition, specific mitigation measures for this resource are identified below.

No Action Alternative

The No Action Alternative would not affect hydrology. Under the No Action Alternative, the Hydroelectric Project would continue to operate consistent with its current FERC license. The instream flow releases would be the license-required minimum flows below dams (i.e., 3 cfs in North Fork Battle Creek and 5 cfs in South Fork Battle Creek). The actual release flows are often set at 2 cfs above the FERC requirements to ensure compliance with the minimum flows. No hydrology impacts would occur under this alternative.

Five Dam Removal Alternative (Proposed Action)

Impact 4.3-1 Less than Significant—In-water construction could result in short-term disruption of streambed and flows.

Implementation of the Five Dam Removal Alternative would result in short-term, localized disruption to the hydraulics near the sites where in-water construction affects the bed and banks of Battle Creek. However, these localized impacts would be mitigated by Reclamation during construction as described in the General Environmental Protection Measures, and all natural hydrologic processes would return to their normal dynamic equilibrium within 1 year. This impact is considered less than significant.

Impact 4.3-2 Beneficial—Coleman Diversion Dam removal could reduce the 10-, 25-, and 50-year floodwater surface profiles at Inskip Powerhouse.
Hydraulic analyses conducted by Reclamation (Reclamation 2001a) for the removal of Coleman Diversion Dam indicate that the dam removal would reduce floodwater surface profiles at Inskip Powerhouse by approximately 6.2, 5.4, and 4.9 feet for the 10-, 25-, and 100-year floods, respectively. This impact is beneficial because it would reduce the exposure of Inskip Powerhouse structures to a significant risk of damage from flooding.

No Dam Removal Alternative

Impact 4.3-3 Less than Significant—In-water construction could result in short-term disruption of streambed and flows.
Implementation of the No Dam Removal Alternative would result in short-term, localized disruption to the hydraulics near the sites where in-water construction affects the bed and banks of Battle Creek. However, these localized impacts would be mitigated by Reclamation during construction as described in the General Environmental Protection Measures, and all natural hydrologic processes would return to their normal dynamic equilibrium within one year. This impact is considered less than significant.

Six Dam Removal Alternative

Implementation of the Six Dam Removal Alternative would result in similar impacts on hydrology as those identified for the Five Dam Removal Alternative. An additional impact associated with the removal of Eagle Canyon Dam is addressed below.

Impact 4.3-4 Less than Significant—Removal of Eagle Canyon Diversion Dam could result in minor increases to downstream bed elevations.
The amount of sediment stored behind Eagle Canyon Diversion Dam is estimated to be 3,200 cubic yards. Because this amount is relatively small, releasing sediment from behind the dam would result in only minor impacts. To limit the effect of the high concentrations of fine material, the removals of Eagle Canyon and Coleman Diversion Dams should be separated by at least 2 months. If the removals were scheduled for the same time, high concentrations of fine material may exist in both North Fork Battle Creek and South Fork Battle Creek simultaneously. If the removals were separated, clean water from one fork would dilute the high concentrations of fine material coming from the fork on which the dam was removed.

As part of the Six Dam Removal Alternative, Reclamation will construct a pilot channel through the sediments behind the dam. The pilot channel would facilitate the distribution of sediments by natural high-flow events and ensure that the mass of sediment does not impede fish passage, should low flows predominate after dam removal. Under low-flow conditions, the pilot channel geometry would provide a sufficient depth of water and keep flow velocities low enough to support fish passage. Under typical winter flow conditions, sediments would quickly begin to erode and distribute downstream. This impact is considered less than significant.

Impact 4.3-5 Less than Significant—In-water construction could result in short-term disruption of streambed and flows.
This impact is the same as Impact 4.3-1 described above for the Five Dam Removal Alternative and is considered less than significant.

Impact 4.3-6 Beneficial—Coleman Diversion Dam removal could reduce the 10-, 25-, and 50-year floodwater surface profiles at Inskip Powerhouse.
This beneficial impact is the same as Impact 4.3-2 described above for the Five Dam Removal Alternative.

Three Dam Removal Alternative

Implementation of the Three Dam Removal Alternative would result in similar impacts on hydrology as those identified for the Five Dam Removal Alternative.

Impact 4.3-7 Less than Significant—In-water construction could result in short-term disruption of streambed and flows.
This impact is the same as Impact 4.3-1 described above for the Five Dam Removal Alternative and is considered less than significant.

Impact 4.3-8 Beneficial—Coleman Diversion Dam removal could reduce the 10-, 25-, and 50-year floodwater surface profiles at Inskip Powerhouse.
This beneficial impact is similar to Impact 4.3-2 described above for the Five Dam Removal Alternative.

Cumulative Impacts

Cumulative impacts resulting from changes in flow or sediment movements in Battle Creek are not anticipated by implementing the Restoration Project and other related projects (including those mentioned in Chapter 6) in the vicinity of the project area. No other projects that could modify Battle Creek hydrology are proposed.

Downstream of the Restoration Project area, several modifications are proposed for the Coleman National Fish Hatchery, including the screening of the hatchery's water intakes and modifying the hatchery's barrier weir and upstream fish ladder. These projects would not result in a change to hydraulic conditions in Battle Creek.

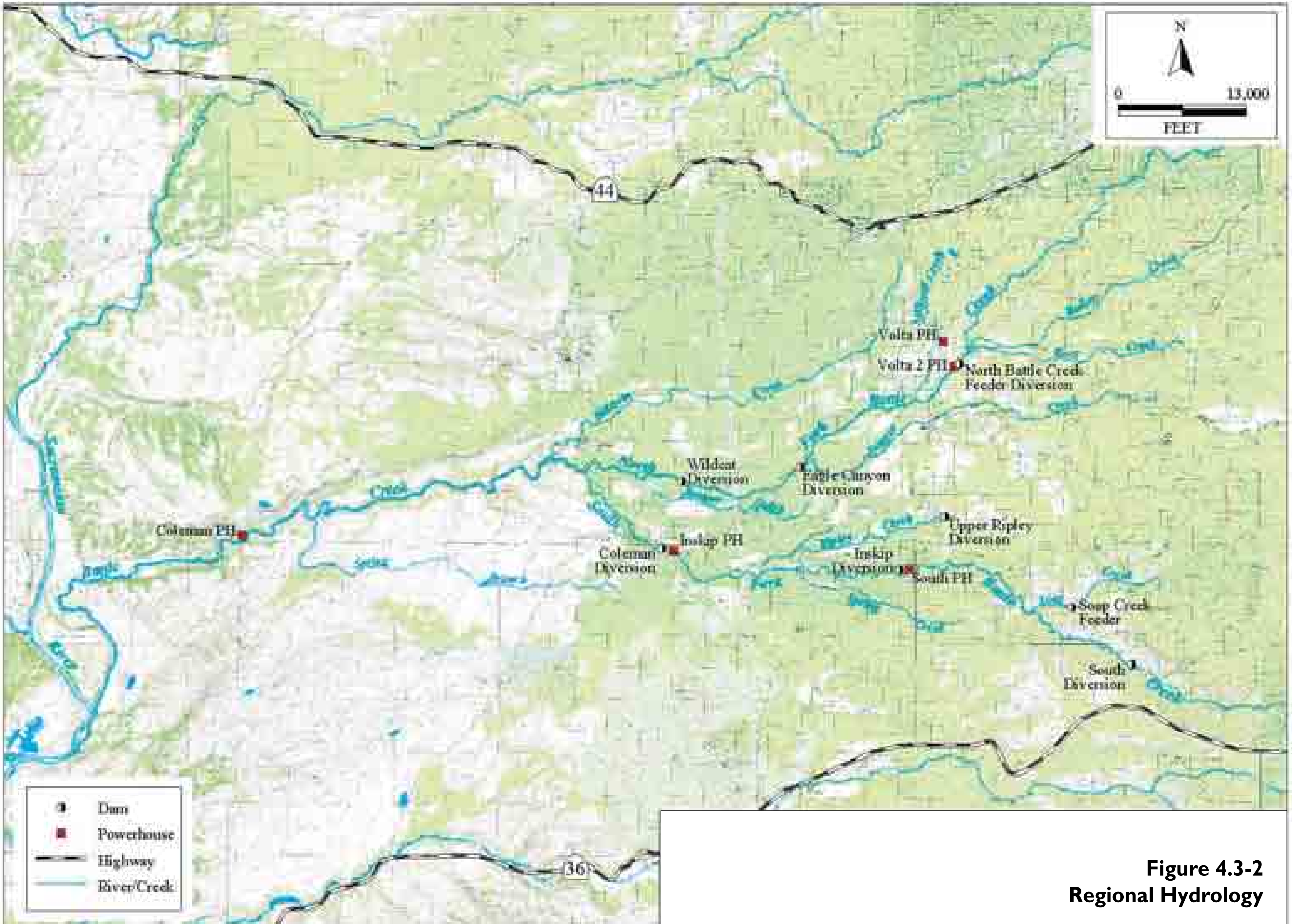


Figure 4.3-2
Regional Hydrology

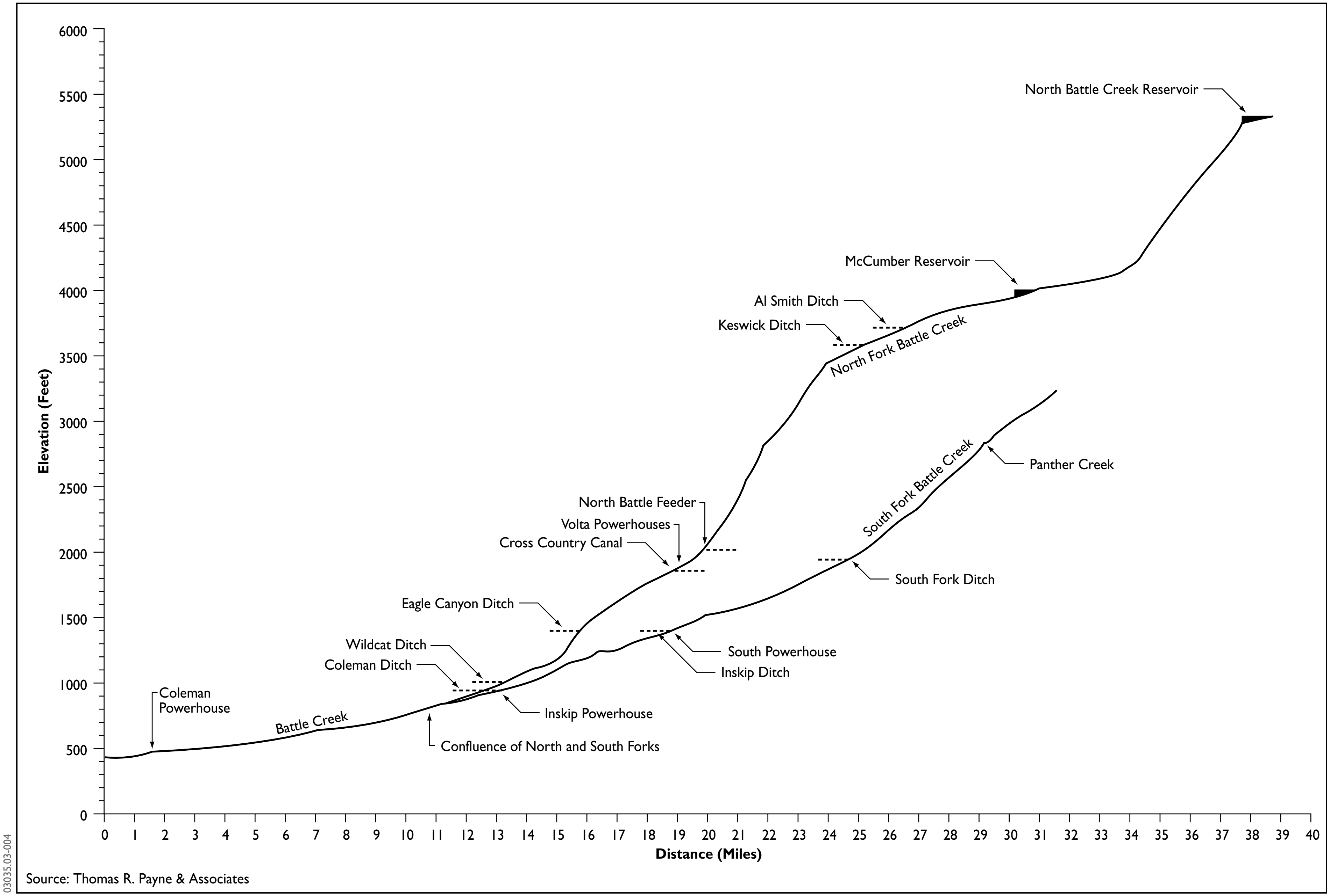
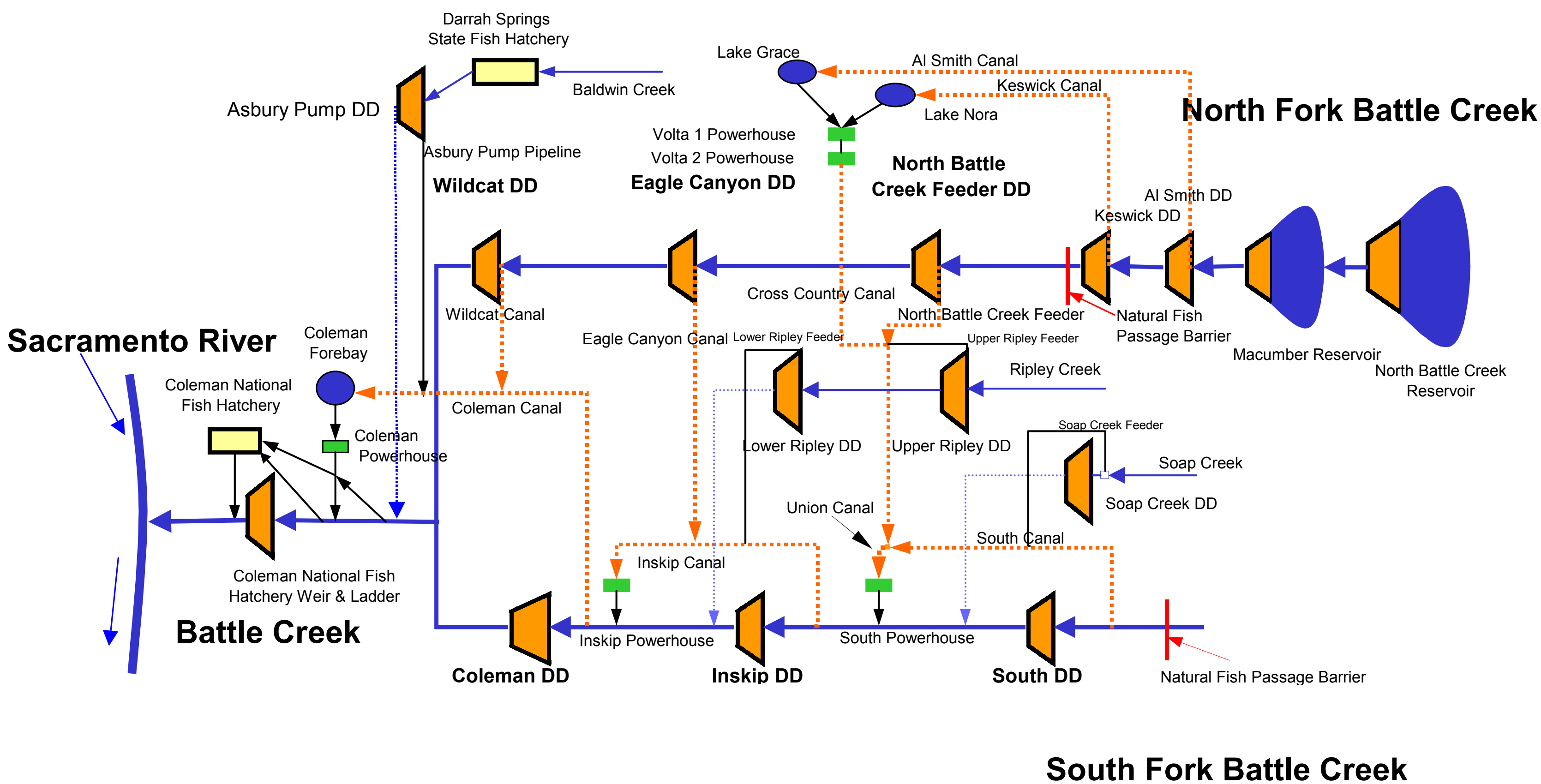


Figure 4.3-5
Longitudinal and Elevation View of the Battle Creek System



DD = diversion dam

Figure 4.3-7
Battle Creek Hydroelectric Project Flow Routing

4.4 Water Quality

Affected Environment

Battle Creek, a perennial spring-fed, cold-water stream, drains the western flank of Mount Lassen and enters the Sacramento River from the east approximately 5 miles east of the town of Cottonwood, California. Battle Creek is composed of two main branches, North Fork Battle Creek (approximately 29.5 miles in length from its headwaters to confluence) and South Fork Battle Creek (approximately 28 miles in length from its headwaters to confluence). The two forks join approximately 17 miles east of Battle Creek's confluence with the Sacramento River.

Cold Bluff Springs Enters South Fork Battle Creek and Improves Water Temperatures

Battle Creek is the largest spring-fed tributary to the Sacramento River between Keswick Dam and the Feather River, with a median September flow of 250 cfs. The average flow is 500 cfs. Flows typically remain higher throughout the winter and spring and decrease to about one-half that amount in the summer and fall. Battle Creek flows through remote, deep, shaded canyons and riparian corridors with little development near its banks. Numerous spring flows enter Battle Creek (primarily, North Fork Battle Creek) from the canyon walls along the watercourse, adding significant inflow at a fairly constant rate with a relatively cool temperature. Thick vegetation, rough terrain, and private ownership limit human access. Native vegetation and the land's limited suitability for agriculture, timber harvesting, and urban development protect Battle Creek's watershed from erosion. The watershed is comparatively undisturbed.

Water temperature and turbidity are two water quality factors that are important to chinook salmon and steelhead and that could potentially be affected by Hydroelectric Project operations.

Temperature

Elevated water temperature is often considered the most important water quality factor limiting habitat productivity for fish. The sensitivity and specific effects of elevated water temperatures vary with the life stage of chinook salmon and steelhead (Appendix D).

Several factors influence water temperature in Battle Creek, including air temperature, streamflow, and riparian vegetation. The upstream reaches are naturally cooler because of the lower ambient air temperature. North Fork Battle Creek flows through a steep canyon, which helps shade the water. Numerous springs continually feed cold water into Battle Creek. South Fork Battle Creek is fed by fewer springs and is exposed to more direct sunshine as it flows through a less confined (i.e., less shaded) valley. Therefore, the reaches of South Fork Battle Creek are generally warmer than the North Fork Battle Creek reaches.

The operations of Hydroelectric Project facilities also influence water temperature in Battle Creek. Diversions to these facilities reduce the streamflow, causing the water remaining in the creek to warm more rapidly as it moves downstream. Discharges from South Powerhouse and Inskip Powerhouse cool South Fork Battle Creek water substantially, producing two cool zones in South Fork Battle Creek located below Inskip Diversion Dam and below Coleman Diversion Dam.

A temperature model was developed and verified for the Battle Creek system (PG&E 2001). For calibration, the USFWS stream network temperature model (SNTEMP) was run with daily meteorology and flow data for the summer period of 1999 for each of the seven reaches simulated. Along North Fork Battle Creek these reaches included below North Battle Creek Feeder Diversion Dam, below Eagle Canyon Diversion Dam, and below Wildcat Diversion Dam. Along South Fork Battle Creek these reaches included below South Diversion Dam, below Inskip Diversion Dam, and below Coleman Diversion Dam. The seventh reach was along the mainstem between the confluence of North Fork and South Fork Battle Creek and Coleman Powerhouse. The model simulated average monthly temperature profiles in each reach for baseline conditions, No Action Alternative, and each of the Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal). However, since the SNTEMP model requires many data files and operates as a separate modeling system, a simplified, yet accurate, temperature prediction method was developed for the monthly fish production model (Appendix M).

Sediment

Excessive sediment can increase turbidity and reduce light penetration, resulting in the reduction in prey capture for sight-feeding predators, reduction in light available for photosynthesis, clogging of gills and filter mechanisms of fish and aquatic invertebrates, reduction in spawning and juvenile fish survival, smothering of bottom-dwelling organisms, changes in substrate composition, and reduction in aesthetic values. Concentrations of nutrients and other pollutants (such as metals and certain pesticides) associated with sediment particles could also increase. Although these effects are usually short-term and greatly diminish after revegetation, sediment and sediment-borne pollutants may be remobilized under suitable hydrologic and hydraulic conditions.

Historical Water Quality Data

Historical water quality (minerals and nutrients) data were obtained for the following Battle Creek locations:

- Below the Coleman National Fish Hatchery from the U.S. Geological Survey (USGS) (1961–1970), EPA (1971–1972), and DWR (1988–1989) (Tables N-1 through N-3 in Appendix N, respectively).
- Below Coleman Powerhouse from the EPA (1971–1972) and the SWRCB (1955–1989) (Tables N-4 and N-5 in Appendix N, respectively).
- Near Coleman Powerhouse from the EPA (1971–1972) (Table N-6 in Appendix N).
- South Fork Battle Creek below the diversion to Coleman Canal from the SWRCB (1960–1982) (Table N-7 in Appendix N).
- North Fork Battle Creek below Volta 2 Powerhouse from the SWRCB (1977–1982) (Table N-8 in Appendix N).
- Battle Creek approximately 300 ft downstream from Jelly's Ferry Road Bridge from DWR (1996–1998).
- North Fork Battle Creek at Wildcat Road from Larry Walker Associates (2001–2002).
- South Fork Battle Creek at Manton Road from Larry Walker Associates (2001–2002).
- Battle Creek below Coleman National Fish Hatchery from Larry Walker Associates (2001–2002).

These data sources represent all available data. The data were collected intermittently and only represent a snapshot of what was actually occurring. Table 4.4-1 presents a summary of the information found in Appendix N, Tables N-1 through N-8. The data for 1955–1989 indicate that the existing surface water quality is excellent. All concentrations of nonmetals and metals were within the limits recommended for aquatic life by the EPA's aquatic life criteria (EPA 1999). Water quality in Battle Creek is influenced by seasonal changes in flow (i.e., runoff vs. baseflow), precipitation inputs, and biological activity. Flow variation has especially strong effects on metal and nonmetal ion concentrations. On October 6, 1999, Reclamation personnel sampled the water quality and sediment in the Battle Creek watershed one time while Battle Creek was at low flow (Table 4.4-2).

Unfiltered water samples were collected at eight sites in the Battle Creek watershed and assayed for metals, TSS, and oil and grease. The assay results were compared to the EPA's aquatic life criteria (EPA 1999). At each site, pH, specific conductance, turbidity, temperature, and dissolved oxygen were measured. All of the constituents were within the recommended limits for aquatic life. The TSS concentration was also within the recommended limits for aquatic life. The oil and grease concentration was less than 5 milligrams per liter at each site. The concentrations of nonmetals are presented in Table 4.4-2. The surface waters in the Battle Creek watershed have low hardness and alkalinity, which are important for determining the toxicity of several heavy metals (cadmium, chromium, copper, lead, nickel, silver, and zinc). The concentrations of these metals were all below the toxicity limits for aquatic life.

Sediment Data

Reclamation also collected composite sediment samples at Wildcat, South, Coleman, Soap Creek Feeder, and Lower Ripley Creek Feeder diversion dams on October 6, 1999. Little organic material or fine sediment was found at the dams or in their catch basins, except at Lower Ripley Creek Feeder. It is believed that most of the fine sediment that is washed into the creek annually is carried through the watershed and past the dams by high seasonal runoff. Debris in the creek consisted of dead trees, boulders, and sand. The sediments were visually characterized as small rocks, sand, and some silt; organic material was less commonly found. The concentrations of metals in the sediment are presented in Table 4.4-3. Total threshold limit concentration criteria[1] based on wet weight are listed in Table 4.4-3. The metal values for each of the five sediment samples are less than 1% of the criteria. None of the sediments sampled behind the five dams on October 6, 1999, were found to be toxic for aquatic life. The sediment samples were also assayed for polychlorinated biphenyls. None of the aroclors were detected at the reporting limit of 0.033 milligrams per kilogram in any of the sediment samples.

[1] The total threshold limit concentration criteria are described in Title 22, Part 66261.24 of the California Code of Regulations and specify element concentrations in sediment that are classified as potentially toxic.

Table 4.4-2. Water Quality Data for Battle Creek on October 6, 1999

Constituent	Upstream of North Battle Creek Feeder Dam	Confluence of North Fork and South Fork Battle Creek	Coleman Diversion Dam	South Diver-sion Dam	Soap Creek	Inskip Diver-sion Dam	Eagle Canyon	Soap Creek Diver-sion Dam
Temperature, °F	52.0	56.6	54.8	51.3	49.5	53.8	53.4	50.2
Turbidity, NTU	4	3	4	2	29	18	3	7
Electrical conductivity, : mho/cm	137	128	125	108	58	121	137	74
Total suspended solids, mg/L	<3	<3	10	<3	<3	<3	<3	
Dissolved oxygen	10.4	10.2	10.0	10.3	10.4	10.8	11.0	10.3
pH	6.94	7.73	8.07	7.97	8.14	7 .71	7.99	8.14
Total alkalinity, mg/L					30			
Carbonate, mg/L					<10			
Hydroxide, mg/L					<10			
Bicarbonate, mg/L					30			
Calcium, mg/L	11.3	9.5	9.7	9.8	2.7	9.3	10.4	
Magnesium, mg/L	7.0	6.1	5.9	4.3	1.5	5.6	7.5	
Sodium, mg/L	6.4	6.6	6.5	4.2	4.3	6.3	7.1	
Potassium, mg/L	2.5	2.4	2.5	1.8	3.5	2.3	2.5	
Chloride, mg/L					<1			
Sulfate, mg/L					<0.5			
Phosphorus, mg/L	0.044*	0.037*	0.054*	<0.050	0.035*	0.041*	0.046*	
Oil & grease, mg/L	<5	<5	<5	<5	<5	<5	<5	
Aluminum, : g/L	50	68	400	<50	690	83	64	
Antimony, : g/L	<2	<2	<2	<2	<2	<2	<2	
Arsenic, : g/L	<2	<2	<2	<2	<2	<2	<2	
Barium, : g/L	9.5	12.0	16.0	8.3	70.0	12.0	10.0	
Beryllium, : g/L	<1	<1	<1	<1	<1	<1	<1	
Boron, : g/L	24*	37*	38*	<50	11*	43*	33*	
Cadmium, : g/L	<1	<1	<1	<1	<1	<1	<1	
Chromium, : g/L	2.80	1.60*	2.30	1.30*	0.74*	2.00	1.50*	

Constituent	Upstream of North Battle Creek Feeder Dam	Confluence of North Fork and South Fork Battle Creek	Coleman Diversion Dam	South Diver-sion Dam	Soap Creek	Inskip Diver-sion Dam	Eagle Canyon	Soap Creek Diver-sion Dam
Cobalt, : g/L	<1	<1	<1	<1	<1	<1	<1	
Copper, : g/L	0.74*	1.4*	1.5*	1.2*	1.6*	0.63*	0.62*	
Iron, : g/L	42*	65*	420**	<50	120	83	38	
Lithium, : g/L	3.4*	3.9*	3.7*	1.1*	5.0	4.5*	4.2*	
Lead, : g/L	<1	<1	0.20	<1	0.37*	<1	<1	
Manganese, : g/L	5.4	6.5	21.0	1.0	1.1	5.3	3.2	
Mercury, : g/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Molybdenum, : g/L	<1	<1	<1	<1	<1	0.43*	0.59*	
Nickel, : g/L	0.86*	<2.00	0.46*	<2.00	<2.00	<2.00	<2.00	
Selenium, : g/L	<2	<2	<2	<2	<2	<2	<2	
Strontium : g/L	89	66	69	77	25	66	73	
Silver, : g/L	<1	<1	<1	<1	<1	<1	<1	
Titanium, : g/L	3.3	4.4	22.0**	1.6*	16.0	5.4	3.9	
Tin, : g/L	<10	<10	<10	<10	<10	<10	<10	
Thallium, : g/L	<1	<1	<1	<1	<1	<1	<1	
Vanadium, : g/L	5.9*	5.3*	7.3*	3.4*	<10	5.6*	6.3*	
Uranium, : g/L	<5	<5	<5	<5	<5	<5	<5	
Zinc, : g/L	17.0	8.4	16.0	5.2	6.1	34.0	14.0	

Source: Bureau of Reclamation 1999, unpublished data

°F = degrees Fahrenheit; NTU = nephelometric turbidity units; : mhos/cm = micromhos per centimeter; mg/L = milligrams per liter; : g/L = micrograms per liter.

* Estimated result. Result is less than reporting limit.

** Preliminary results pending.

Table 4.4-3. Sediment (Total Digestion) Data for Restoration Project on October 6, 1999 (wet weight, milligram per kilogram)

Constituent	Wildcat Diversion Dam	Coleman Diversion Dam	South Diversion Dam	Soap Creek Diversion Dam	Ripley Diversion Dam	Earth's Crust	Total Threshold Limit Concentration
Calcium	1,250	2,420	2,080	418	1,480	41,500	*
Magnesium	2,870	3,130	3,480	488	1,080	23,300	*
Sodium	236	522	456	99	109	23,600	*
Potassium	208	2254	180	164	214	20,900	*
Phosphorus	128	175	210	45	127	1,050	*
Aluminum	9,190	11,500	8,420	3,760	10,200	83,200	*
Antimony	<0.20	<0.20	<0.20	<0.20	<0.20	0.2	500
Arsenic	1.0	1.1	0.38	0.70	0.54	1.80	500
Barium	43.2	36.3	26.9	24.6	48.4	4,250	10,000
Beryllium	0.22	0.18	0.12	0.16	0.22	2.8	75
Boron	<5.0	<5.0	<5.0	<5.0	<5.0	10	*
Cadmium	<0.10	<0.10	<0.10	<0.10	<0.10	<2	100
Chromium	11.5	13.9	4.7	1.2	21.9	100	2,500
Cobalt	5.0	5.3	3.8	1.0	7.3	25	8,000
Copper	7.4	10.6	8.0	2.3	8.0	55	2,500
Iron	9,150	15,500	7,140	2,490	8,070	56,300	*
Lithium	6.9	5.5	3.5	2.8	5.7	20	*
Lead	2.2	1.7	1.3	1.9	3.1	12.5	1,000
Manganese	147.0	82.6	108.0	46.4	294.0	9,500	3,500
Mercury	<0.04	<0.04	<0.04	<0.04	<0.04	0.08	2,000
Molybdenum	0.13	0.14	0.15	0.18	<0.1	1.5	20
Nickel	17.7	16.6	14.9	1.8	14.2	75	100
Selenium	<0.20	<0.20	<0.20	<0.20	0.071	0.05	*
Strontium	13.1	24.1	22.0	3.3	18.5	375	500
Silver	<0.10	<0.10	<0.10	<0.10	<0.10	0.07	*
Titanium	413	487	380	115	455	5,700	*
Tin	<1.0	<1.0	<1.0	<1.0	<1.0	2	*
Thallium	<0.10	<0.10	<0.10	<0.10	<0.10	0.45	700
Vanadium	33.2	51.1	30.4	7.9	30.4	135	2,400
Uranium	<0.5	<0.5	<0.5	<0.5	<0.5	2.7	*

Zinc	15.2	15.8	11.9	5.6	14.8	70	5,000
% Moisture	38.9	25.2	22.0	25.6	72.6	*	*
Wet Total	23,748.75	34,252.92	22,582.05	7,678.54	22,089.13	*	*
Dry Total	38,869	41,793	28,957	10,665	80,616	270,189	*
Aroclor 1016	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	**
Aroclor 1221	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	**
Aroclor 1232	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	**
Aroclor 1242	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	**
Aroclor 1248	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	**
Aroclor 1254	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	**
Aroclor 1260	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	**

Source: Bureau of Reclamation 1999, unpublished data
* No value.
** Total polychlorinated biphenyl value is 50 milligrams per kilogram.

Regulatory Setting

The following laws, regulations, or policies are related to water quality management in the stream reaches influenced by the operation of the Hydroelectric Project diversions and canals. Additional descriptions of these are found in Chapter 5, "Consultation and Coordination."

- Federal Clean Water Act (33 USC 1251-1376) as administered by the SWRCB and the CVRWQCB. The SWRCB will issue a Clean Water Act Section 401 permit (with technical conditions) for wetland and instream activities. The CVRWQCB will monitor compliance with the NPDES General Permit for Storm Water Discharges Associated with Construction Activities (General Permit). Reclamation and/or the construction contractor will develop and implement SWPPPs as a condition of the General Permit. The CVRWQCB will also require compliance under the General Order for Dewatering and other Low Threat Discharges to Surface Waters.
- Porter-Cologne Water Quality Control Act (California Water Code §13000 *et seq.*), as it governs the Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region (Basin Plan) CVRWQCB 1998).

Environmental Consequences

Summary

Water quality in the area surrounding and including the Restoration Project is generally managed in accordance with the Basin Plan (CVRWQCB 1998). The Basin Plan designates beneficial uses for the Sacramento River basin, which includes Battle Creek. Those designated uses potentially impacted by the Restoration Project include municipal, agricultural, hydroelectric, and cold-water habitat. Certain water quality conditions are needed to support these beneficial uses. Because the water quality objectives are most stringent for cold-water habitat uses for spawning and production of fish, implementation of the Restoration Project in a manner that protects this use should protect all other uses. Temperature effects are the most likely water quality changes that may impact cold-water habitat. However, no direct assessment of impacts from temperature changes was performed, because these impacts on cold-water habitat and fish production were addressed under the fish impact analysis. Specific ways in which water quality changes may impact the spawning and rearing of cold-water fish are discussed in Section 4.1, "Fish."

The discharge of coarse sediment from behind the dams during their removal, as proposed under the Five Dam, Six Dam, and Three Dam Removal Alternatives, may result in less-than-significant impacts to water quality. The bulk of the alluvial material behind the dams would be discharged during high flow events, such as major winter storms. These storms provide sufficient energy to transport sediment over spawning areas rather than allow the sediment to form harmful deposits on top of the stream bottom. Synchronizing downstream transport of the alluvial materials with major storm events would be accomplished by excavating a low-flow or pilot channel.

Construction activities associated with the Action Alternatives could have a limited impact on the beneficial uses of Battle Creek's water. Project construction of the Action Alternatives could result in inadvertent spills of hazardous materials used in standard construction practices. Reclamation will implement mitigation measures to reduce potential impacts to a less-than-significant level. Removal of the Coleman Diversion Dam could cause less-than-significant impacts associated with short-term increased turbidity and settleable material load on the Coleman National Fish Hatchery water treatment plant.

Operation-related impacts would produce significant improvements to the water temperature regime for spawning and production of cold-water fish. These improvements would be achieved by substantially increasing the amount of water released to Battle Creek from all dams and major cold-water springs. The proposed modifications in the powerhouse water conveyance system on South Fork Battle Creek would increase water temperatures by isolating the cool powerhouse discharge from South Fork Battle Creek.

Impact Significance Criteria

Water quality constituents that could be impacted by the Restoration Project were selected for analysis. The water quality objectives for each constituent as described in the Basin Plan (CVRWQCB 1998) and the way they have been implemented on similar projects (e.g., Saeltzer Dam Fish Passage and Flow Protection Project) were used to determine if an impact was significant. For this analysis, impacts were considered significant if implementation of the Restoration Project would result in any of the following:

- Turbidity increase in Battle Creek over background levels as measured in nephelometric turbidity units (NTUs) by more than the numerical objectives contained in the Basin Plan:

  According to the Basin Plan (CVRWQCB 1998), an appropriate averaging period may be applied, provided that beneficial uses will be fully protected. Similar projects in the upper Sacramento River basin have had a monitoring requirement that, during in-water working periods, a turbidity increase of 15 NTUs over background turbidity is allowed up to 500 feet downstream of the work site, using a 12-hour averaging interval to determine compliance.

- Increased suspended material concentrations in Battle Creek that may leave deposits on the stream bottom that cause nuisance or adversely affect beneficial uses.

- Cause an increase of more than 5ºF above the natural receiving water temperature.
- A release of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, and aquatic life.

For this analysis, the impacts resulting from Restoration Project activities were considered beneficial if they would improve water quality management in Battle Creek to better attain Basin Plan objectives, specifically cold-water habitat for spawning and rearing of fish.

Impact Assessment

As applicable, the General Environmental Protection Measures listed in the introduction to this chapter shall be utilized for this resource. In addition, specific mitigation measures for this resource are identified below.

No Action Alternative

The No Action Alternative would not affect water quality. Under the No Action Alternative, the Hydroelectric Project would continue to operate consistent with the current FERC license. The instream flow releases would be the license-required minimum flows below dams (i.e., 3 cfs in North Fork Battle Creek and 5 cfs in South Fork Battle Creek). The Hydroelectric Project canal system would continue to convey and discharge to the lower elevation reaches of South Fork Battle Creek substantial amounts of cooler waters from North Fork Battle Creek and major springs in the watershed. The temperature regime of Battle Creek under the No Action Alternative would likely not support anything more than remnant populations of coldwater habitat users described in the purpose and need, except for fall-run chinook salmon. No impact would occur on water quality under this alternative.

Five Dam Removal Alternative (Proposed Action)

Impact 4.4-1 Significant—Increased erosion and subsequent discharge of settleable material into Battle Creek as a result of removing diversion dams and constructing fish screens and fish ladders.

Construction of access roads, staging areas, stream crossings, and cofferdams associated with the removal of Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman diversion dams and construction of fish screens and fish ladders at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams could potentially cause water turbidity and suspended material concentrations to exceed water quality limits for short-term periods. Increases in turbidity and suspended materials would likely occur during work in Battle Creek's channel. The newly disturbed soils upslope from Battle Creek also have the potential to erode and increase water turbidity and settleable material concentrations, if this material enters Battle Creek. Implementing the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.4-1. To avoid or minimize potential impacts related to erosion and subsequent discharge of settleable material and runoff, Reclamation will develop an erosion control plan in coordination with the CVRWQCB through the Section 401, Clean Water Act permitting process in obtaining the storm water management approval for the Restoration Project. The CVRWQCB will use this plan in developing the SWPPP approval for the Restoration Project. The plan would contain the following BMPs for all areas disturbed by the Restoration Project:

- Monitoring of water turbidity would be conducted immediately above and 500 feet downstream of the construction site a minimum of two times each workday. If downstream turbidity levels are found to exceed a turbidity increase of 15 NTUs over background turbidity, construction activities will cease until turbidity decreases to acceptable levels.
- During work in a flowing stream, the entire streamflow will be diverted around or under the work area by a barrier, culvert, channel, or berm constructed of clean gravel 1 to 6 inches in diameter (clean is defined as meeting the California Department of Transportation's cleanliness specification 85). The barrier and/or new channel will be constructed in a manner that will minimize sediment discharges and facilitate any necessary fish rescue operations and fish escape from the work area.
- Small sediment catchment basins or traps will be installed to prevent sediment from being transported away from development sites. These basins will be sized and sited to minimize any impacts on riparian areas and wet areas. Types of sediment traps to be considered will include filter berms, straw bales, filter inlets, vegetative filter strips, and culver risers.
- Disturbed soils will be revegetated and stabilized. Reseeding and mulching work will be completed by October 1 of the year following the completion of activities at each dam site. If erosion control practices are not installed by that date, exposed soils could require additional treatment following seasonal rains and subsequent erosion.
- Disturbed areas will be seeded with native plant species approved by a revegetation specialist or erosion control specialist. Special emphasis will be given to native plant assemblages that were characteristic of the site prior to construction.
- Temporary sediment control measures (i.e. Straw bale dikes or filter fabric barriers) will be located downslope of disturbed areas to act as sediment traps. These measures will detain sediment-laden runoff until disturbed areas are stabilized.

These erosion control measures will be completed in coordination with the revegetation activities needed to mitigate impacts to native vegetation, as discussed in Section 4.2, "Botanical, Wetland, and Wildlife Resources."

Implementation of the erosion control plan measures would reduce impacts to less-than-significant levels.

Impact 4.4-2 Significant—Potential spills of hazardous materials could occur.

Project construction could result in inadvertent spills of hazardous materials used in standard construction practices. Construction would require the transport and use of potentially hazardous materials, such as gasoline, diesel, concrete, cement, industrial chemicals, and other hazardous chemicals. Implementing the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measure for Impact 4.4-2. To avoid or minimize potential impacts related to potentially hazardous spills, Reclamation will implement the following measures.

- Reclamation will develop a spill prevention control and countermeasures plan in coordination with the CVRWQCB through the Section 401, Clean Water Act permitting process in obtaining approval for the Restoration Project.
- Soils contaminated with fuels or chemicals will be disposed of in a suitable location to prevent discharge to surface waters.
- Temporary cofferdams will be used to separate construction areas from flowing waters.
- On-site fuels and toxic materials will be placed or contained in an area protected from direct runoff.
- If hazardous materials were released, the Coleman National Fish Hatchery will be immediately notified.
- Cement and concrete delivery and transfer equipment will be washed in contained areas protected from direct runoff until the material sets.

Implementation of the spill prevention control and countermeasures plan would reduce impacts resulting from potential spills of hazardous materials to a less-than-significant level.

Impact 4.3-3 Less than Significant—Removal of South and Coleman Diversion Dams could cause erosion of minor amounts of sediment from behind the dam.

The amount of sediment that would be eroded from behind South and Coleman Diversion Dams after their removal was calculated based on the simulated changes in cross-sectional geometry for each year (Reclamation 2001b). Most of the sediment would be moved and redistributed within the first year of normal winter flows. The amount of additional sediment moved downstream would not substantially increase the sediment movement that occurs over the South and Coleman Diversion Dams. The sediment deposits behind Eagle Canyon, Wildcat, Lower Ripley Creek Feeder, and Soap Creek Feeder Diversion Dams are not considered large enough to be an impact.

Modeling conducted by Reclamation (2001b) predicts that, after dam removal, the bed elevation immediately below South and Coleman Diversion Dams would increase and the stream gradient would stabilize within a few years. Previous field studies of sediment release in similar streams indicate that the fine sediment would be deposited in the upstream pools first and then gradually transported downstream. Each large flow event, expected under normal winter and spring flow conditions, would likely scour the fine sediment from the pool and deposit it in downstream reaches. At each successive pool downstream, the maximum amount of deposition would become less (Wohl and Cenderelli 2000). Eventually, the stream would return to normal sediment equilibrium conditions.

As part of the Five Dam Removal Alternative, Reclamation would construct a pilot channel through the sediments behind Coleman and South Diversion Dams. The pilot channel would facilitate the distribution of sediments by natural high-flow events and ensure that the mass of sediment would not impede fish passage, should low flows predominate after dam removal. Under low-flow conditions, the pilot channel geometry would provide a sufficient depth of water and keep flow velocities low enough to support fish passage. Under typical winter flow conditions, sediments would quickly begin to move and redistribute downstream.

To confirm that sediment is distributed downstream of South and Coleman Diversion Dams following the removal of these dams, Reclamation would implement a sediment monitoring plan, as described in the General Environmental Protection Measures listed in the introduction to this chapter. In the dry season before South and Coleman Diversion Dams are to be removed, Reclamation would initiate the sediment monitoring plan, which would include the following items. Monitoring would continue after dam removal, as discussed below.

- **Perform surveys during the dry season preceding the dam removal to provide a baseline for changes induced by the dam removal.** Cross-sections would be surveyed every 100 feet for 0.5 mile downstream of South and Coleman Diversion Dams. The surface layer of bed material would be sampled either by the pebble-count procedure or grab samples. Cross-sectional information would also be collected near structures that would potentially be affected.
- **For the first wet season, collect a sequence of photographs in the reservoir region to provide important insights into the behavior of the sediment previously trapped behind the dam.** A still camera installed at each dam site would be set to take pictures once a day immediately following dam removal. Once the reservoir region sediments change more slowly, the interval for pictures can be reduced to once a week.
- **Continue monitoring turbidity and TSS downstream of Coleman Diversion Dam at the County Road Bridge and upstream of the intakes to the Coleman National Fish Hatchery.** Samples would be collected as close as possible to the peak flow of each high-flow period. At a minimum, sampling should be performed monthly.

Impact 4.4-4 Less than Significant—Minor amounts of sediment released by the removal of Coleman Diversion Dam would be deposited at the County Road Bridge.

Sediment released from behind Coleman Diversion Dam may be deposited at the County Road Bridge, which is located approximately 0.8 mile downstream of the dam. Because the creek bed is mobile, it is scoured during each large flow event, and the subsequent low-flow periods refill the scoured regions. Therefore, the creek bed exhibits natural variations. Simulations conducted by Reclamation (2001a) showed a slight alteration in streambed elevation (less than 1 foot over 6 years) near the bridge during the years following dam removal. A change of 1 foot over 6 years is considered less than significant, and the bed is considered stable in the reach near the bridge.

No significant impact to the hydraulics near the County Road Bridge would occur because the minor amounts of sediment released and the minor change in bed stability would not substantially alter the course of Battle Creek and the minor amounts of sediment released would not expose people to an increased risk of bridge failure.

Other simulations under varying types of water years gave similar results (Reclamation 2001b). In particular, for both the normal and dry water year simulations, the magnitude of bed elevation change was less near the bridge. This impact is considered less than significant.

Impact 4.4-5 Less than Significant—Short-term increased turbidity and settleable material load on the Coleman National Fish Hatchery water treatment plant as a result of removing Coleman Diversion Dam.

The amount of fine sediment behind Coleman Diversion Dam likely would not increase turbidity at the Coleman National Fish Hatchery water intakes because less sediment is trapped behind the dam (Table 4.3-1). The Coleman National Fish Hatchery water supply is taken from Battle Creek and Coleman Canal at three locations that are 10 stream miles downstream of Coleman Diversion Dam. The water supply intakes are taken from Coleman Canal via the Coleman Powerhouse tailrace connector and from two locations directly on Battle Creek.

Because it has the best water quality, the Coleman Powerhouse tailrace is the Coleman National Fish Hatchery's primary water supply (Intake 1) (USFWS 1999). The Coleman National Fish Hatchery water demands are the lowest during the summer, and the Coleman Powerhouse tailrace becomes the sole water supply for the Coleman National Fish Hatchery, except during emergencies when the powerhouse is shut down. The water quality of the Coleman Powerhouse tailrace would not be impacted by any construction activity on either North Fork or South Fork Battle Creek because the Coleman Canal would be isolated from the creek by the tailrace connector between the Inskip Powerhouse and the Coleman Canal. The tailrace connector would be constructed before dam removal and screen and ladder construction.

The two additional intakes that supply water to Coleman National Fish Hatchery directly from Battle Creek would be subject to increased turbidity during emergencies that shut off the primary intake at the Coleman Powerhouse tailrace. These intakes are located directly on Battle Creek approximately 10 miles downstream of Coleman Diversion Dam, where the maximum sediment concentrations are predicted to be approximately one-half of those at the confluence of North Fork and South Fork Battle Creek. Prior to its use, water diverted to the Coleman National Fish Hatchery is filtered to remove settleable material and turbidity. The water treatment system includes a settling pond and an oversized sand filter to process sediment-laden and turbid water produced by extreme winter storms. The capacity of the sand filter is 20% greater than the capacity of the ozone plant used to sterilize the water (USFWS 1997a).

The increased turbidity and sediment load resulting from the Five Dam Removal Alternative could affect the Coleman National Fish Hatchery water treatment plant. Hatchery personnel would be notified of substantial erosion events during screen and ladder construction, dam removal, and observations of significant fluvial erosion of alluvial deposits during winter storms. Construction activity would cease if flow to the Coleman National Fish Hatchery were interrupted. This notification would allow the Coleman National Fish Hatchery personnel to prepare and properly maintain the water treatment plant. This impact is considered less than significant because increased turbidity would be minor and temporary, and hatchery personnel would be notified if substantial erosion at the Coleman Diversion Dam occurs during construction.

No Dam Removal Alternative

Impacts to water quality resulting from the construction of fish screens and ladders would be similar to those described for the Five Dam Removal Alternative.

Impact 4.4-6 Significant—Increased erosion and subsequent discharge of settleable material and runoff into Battle Creek as a result of constructing fish screens and fish ladders.

This impact is similar to Impact 4.4-1 described above for the Five Dam Removal Alternative. Construction of access roads, staging areas, stream crossings, and cofferdams associated with construction of fish screens and fish ladders at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman diversion dams could potentially cause water turbidity and suspended material concentrations to exceed water quality limits for short-term periods. Implementing the mitigation measure for Impact 4.4-1 would reduce this significant impact to a less-than-significant level.

Impact 4.4-7 Significant—Potential spills of hazardous materials could occur.

This impact is similar to Impact 4.4-2 described above for the Five Dam Removal Alternative. As described under Impact 4.4-2, project construction could result in inadvertent spills of hazardous materials used in standard construction practices. Construction would require the transport and use of potentially hazardous materials, such as gasoline, diesel, concrete, cement, industrial chemicals, and other hazardous chemicals. Implementing the mitigation measure for Impact 4.4-2 would reduce this significant impact to a less-than-significant level.

Six Dam Removal Alternative

Impacts to water quality resulting from the construction of fish screens and ladders and the six dam removals would be similar to those described for the Five Dam Removal Alternative.

Impact 4.4-8 Significant—Increased erosion and subsequent discharge of settleable material and runoff into Battle Creek as a result of removing of diversion dams and constructing fish screens and fish ladders.

This impact is similar to Impact 4.4-1 described above for the Five Dam Removal Alternative. Construction of access roads, staging areas, stream crossings, and cofferdams associated with the removal of Eagle Canyon, Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman diversion dams and construction of fish screens and fish ladders at North Battle Creek Feeder and Inskip diversion dams could potentially cause water turbidity and suspended material concentrations to exceed water quality limits for short-term periods. Implementing the mitigation measure for Impact 4.4-1 would reduce this significant impact to a less-than-significant level.

Impact 4.4-9 Significant—Potential spills of hazardous materials could occur.

This impact is similar to Impact 4.4-2 described above for the Five Dam Removal Alternative. As described under Impact 4.4-2, project construction could result in inadvertent spills of hazardous materials used in standard construction practices. Construction would require the transport and use of potentially hazardous materials, such as gasoline, diesel, concrete, cement, industrial chemicals, and other hazardous chemicals. Implementing the mitigation measure for Impact 4.4-2 would reduce this significant impact to a less-than-significant level.

Impact 4.4-10 Less than Significant—Removal of South and Coleman Diversion Dams could cause erosion of minor amounts of sediment from behind the dam.

This impact is similar to Impact 4.3-3 described above for the Five Dam Removal Alternative. The sediment deposits behind Eagle Canyon, Wildcat, Lower Ripley Creek Feeder, and Soap Creek Feeder Diversion Dams are not considered large enough to be an impact. This impact is considered less than significant.

Impact 4.4-11 Less than Significant—Minor amounts of sediment released by the removal of Coleman Diversion Dam would be deposited at the County Road Bridge.

This impact is the same as Impact 4.3-4 described above for the Five Dam Removal Alternative and is considered less than significant.

Impact 4.4-12 Less than Significant—Short-term increased turbidity and settleable material load on the Coleman National Fish Hatchery water treatment plant as a result of removing Coleman Diversion Dam.

This impact is similar to Impact 4.4-5 described above for the Five Dam Removal Alternative and is considered to be less than significant. No sediment modeling studies were performed to predict the amount of sediment released by the removal of Eagle Canyon Diversion Dam, which is located upstream from Wildcat Diversion Dam on North Fork Battle Creek. It is assumed that the impacts resulting from the removal of this dam would be less than those associated with the removal of Coleman Diversion Dam; that is, only a minor amount of fine material would be discharged, provided similar mitigation measures are employed.

Three Dam Removal Alternative

Impacts to water quality resulting from the construction of fish screens and ladders and the three dam removals would be the same as those described for the Five Dam Removal Alternative.

Impact 4.4-13 Significant—Increased erosion and subsequent discharge of settleable material and runoff into Battle Creek as a result of removing diversion dams and constructing fish screens and fish ladders.

This impact is similar to Impact 4.4-1 described above for the Five Dam Removal Alternative. Construction of access roads, staging areas, stream crossings, and cofferdams associated with the removal of Eagle Canyon, Wildcat, and Coleman diversion dams and construction of fish screens and fish ladders at North Battle Creek Feeder, South, and Inskip diversion dams could potentially cause water turbidity and suspended material concentrations to exceed water quality limits for short-term periods. Implementing the mitigation measure for Impact 4.4-1 would reduce this significant impact to a less-than-significant level.

Impact 4.4-14 Significant—Potential spills of hazardous materials could occur.

This impact is similar to Impact 4.4-2 described above for the Five Dam Removal Alternative. As described under Impact 4.4-2, project construction could result in inadvertent spills of hazardous materials used in standard construction practices. Construction would require the transport and use of potentially hazardous materials, such as gasoline, diesel, concrete, cement, industrial chemicals, and other hazardous chemicals. Implementing the mitigation measure for Impact 4.4-2 would reduce this significant impact to a less-than-significant level.

Impact 4.4-15 Less than Significant—Removal of Coleman Diversion Dam could cause erosion of minor amounts of sediment from behind the dam.

This impact is the same as Impact 4.3-3 described above for the Five Dam Removal Alternative, except that South Diversion Dam would not be removed under this alternative. The sediment deposits behind Eagle Canyon and Wildcat Diversion Dams are not considered large enough to be an impact (Table 4.3-1). This impact is considered less than significant.

Impact 4.4-16 Less than Significant—Minor amounts of sediment released by the removal of Coleman Diversion Dam would be deposited at the County Road Bridge.

This impact is the same as Impact 4.3-4 described above for the Five Dam Removal Alternative and is considered less than significant.

Impact 4.4-17 Less than Significant—Short-term increased turbidity and settleable material load on the Coleman National Fish Hatchery water treatment plant as a result of removing Coleman Diversion Dam.

This impact is similar to Impact 4.4-5 described above for the Five Dam Removal Alternative and is considered to be less than significant. It is assumed that the impacts resulting from the removal of Eagle Canyon Diversion Dam would be similar to those associated with the removal of Wildcat Diversion Dam; that is, only a minor amount of fine material would be discharged, provided similar mitigation measures are employed.

Cumulative Impacts

Cumulative water quality impacts associated with the Proposed Action and past, present, or probable future projects would not occur in the Battle Creek watershed because no other projects (including related projects described in Chapter 6) would incrementally contribute to degradation of water quality conditions in Battle Creek. The Proposed Action would generally improve water quality conditions, and no other proposed projects could result in cumulative decline in Battle Creek water quality.

Table 4.4-1. Water Quality Data Summary for Various Locations on Battle Creek, 1955–1989

Constituent	Below Coleman National Fish Hatchery[1]			Below Coleman Powerhouse[2]			Near Coleman Powerhouse[3]			South Fork Battle Creek[4]			North Fork Battle Creek[5]		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Turbidity, NTU	5	1	1	125	0	6				35	1	6	25	0	3
Electrical conductivity, µmho/cm	258	30	129	276	56	127				159	59	108	200	82	130
Total dissolved solids, mg/L	125	86	110	133	63	97									
Total suspended solids, mg/L	722.0	1.0	39.0	16.0	2.0	7.4	2.0	0.2	1.1						
Total residue, mg/L	180	60	99	146	66	101	118	60	95						
Dissolved oxygen, mg/L	12.0	3.2	9.4	13.0	6.3	11.2				11.6	8.5	10.1	11.4	5.7	9.8
Biochemical oxygen demand, mg/L	2.8	1.0	2.1	4.0	1.2	2.6	3.3	0.8	1.6						
PH	8.6	7.1	7.9	8.6	7.2	7.9				8.6	7.1	7.6	8.3	7.2	7.6
Total hardness, mg/L	110	29	52	116	22	55	115	48	73	49	21	35	47	32	39
Alkalinity, mg/l	90	34	65	88	23	66	94	54	72	58	23	41	56	36	45
Calcium, mg/L	12.0	7.0	9.6	12.0	4.0	9.1				7.9	5.0	6.5	9.0	6.0	8.0
Magnesium, mg/L	8.0	3.6	6.5	11.0	3.0	6.5				3.5	2.0	2.8	6.0	4.0	5.0
Sodium, mg/L	9.6	3.9	7.8	30.0	2.7	8.0				7.7	3.0	5.2	6.0	4.0	4.9
Potassium, mg/L	3.1	1.5	2.0	3.5	1.1	2.0				1.7	1.3	1.5	1.9	1.5	1.7
Chloride, mg/L	22.0	0.1	2.1	30.0	0.0	10.1				1.3	1.0	1.1	1.0	0.7	0.9
Fluoride, mg/L	0.10	0.00	0.02	0.2	0.0	0.1									
Sulfate, mg/L	3.4	0.0	2.1	9.5	0.0	2.3				1.5	.15	1.5			
Ammonia + organic nitrogen, mg/L	0.5	0.2	0.4							1.3	0.3	0.7	00.40	0.12	0.27
Ammonia + ammonium, mg/L	0.30	0.03	0.16	0.35	0.01	0.19	0.32	0.02	0.15						

Constituent	Below Coleman National Fish Hatchery[1]			Below Coleman Powerhouse[2]			Near Coleman Powerhouse[3]			South Fork Battle Creek[4]			North Fork Battle Creek[5]		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Nitrite + nitrate, mg/L	0.01	0.01	0.01							0.18	0.02	0.11	0.08	0.02	0.06
Nitrite-nitrogen, mg/L	0.01	0.15	0.06	0.20	0.02	0.9	0.06	0.01	0.04						
Nitrate-nitrogen, mg/L	1.00	0.00	0.29	1.40	0.00	0.35	0.22	0.10	0.16	0.30	0.01	0.15	0.11	0.00	0.03
Total Kjeldahl nitrogen, mg/L	0.71	0.22	0.40	0.88	0.14	0.48	0.52	0.23	0.37				0.10	0.00	0.05
Total phosphate, mg/L	0.64	0.15	0.35	0.88	0.23	0.47	0.30	0.20	0.23						
Orthophosphate, mg/L	0.25	0.01	0.07	0.30	0.00	0.09	0.08	0.01	0.04	0.03	0.02	0.03	0.04	0.02	0.02
Total phosphorus, mg/L	0.05	0.04	0.05							0.07	0.04	0.06	0.08	0.03	0.05
Silicon dioxide, mg/L	48	35	42	53	30	42				34	34	34			
Arsenic, μg/L				20	3	0									
Boron, μg/L	300	0	37	470	0	38				100	40	70	100	0	50
Cadmium, μg/L	<5	<5	<5												
Chromium, μg/L				0	0	0									
Copper, μg/L	<5	<5	<5	20	0	2									
Iron, μg/L	0.2	<0.1	0.1	90	10	20									
Lead, μg/L	<5	<5	<5	0	0	0									
Manganese, μg/L	47	37	25	0	0	0									
Mercury, μg/L	<1	<1	<1												
Zinc, μg/L	33	<5	16	30	0	5									

Sources: [1]USGS (1961–1970), USEPA (1971–1972), and DWR (1988–1989); [2]USEPA (1971–1972) and SWRCB (1955–1989); [3]USEPA (1971–1972); [4]SWRCB (1960–1982); [5]SWRCB (1977–1982).

NTU = nephelometric turbidity units; μmho/cm = microhmos per centimeter; mg/L = milligrams per liter; μg/L = micrograms per liter.

4.5 Groundwater

Affected Environment

The Restoration Project area is located within four separate groundwater basins as delineated by DWR (DWR 2003). The four basins are the Modoc Plateau Pleistocene Volcanic Area Basin, the North Fork Battle Creek Basin, the Sacramento Valley Eastside Basin, and the Redding Basin. The Redding Basin is divided into two subbasins: the South Battle Creek Subbasin and the Millville Subbasin. The following sections describe the North Fork Battle Creek and Redding Basins in detail. DWR has not described the Modoc Plateau Pleistocene Volcanic Area Basin and the Sacramento Valley Eastside Basin in detail at the time of this report.

North Fork Battle Creek Basin

Water-bearing formations in the North Fork Battle Creek Basin include the Quaternary alluvium and underlying volcanic rocks. Alluvium is approximately 32 feet thick overlying a succession of volcanic rocks (DWR 2003). The volcanic rocks are composed of two 10- to 40-foot thick flows, which are separated by a 40- to 80-foot section of sand, gravel, ash, and cinders. DWR (2003) indicates that the interbedded sand-gravel-ash-cinder strata is the primary groundwater source in the area.

Redding Basin

South Battle Creek Subbasin

The South Battle Creek Subbasin is comprised of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include younger alluvium and the Pleistocene Modesto Formation. The Tertiary deposits include the Tuscan Formation and possibly the Tehama Formation along the Sacramento River. The Tuscan Formation is the primary water-bearing unit in the subbasin. The Tehama Formation may extend beyond the Sacramento River. The following descriptions are from DWR (2003). The Tehama Formation is described in the Millville Subbasin section.

Holocene Alluvium

The Holocene alluvium consists of unconsolidated gravel, sand, silt, and clay from stream channel and floodplain deposits. These deposits are found along the Sacramento River. The thickness ranges up to 30 feet. This unit represents the perched water table and the upper part of the unconfined zone of the aquifer.

Pleistocene Modesto Formation

The Modesto Formation consists of terrace deposits containing poorly consolidated gravel with some sand and silt. These deposits are found along Inks Creek, Battle Creek, and the Sacramento River. The thickness varies by up to 50 feet. The sediments are moderately to highly permeable and can yield limited domestic water supplies.

Pliocene Tuscan Formation

The Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone, and volcanic ash layers, and is the principal water-bearing formation in the subbasin. Generally, the formation is described as four separate but lithologically similar units, Units A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units.

Unit A is the oldest water-bearing unit of the formation and is characterized by the presence of metamorphic clasts within interbedded lahars, volcanic conglomerate, volcanic sandstone, and siltstone.

Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Coarse cobble-to-boulder conglomerate predominates in the eastern and northern parts of mapped unit. This portion of the formation is approximately 430 feet thick.

Unit C is the primary surficial deposit in the subbasin and consists of several massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. The thickness of Unit C exposed in the vicinity of Tuscan Springs and Tuscan Buttes ranges from 165 to 265 feet.

Unit D consists of fragmental deposits characterized by large monolithologic masses of andesite, pumice, and fragments of black obsidian in a mudstone matrix. The deposit varies in thickness from 30 to 160 feet. The total thickness of the Tuscan Formation ranges from approximately 750 feet in the northeastern extents of the subbasin to 2,400 feet at the Sacramento River (DWR 2003).

Millville Subbasin

The Millville Subbasin aquifer system is comprised of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene alluvium and the Pleistocene Modesto and Riverbank Formations. The Tertiary deposits include the Pliocene Tehama Formation along the Sacramento River and the Tuscan Formation; the latter is the primary water-bearing unit in the subbasin. The following descriptions of water-bearing formations are from DWR (2003).

Holocene Alluvium

The alluvium consists of unconsolidated gravel, sand, silt, and clay from stream channel and floodplain deposits. These alluvial deposits are found along stream and river channels. The thickness ranges up to 30 feet. This unit represents the perched water table and the upper part of the unconfined zone of the aquifer. Although the alluvium is moderately permeable, it is not a significant contributor to groundwater usage due to its geomorphic distribution.

Pleistocene Modesto and Riverbank Formations

The Modesto and Riverbank formations consist of poorly consolidated gravel with some sand and silt deposited during the Pleistocene. The formations are usually found as terrace deposits near the surface along the Sacramento River and its tributaries. The thickness ranges up to 50 feet. They are moderately to highly permeable and can yield limited domestic water supplies.

Pliocene Tehama Formation

The Tehama Formation consists of locally cemented silts, sand, gravel, and clay of fluviatile origin derived from the Klamath Mountains and Coast Ranges. The permeability of the formation is moderate to high with yields of 100 to 1,000 gallons per minute (gpm).

Pliocene Tuscan Formation

The Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone, and volcanic ash layers, and is the principal water-bearing formation in the subbasin. The formation is described as four separate but lithologically similar units, Units A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units.

Occurrence and Movement of Groundwater

As mentioned previously, the Tuscan Formation is an important aquifer in the northeastern part of the Sacramento Valley and yields large quantities of fresh water. The aquifer is not a distinct, single geologic unit; rather, it contains water in fractured basalt flows, volcanic pipes, tuff beds, rubble zones, and interbedded sand layers. These water-bearing zones have little surface expression and typically must be located by exploratory drilling (Planert and Williams 1995). Perhaps of greater importance to the Restoration Project is a shallow, discontinuous, unconfined aquifer system comprised of volcanic and sedimentary (primarily alluvial) deposits that overlays the Tuscan Formation. As described above, these shallow deposits contain appreciable amounts of freshwater and are a major source of late spring to early fall baseflow for Battle Creek. Depth to groundwater is variable.

In the northern part of the Sacramento Valley, groundwater flows away from the Valley walls then generally southwestward. Recharge is from the Cascade Range geomorphic province, and groundwater is discharged to the Sacramento River or moves into the Butte Basin south of Chico. Most of the streams entering the Sacramento Valley are losing streams (i.e., they lose a portion of their flow to groundwater aquifer recharge), at least over part of their courses, and much of the groundwater recharge is from this source (Hull 1984). Battle Creek, because it cuts through volcanic and sedimentary deposits that contain fresh groundwater, is predominantly a gaining stream (i.e., it gains flow from groundwater discharge).

Groundwater Quality

The chemistry of groundwater in the Sacramento Valley is greatly influenced by the chemistry of the recharge areas along the Valley margins. The chemistry of groundwater in the Restoration Project reflects the low concentrations of dissolved solids carried by recharge from the Cascade Range, having low mean concentrations of magnesium, sodium, bicarbonate, sulfate, and chloride. Silica concentrations are high as a result of the solution of volcanic glass. The groundwater in the region has relatively high average nitrate-nitrogen concentrations (Hull 1984). Alkali feldspars and halloysite appear to be the most significant aluminosilicate minerals affecting water chemistry. Table 4.5-1 presents the mean, minimum, and maximum chemical concentrations for groundwater in Shasta and Tehama Counties. The distribution of chemical constituents in the groundwater is very similar to the distribution in surface streams draining into the valley (Hull 1984). The average groundwater temperature in the Sacramento Valley is 68°F (Hull 1984).

Table 4.5-1. Groundwater Quality from Wells in Shasta and Tehama Counties

Constituent	Mean (mg/L)	Minimum (mg/L)	Maximum (mg/L)
Dissolved solids	231	137	571
Calcium	26	14	75
Magnesium	19	9.1	60
Sodium	14	3.9	68
Potassium	1.3	0.3	5.9
Bicarbonate	170	98	400
Sulfate	8.1	0.0	71
Chloride	6.5	0.9	97
Fluoride	0.11	0.1	0.3
Nitrate-nitrogen	2.7	0.2	27
Phosphate	0.05	0.0	0.31
Silica	51	35	67
Iron	4.8	0	170
Manganese	3.4	0	10
Arsenic	1.2	0	4
Boron	0.066	0	1.50

Source: Hull 1984
mg/L = milligrams per liter

The EPA's Storage and Retrieval Water and Biological Monitoring Data database was accessed for information on wells in the area surrounding and including the Restoration Project; however, it did not contain any such information.

Regulatory Setting

The following laws, regulations, or policies relate to land use within the Restoration Project:

- SWRCB Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Water in California, generally restricts dischargers from reducing the water quality of surface water and groundwater.
- SWRCB Resolution No. 88-63, Sources of Drinking Water Policy, specifies that all groundwaters in California are to be protected as existing or potential sources of municipal and domestic supply.
- The Porter-Cologne Water Quality Control Act (Water Code §13000 *et seq.*) establishes the SWRCB and each Regional Water Quality Control Board as the state agencies for having primary responsibility in coordinating and controlling water quality in California.
- The Water Quality Control Plan for the Sacramento and San Joaquin River Basins consists of a designation or establishment for the water within the Sacramento and San Joaquin River Basins of beneficial uses to be protected, water quality objectives to protect those uses, and a program of implementation needed for achieving the objectives.
- The Shasta County General Plan (Shasta County 1998) contains a policy objective to protect surface and groundwater resources so that all present and future Shasta County residents have a reasonable assurance that an adequate quantity and quality of water exists.
- The Tehama County General Plan (Tehama County Community Development Group 1983) contains policies to preserve groundwater recharge areas identified on Plan Land Use Maps and to prevent water pollution from point and non-point sources.
- The Groundwater Management Act, commonly referred to as AB 3030, was signed into law on September 26, 1992, and became effective on January 1, 1993. The legislation is designed to provide local public agencies with increased management authority over groundwater resources in addition to those existing groundwater management capabilities. AB 3030 was developed in response to EPA's Comprehensive State Groundwater Protection Programs.

Environmental Consequences

Summary

No significant groundwater impacts are associated with the No Action Alternative. The potential for inadvertent hazardous materials spills during construction of the Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal) could result in significant localized groundwater effects. Groundwater in the Restoration Project area would not be affected by operation of the Restoration Project.

Impact Significance Criteria

For this analysis, impacts would be considered significant if implementation of the Restoration Project would:

- Violate any water quality standards or waste discharge requirements as discussed in the Regulatory Setting.
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted).

Impact Assessment

As applicable, the General Environmental Protection Measures listed in the introduction to this chapter shall be utilized for this resource.

No Action Alternative

The No Action Alternative would not affect groundwater. Under this alternative, groundwater conditions in the Restoration Project would continue as they have historically, and there would be no impact to groundwater resources.

Five Dam Removal Alternative (Proposed Action)

Impact 4.5-1 Significant—Potential spills of hazardous materials could occur and contaminate the shallow groundwater system.
Any dewatering necessary for construction activities for the Five Dam Removal Alternative may result in inadvertent spills of hazardous materials that, if not

attended to, could contaminate the shallow groundwater system. Project construction could result in inadvertent spills of hazardous materials used in standard construction practices. Construction would require the transport and use of potentially hazardous materials, such as gasoline, diesel fuel, concrete, cement, industrial chemicals, and other hazardous chemicals. Implementing the following mitigation measure would reduce this significant impact to a less-than-significant level.

Mitigation Measure for Impact 4.5-1. To avoid or minimize potential impacts to the shallow groundwater system related to potentially hazardous spills, Reclamation will implement the following measures:

- Reclamation will develop a spill prevention control and countermeasures plan in coordination with the CVRWQCB through the Section 401, Clean Water Act, permitting process in obtaining approval for the Restoration Project.
- Soils contaminated with fuels or chemicals will be disposed of in a suitable location to prevent discharge to surface waters.
- Temporary cofferdams with culverts will be used to divert flowing waters around construction areas.
- On-site fuels and toxic materials will be placed or contained in an area protected from direct runoff.
- If hazardous materials are released, the Coleman National Fish Hatchery will be immediately notified.
- Cement and concrete delivery and transfer equipment will be washed in contained areas protected from direct runoff until the material sets.

Implementation of the spill prevention control and countermeasures plan would reduce impacts resulting from potential spills of hazardous materials to a less-than-significant level.

No Dam Removal Alternative

Impact 4.5-2 Significant—Potential spills of hazardous materials could occur and contaminate the shallow groundwater system.

Any dewatering necessary for construction activities for the No Dam Removal Alternative may result in inadvertent spills of hazardous materials that, if not attended to, could contaminate the shallow groundwater system. Project construction could result in inadvertent spills of hazardous materials used in standard construction practices. Construction would require the transport and use of potentially hazardous materials, such as gasoline, diesel fuel, concrete, cement, industrial chemicals, and other hazardous chemicals. This impact is similar to Impact 4.5-1 described under the Five Dam Removal Alternative. Implementing the mitigation measures for Impact 4.5-1 would reduce this significant impact to a less-than-significant level.

Six Dam Removal Alternative

Impact 4.5-3 Significant—Potential spills of hazardous materials could occur and contaminate the shallow groundwater system.
Any dewatering necessary for construction activities for the Six Dam Removal Alternative may result in inadvertent spills of hazardous materials that, if not attended to, could contaminate the shallow groundwater system. Project construction could result in inadvertent spills of hazardous materials used in standard construction practices. Construction would require the transport and use of potentially hazardous materials, such as gasoline, diesel fuel, concrete, cement, industrial chemicals, and other hazardous chemicals. This impact is similar to Impact 4.5-1 described under the Five Dam Removal Alternative. Implementing the mitigation measures for Impact 4.5-1 would reduce this significant impact to a less-than-significant level.

Three Dam Removal Alternative

Impact 4.5-4 Significant—Potential spills of hazardous materials could occur and contaminate the shallow groundwater system.
Any dewatering necessary for construction activities for the Three Dam Removal Alternative may result in inadvertent spills of hazardous materials that, if not attended to, could contaminate the shallow groundwater system. Project construction could result in inadvertent spills of hazardous materials used in standard construction practices. Construction would require the transport and use of potentially hazardous materials, such as gasoline, diesel fuel, concrete, cement, industrial chemicals, and other hazardous chemicals. This impact is similar to Impact 4.5-1 described under the Five Dam Removal Alternative. Implementing the mitigation measures for Impact 4.5-1 would reduce this significant impact to a less-than-significant level.

Cumulative Impacts

Cumulative groundwater impacts associated with the Proposed Action and past, present, or probable future projects would not occur in the Battle Creek watershed because no other projects that could affect groundwater availability are proposed within the Battle Creek watershed (including those projects mentioned in Chapter 6, “Related Projects”).

4.6 Land Use

Affected Environment

Regional Setting

The Battle Creek watershed lies on the volcanic slopes of Mt. Lassen in southeastern Shasta and northeastern Tehama Counties. The Restoration Project area is located in southern Shasta and northern Tehama Counties on lands south of Shingletown and Highway 44, and north of Paynes Creek and Highway 36.

Tehama County

Much of the Restoration Project is located in Tehama County. In 2002, about 36% of the county's population lived within the incorporated cities of Red Bluff, Corning, and Tehama; the remaining 64% of the population lived in rural areas (California Department of Finance 2002). Tehama County is officially classified as rural because its population centers are defined as rural communities (areas with populations less than 20,000). Therefore, the portion of the Restoration Project located in Tehama County is rural.

Tehama County is crossed by both Highway 99 and Interstate 5 and is the site of urban and other nonagricultural development centers. Tehama County's residential areas center around Red Bluff, Bowman, Bend, Los Molinos, and Proberta. The major urban center in the county is Red Bluff. Town centers are located in the areas of Los Molinos, Tehama, and Lake California. Town centers share many of the same characteristics as urban centers. However, town centers are not incorporated areas and typically serve smaller populations. Rural service centers are located near Proberta, Gerber, and Dairyville. Rural communities are located in the areas of Bowman and Bend. Rural communities have few urban services and much lower population densities and provide access to the natural environment as a major element in daily life. Much of the remaining land outside the residential, urban, and rural areas is characterized as agricultural land.

The basic goal of the Tehama County General Plan (Tehama County Community Development Group 1983) is the resolution of the inherent conflict between agricultural and nonagricultural land uses. The General Plan contains policies designed to prevent the piecemeal conversion of agricultural land to other uses by directing urban growth to land with relatively low agricultural capability, including the residential areas, town centers, rural service centers, and rural communities mentioned above.

Shasta County

The northern portion of the Restoration Project is located in the rural areas of Shasta County. Shasta County includes the incorporated cities of Anderson, Shasta Lake, and Redding. According to the Shasta County General Plan, Shasta County has three urban centers around these three incorporated cities (Shasta County 1998). These urban areas function as the county's major employment and retail trade centers. The four town centers in the county are Cottonwood, Palo Cedro, Burney/Johnson Park, and Fall River Mills/McArthur. There are also 25 rural communities in Shasta County.

Based on information from the 2000 U.S. Census and the California Department of Finance, approximately 63% of the county's population lives in the three incorporated cities of Anderson, Shasta Lake, and Redding and the unincorporated community of Cottonwood (U.S. Census Bureau 2001a; California Department of Finance 2002). The northeastern portion of the county, which houses another 5.5% of the county's population, represents the region's major public and private investments in the facilities and services required by urban development.

County Land Uses

Outside the incorporated areas of Tehama and Shasta Counties, the two principal land uses are timber and agriculture. These land uses are discussed below.

Timber

Timber is a major industry in both Tehama and Shasta Counties. Timberland is highly valued for its economic contribution to revenue and employment and for its beneficial contributions to wildlife habitat, watershed protection, erosion control, open space, scenic amenities, and recreation. To protect timberland, Timber Preserve Zoning was established in the 1970s. See the discussion under "Regulatory Setting" below for more information on Timber Preserve Zoning.

Timber covers a substantial portion of Tehama County, with about 24% of the county devoted to commercial forestland (Tehama County Community Development Group 1983). Virtually all of the county's timber resources are protected from conversion to other uses and from potential adjacent land use conflicts through the use of Timber Preserve Zoning.

Slightly more than 50% of Shasta County is dedicated to commercial forest use. Similar to Tehama County, much of this timberland is protected through Timber Preserve Zoning.

Agriculture

Much of the unincorporated land in Tehama and Shasta Counties not used for timber production is agricultural land, which is defined as land and accompanying activities used for the production of crops and livestock. Cropland and grazing land are also considered major open space resources as working landscapes. Both counties participate in the Williamson Act and have established agricultural preserves to encourage long-term agricultural production. See the discussion under “Regulatory Setting” below for more information on the Williamson Act.

The preservation of agricultural resources is identified as an objective in both county general plans. Tehama County is characterized as an agricultural county where agriculture has historically been and will continue to be a major force in the county’s economic base. In 2000, the Farmlands Mapping and Monitoring Program of the California Department of Conservation identified approximately 950,800 acres of agricultural (including grazing) land in Tehama County as a whole. Conversion of agricultural lands to other uses is less common in Tehama County than in counties to the south. During the period from 1998 to 2000, approximately 382 acres of agricultural land was converted to “urban and built up land” and approximately 1,094 acres to “other land” under the Program’s land use categories. Urban and built up land consists of land occupied by structures with a building density of at least one unit to 1.5 acres or approximately six structures per 10 acres. The other land category consists of land that doesn’t meet the criteria for agricultural or urban land. (California Department of Conservation 2001).

In Shasta County, in addition to its economic contribution, the agricultural community is in large part responsible for the area’s rural character. Agricultural land is a major component of Shasta County’s resource land base and a major element in defining the quality of life available to its residents. Approximately 444,800 acres of land was in agricultural use (including grazing) within Shasta County in 2000 according to the Farmland Mapping and Monitoring Program. Similar to Tehama County, conversion of agricultural land to other uses is relatively rare. During the period from 1998 to 2000, approximately 242 acres of agricultural land was converted to urban uses and approximately 504 acres was converted to “other land,” as identified under the Program’s land use categories (California Department of Conservation 2000). The conversion to other land was primarily due to new ranchettes on the Tuscan Buttes NE and Shingletown quadrangles (California Department of Conservation 2000). The modest size of these conversions indicates that agricultural land uses continue to predominate in both counties.

Land within the Restoration Project Area

Most of the land within the Restoration Project area, in both counties, is private land zoned for agriculture (including grazing). In Tehama County there is also one 63-acre area zoned as NR (natural resources and recreation) and one area as

TPZ (timber preserve zone) (Halpin pers. comm.). Similarly, Shasta County has one area designated as a TPZ and a small amount of residential zoning (Rogers pers. comm.). The general plans for each county do not have any new uses designated for any of the Restoration Project land. The area is primarily designated for agricultural/grazing usage (Halpin pers. comm.; Rogers pers. comm.).

Private Land

The majority of the land within the Restoration Project is privately owned and includes private timber and grazing land (see Figure 4.6-1). At present, a number of landowners manage their lands adjacent to the upland areas of Battle Creek primarily for agriculture or cattle grazing. Historically, some landowners have protected these upland areas from human disturbance by limiting access and by focusing land management on areas away from the water. However, other landowners have begun to supplement their incomes from agriculture and cattle ranching with the sale of trespass rights for hunting and fishing to allow the public access for these activities (McCampbell pers. comm.).

Private land managed for agriculture or cattle grazing within the Restoration Project area includes one 47-acre parcel of farmland of state importance in Shasta County. Agricultural private land also encompasses about a dozen parcels of farmland of local importance between the two counties. The largest parcel of farmland of local importance comprises 294 acres; most other parcels are less than half that acreage (California Department of Conservation 2001). Additionally, the project area in both counties includes a fair number of Williamson Act lands (Halpin pers. comm.; Rogers pers. comm.)[1]. There is no designated prime farmland within the project area boundaries. (California Department of Conservation 2001).

The Restoration Project area also includes two small Timber Preserve Zones—one in Shasta County and one in Tehama County (Halpin pers. comm.; Rogers pers. comm.).

Public Land

The U.S. Bureau of Land Management (BLM) administers small portions of public land within the Restoration Project (see Figure 4.6-1). Its Redding Resource Area encompasses approximately 247,500 acres of public land within Butte, Shasta, Siskiyou, Tehama, and Trinity Counties and includes the Restoration Project area. The Redding Resource Management Plan is the planning document that identifies the direction for the management of public

[1] In Tehama County, there are Williamson Act Preserves, used primarily for grazing, in 30N1W 3 and 30N1E 2, 3, 9, 10, 11, and 12 (Halpin pers. comm.). In Shasta County there are Williamson Act Preserves in 30N1W 13, 14, 15, 16, 21, 22, 23 and 30N1E 16, 17, 18, 19, and 20 (Rogers pers. comm.).

land within the Redding Resource Area (BLM 1993). To adequately address issues in this large geographic area, the Redding Resource Area was further broken into smaller areas referred to as management areas. The Restoration Project is located in the Sacramento River and Ishi Management Areas.

As discussed in the Redding Resource Management Plan, efforts are under way to convert some private land along the main stem of Battle Creek to publicly owned land. The portion of the Restoration Project below Manton Road and located in the Sacramento River Management Area would be managed for natural values, semiprimitive recreational opportunities, and the protection of archaeological resources (BLM 1993). See the discussion under "Cumulative Impacts" for more information.

Relevant resource and land use allocation objectives for the Ishi Management Area, which encompasses portions of the Restoration Project area, include:

- improving semiprimitive recreational opportunities,
- enhancing anadromous fisheries,
- maintaining and improving the quality and quantity of riparian vegetation,
- protecting existing wildlife habitat,
- maintaining the scenic quality of the area,
- managing the area as "Semi-Primitive Motorized,"
- limiting vehicles to designated roads and trails,
- closing the corridor to new livestock grazing permits, and
- acquiring available unimproved land within the corridor.

Throughout the Redding Resource Management Plan area, the demand for public land for outdoor recreational uses continues to increase in both intensity and diversity. In many places, public land provides the only readily accessible opportunity to pursue wildland recreational opportunities (BLM 1993). Because of the area's remote nature and the abundance of privately owned land, public access to the Restoration Project is fairly limited. Public access is described further in Section 4.14, "Recreation."

Local Communities

Manton, the only community located in proximity to the Restoration Project, is a rural community center that includes an elementary school serving approximately 70 students, a local store, a diner, and numerous cottage businesses, several with international clients (Paquin-Gilmore 1999). Vineyards and historically grown Manton apples, produced by several local growers, are significant crops in the Manton community. Some haying also occurs here and numerous ranchers raise cattle. Some ranchers have diversified to operate private hunting and fishing clubs on their properties, including deer hunting and catch-and-release fishing.

Oak woodland is also harvested for firewood, and harvesting of lava rocks has increased as another form of income for area landowners (Paquin-Gilmore 1999).

Regulatory Setting

The following laws, regulations, or policies relate to land use within the Restoration Project. Descriptions of these, if not described below, can be found in Chapter 5, “Consultation and Coordination.”

Timber Preserve Zoning

Timber Preserve Zoning was developed as a means to implement the Forest Taxation Reform Act of 1976 (Revenue and Tax Code §§38101-38908). The intent of Timber Preserve Zoning is not only to protect the integrity of timber resources but also to prevent timber harvesting operations from adversely affecting other land uses.

Williamson Act

The California Land Conservation Act of 1965 (Government Code §§51200-51295) (commonly known as the Williamson Act) established a voluntary tax incentive for preserving both agricultural and open space land. The act reduces property taxes in return for the guarantee that the property will remain in agriculture for not less than 10 years, thereby slowing the conversion of agricultural land. Under the act, property owners enter into 10-year contracts with their respective counties. The counties then place restrictions on the land in exchange for tax savings. The properties are taxed according to the income they are capable of generating from agriculture and other compatible uses, rather than being taxed on their full market values.

Farmland Protection Policy Act

Congress enacted the Farmland Protection Policy Act (FPPA) as a subtitle of the 1981 Farm Bill. The purpose of the law is to “minimize the extent to which Federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses” (P.L. 97-98, Section 1539-1549; 7 U.S.C. 4201, et seq). The FPPA also stipulates that federal programs be compatible with state, local, and private efforts to protect farmland. For the purposes of the law, federal programs include construction projects—such as highways, airports, dams and federal buildings—sponsored or financed in whole or part by the federal government, and the management of federal lands. The U.S. Department of Agriculture's Natural Resources Conservation Service is charged with oversight of the FPPA.

The FPPA applies to federal projects that would convert farmland to nonagricultural uses. The Restoration Project will involve a variety of changes to the power facilities along the North and South Forks of Battle Creek, including the removal of dams, installation of fish screens and ladders, construction of water conveyances, and construction/improvement of access roads. None of these activities would affect or convert existing agricultural uses. Therefore, the FPPA does not apply to the Restoration Project.

Environmental Consequences

Summary

No significant land use impacts are associated with the No Action Alternative or the action alternatives. Most of the land in the Restoration Project would not be affected by implementation of the Restoration Project. Disturbance would be limited to areas associated with construction, modification, or removal activities, including stream beds and banks, short-term and long-term access roads, staging areas, and Hydroelectric Project dam site facilities, conveyances, and appurtenant facilities.

Impact Significance Criteria

According to Section 15065 and Appendix G of the State CEQA Guidelines, as well as other concerns in the Restoration Project area, impacts for this analysis would be considered significant if implementation of the Restoration Project would:

- Conflict with established land uses, including recreational, educational, religious, or scientific uses;
- Displace a large number of people;
- Conflict with proposed or approved development plans or adopted zoning; and
- Convert existing agricultural land to nonagricultural use or impair its agricultural productivity.

Impact Assessment

As applicable, the General Environmental Protection Measures listed in the introduction to this chapter shall be utilized for this resource.

No Action Alternative

The No Action Alternative would not impact land use. The No Action Alternative is not expected to conflict with general plans and established land uses, alter existing land uses, displace a large number of people, or convert agricultural land to nonagricultural land.

Five Dam Removal Alternative (Proposed Action)

Impact 4.6-1 Less than Significant—Conversion of lands disturbed by construction activities from open space to Restoration Project support would substantially conflict with existing land uses.
Because of the complexity of the Restoration Project, some lands, dispersed between and near construction sites, would be converted to uses that support the long-term operation and maintenance of the constructed and improved facilities. Although some of the lands disturbed by construction (e.g., staging areas) would be restored or revegetated to conditions approximating their preconstruction condition, others will be permanently converted to other uses, including:

- Access roads, which include improvements to intersections and turnout improvements from main roads, construction of new access roads, and improvements (blading and graveling) to existing access roads;
- Conveyances, which include overflow wasteways, bypass pipelines, chutes, stilling basins, tailrace connectors, channels, tunnels, sluiceway chutes, canals requiring excavation, backfilling, or realignment, and other water conveyances;
- Appurtenant facilities, which include screen boxes, channel and gate structures, sediment trap basins, and tailrace dikes, wasteways, and access ramps; and
- Dam site facilities, which include dams to be removed or improved with fish screens, fish ladders, and cofferdams.

Most of the lands permanently converted to these uses are remote and small and are being converted to passive uses consistent with surrounding agricultural, grazing, and open space uses. Because of the limited extent of land converted, the remote locations' dispersal across a wide area, and continuing access restrictions, this impact is considered to be less than significant. These widespread, small land use conversions would not conflict with established land uses, displace a large number of people, conflict with proposed or approved development plans or adopted zoning, provide access to previously inaccessible areas, result in timber harvesting on protected timberlands, convert protected timberlands to other land uses, convert existing agricultural lands to nonagricultural uses, or impair their agricultural productivity. Therefore, the Five Dam Removal Alternative would have a less-than-significant impact on land use.

No Dam Removal Alternative

Impact 4.6-2 Less than Significant—Conversion of lands disturbed by construction activities from open space to Restoration Project support would substantially conflict with existing land uses.

The No Dam Removal Alternative would involve the construction of new fish screens and fish ladders at six diversion dams (North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams) and would not include the removal of any dams. Some lands, dispersed between and near construction sites, would be converted to uses that support the long-term operation and maintenance of the constructed and improved fish screens and fish ladders. Although some of the lands disturbed by construction (e.g., staging areas) would be restored or revegetated to conditions approximating their preconstruction condition, others would be permanently converted to other uses, including:

- access roads, which include improvements to intersections and turnout improvements from main roads, construction of new access roads, and improvements (blading and graveling) to existing access roads;
- water conveyances, which include chutes and weirs; and
- improved fish screens and fish ladders at the six dam sites.

Because it would affect a smaller area than the Five Dam Removal Alternative (i.e., no construction would occur at Soap Creek Feeder and Lower Ripley Creek Feeder under the No Dam Removal Alternative), the No Dam Removal Alternative would have less impact than the Restoration Project and, therefore, a less-than-significant impact to land use.

Six Dam Removal Alternative

Impact 4.6-3 Less than Significant—Conversion of lands disturbed by construction activities from open space to Restoration Project support would substantially conflict with existing land uses.

The Six Dam Removal Alternative would remove the Eagle Canyon Diversion Dam and its appurtenant facilities, in addition to the five diversion dams described in the Five Dam Removal Alternative (Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams). Otherwise, its physical changes would be essentially the same as those described for the Five Dam Removal Alternative. Although some of the lands disturbed by construction (e.g., staging areas and areas over tunnels and pipelines) would be restored or revegetated to conditions approximating their preconstruction condition, others would be permanently converted to other uses, including:

- access roads, which include improvements to intersections and turnout improvements from main roads, construction of new access roads, and improvements (blading and graveling) to existing access roads;

- conveyances, which include overflow wasteways, bypass pipelines, chutes, stilling basins, tailrace connectors, channels, tunnels, sluiceway chutes, canals requiring excavation, backfilling, or realignment, and other water conveyances;
- appurtenant facilities, which include screen boxes, channel and gate structures, sediment trap basins, and tailrace dikes, wasteways, and access ramps; and
- dam site facilities, which include dams to be removed or improved with fish screens, fish ladders, and cofferdams.

Most of the lands permanently converted to these uses are remote and small and are being converted to passive uses consistent with surrounding agricultural, grazing, and open space uses. Because of the limited extent of land converted, the remote locations' dispersal across a wide area, and continuing access restrictions, this impact is considered to be less than significant. These widespread, small land use conversions would not conflict with established land uses, displace a large number of people, conflict with proposed or approved development plans or adopted zoning, provide access to previously inaccessible areas, result in timber harvesting on protected timberlands, convert protected timberlands to other land uses, convert existing agricultural lands to nonagricultural uses, or impair their agricultural productivity. Therefore, the Six Dam Removal Alternative would have a less-than-significant impact on land use.

Three Dam Removal Alternative

Impact 4.6-4 Less than Significant—Conversion of lands disturbed by construction activities from open space to Restoration Project support would substantially conflict with existing land uses.

The Three Dam Removal Alternative would remove Eagle Canyon, Wildcat, and Coleman Diversion Dams. In addition, the tailrace connection between the South Powerhouse and the Inskip Canal would be an open channel, rather than the full-flow tunnel proposed under the Five Dam Removal Alternative. Wildcat and Coleman Diversion Dams are also proposed for removal under the Five Dam Removal Alternative.

Under the Three Dam Removal Alternative, the South Diversion Dam would not be removed and a fish screen and ladder would be installed at this location. In addition, Soap Creek Feeder and Lower Ripley Creek Feeder would be retained, but no new fish screens and fish ladders would be installed. Accordingly, the construction impacts associated with removal of those dams and the changes to associated structures that are proposed under the Five Dam Removal Alternative would be avoided.

Although some of the lands disturbed by construction (e.g., staging areas and areas over tunnels and pipelines) would be restored or revegetated to conditions approximating their preconstruction condition, others will be permanently converted to other uses, including:

- access roads, which include improvements to intersections and turnout improvements from main roads, construction of new access roads, and improvements (blading and graveling) to existing access roads;
- conveyances, which include overflow wasteways, bypass pipelines, chutes, stilling basins, tailrace connectors, channels, tunnels, sluiceway chutes, canals requiring excavation, backfilling, or realignment, and other water conveyances;
- appurtenant facilities, which include screen boxes, channel and gate structures, sediment trap basins, and tailrace dikes, wasteways, and access ramps; and
- dam site facilities, which include dams to be removed or improved with fish screens, fish ladders, and cofferdams.

Land use impacts associated with the Three Dam Removal Alternative would be similar to those described for the Five Dam Removal Alternative, although less extensive. The Three Dam Removal Alternative would have less impact than the Restoration Project and, therefore, a less-than-significant impact to land use.

Cumulative Impacts

Cumulative land use impacts associated with the Proposed Action and past, present, or probable future projects (including those mentioned in Chapter 6) would not occur in the Battle Creek watershed because the Restoration Project is intended to remove dams, improve fish screens and ladders, and augment instream flows in North Fork and South Fork Battle Creek and some tributaries. Nothing in the Restoration Project is intended to change existing land uses in the Restoration Project or the surrounding lands. The Restoration Project would not impose any additional land use restrictions beyond limiting access to certain facilities for safety concerns and to restrict the opportunities for vandalism.

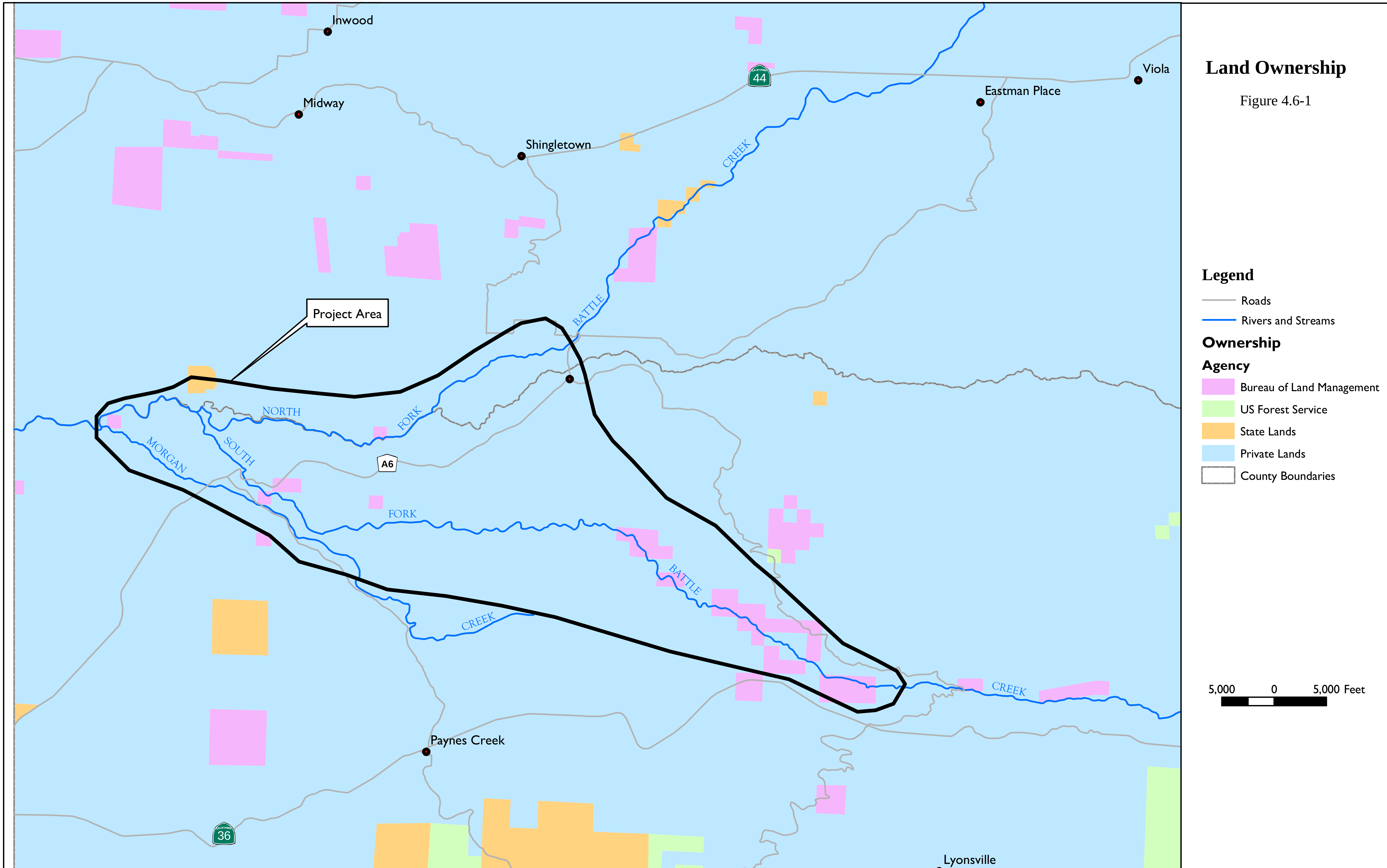
The Nature Conservancy (TNC) has established one conservation easement within the Battle Creek watershed and is negotiating with several other landowners about possibly acquiring others. In 1999, it purchased a conservation easement on the 36,000-acre Denny Ranch, which is located on both the north and south sides of Highway 36 about 7 miles northeast of the intersection of Highway 36 and Highway 99. The property will continue to be operated as a privately owned working cattle ranch, while its natural communities are permanently preserved from subdivision and development land uses. The Denny Ranch links protected BLM lands on its western borders with the Tehama National Wildlife Refuge to the east. In turn, the wildlife refuge adjoins Lassen National Forest and TNC's Dye Creek Preserve.

TNC believes that the next important step in protecting salmon and steelhead along Battle Creek is protecting the relatively pristine riparian habitat along the stream from alteration and preventing the loss or alteration of its cold spring water by well development. In this project, TNC, working in partnership with the BCWC, plans to acquire conservation easement interests from willing landowners on resource-rich Battle Creek properties with the potential for future development. These easements will provide conservation protection of natural processes while maintaining the land in private agricultural use and ownership. It is intended that the terms of the easements, although they may vary slightly to fit a particular property, will help ensure protection of the riparian habitat, prevent excessive water extraction and use, and ensure connectivity of the stream to the surrounding land.

The BLM has also acquired conservation easements on two properties in lower Battle Creek including land along the mouth of the stream. The purpose of these easements, acquired in October 2000 on the Gover Ranch, is to conduct riparian restoration activities along Battle Creek and the Sacramento River and to maintain the agricultural nature of these properties. The BLM will be developing a conservation plan for these properties and anticipates implementing restoration activities during the next 15 to 20 years.

The USFWS and TNC have obtained a conservation easement on Digger Creek in Shasta and Tehama Counties. In late September 2001, the TNC acquired the 1,844-acre Wildcat Ranch, which has approximately 2 miles of frontage along North Fork Battle Creek (TNC 2002). The ranch is just downstream from the 990-acre Canyon Ranch, which TNC previously had protected with a conservation easement. TNC will hold Wildcat Ranch for about 2 years in order to carry out studies and land stewardship work. It then will place a conservation easement on the ranch and sell it to a private buyer (TNC 2002). TNC will hold and monitor the conservation easement to ensure compliance with its terms.

Discussions concerning the establishment of additional conservation easements associated with the Restoration Project are not explicitly stated as part of the Restoration Project as defined for this land use analysis. Should conservation easements be negotiated with landowners in the vicinity of the Restoration Project, these negotiations would be conducted on a willing landowner basis, independent of Restoration Project implementation unless included in private negotiations.



Inwood
Midway
Shingletown
Eastman Place
Viola
44
Project Area
BATTLE
CREEK
NORTH
FORK
MORGAN
SOUTH
A6
FORK
BATTLE
CREEK
CREEK
Paynes Creek
36
Lyonsville
Land Ownership
Figure 4.6-1
Legend
Roads
Rivers and Streams
Ownership
Agency
Bureau of Land Management
US Forest Service
State Lands
Private Lands
County Boundaries
5,000 0 5,000 Feet

4.7 Geology and Soils

Affected Environment

Geology

Regional Setting

The Battle Creek Salmon and Steelhead Restoration Project area is within the Cascade Range Physiographic Province, which borders the northern end of the Sacramento Valley on the east and northeast. The Cascade Province is a young volcano-tectonic province that separates the Sierra Nevada Range from the Klamath Mountains, and contains numerous stratovolcanoes. Stratovolcanoes, or composite volcanoes, are constructed of alternating layers of lava and pyroclastic deposits (mostly ash) along with dikes and sills. Tertiary to Quaternary age (Pliocene to Recent) volcanism within this province formed a constructional plateau that dominates geology within the project area and the surrounding region (Figure 4.7-1). This volcanic plateau is tilted slightly to the west and is deeply dissected by numerous west-southwest to west-northwest trending drainages, some of which are bounded by steep canyon walls.

The Sacramento Valley is situated to the west of the project area. The Valley is a complex structural trough, bordered on both its east and west margins by a series of normal faults, and farther to the west by a series of right-lateral strike-slip faults. Recent seismotectonic and neotectonic studies (Unruh et al. 1995) show the presence of active west-to-east directed thrust faulting at depth within, and west of, the Sacramento Valley.

In the northern part of the Sacramento Valley, broad open folds have been superimposed on trough sediments. Within the area between Red Bluff and Anderson, major fold axes trend east-west and are locally associated with normal faults of similar orientations (Cox 1971). The Battle Creek fault is one of these northeast-trending fault systems.

The most regionally extensive volcanic unit between Chico and Redding is the Tuscan Formation. The Tuscan Formation is a series of lahars (i.e., volcanic mudflows) composed of tuff breccia and lapilli tuff, with minor lava flows, flow breccia, airfall tuff, and reworked fluvial volcanic sediments of late Pliocene age. This unit has a maximum thickness of about 1,700 feet and once covered approximately 2,000 square miles (Lydon 1968).

Forcefully intruding into the Tuscan Formation are several Quaternary Age basaltic to andesitic volcanic centers with cinder cones, scoria, lava flows, and associated airfall and fluvial deposits. Felsic volcanism in the eastern part of the area produced flows of rhyolite and dacite, with local accumulations of airfall tuff and pyroclastics. During formation of the volcanic centers, large areas of the basement tuff breccia underwent brittle fracture, and swarms of north to north-northwest and north-northeast trending fractures developed within it (Helley and Harwood 1985).

Local Setting

The project area has young volcanic centers bordering three of its sides: Black Butte to the north and northwest, Inskip Hill to the south and southwest, and Digger Butte to the east. Black Butte volcano borders the project area on the northwest, is within 3 miles of Wildcat Dam, and 7 miles of North Battle Creek Feeder Dam. This classically shaped volcanic cinder cone dominates the local landscape. Although its exact age is unknown, it probably formed about the same time as the cinder cones of Inskip Hill, Little Inskip Hill, and the Basalt Flows of Paynes Creek, which are dated by Helley and Harwood (1985) to have formed about 12,000 to 26,000 years ago. They also note that the twin volcanic cones of Digger Butte, about 4 miles east of the town of Manton, are about 450,000 years old or somewhat younger.

Farther east, but still within 20 miles, is the youngest volcanic center of significance to the project area, that of Mt. Lassen–Brokeoff Mtn.–Mt. Tehama. Mt. Lassen is the youngest volcano to have formed in the region. At a present day elevation of about 11,000 feet, it is one of the world's largest dacite volcanic domes. It formed over the past 2,000 years, with its most recent devastating eruption in the early 1900s. Schaffer (1999) states that there are 174 recorded eruptions for Mt. Lassen. He also notes that the most recent series of eruptions started on Memorial Day in 1914 and culminated with catastrophic eruptions in 1915 that destroyed a 1 by 3 mile area. From 1915 into 1917, eruptions became less frequent and from 1917 to the present, Mt. Lassen has been dormant. The dams on Battle Creek were built prior to the 1914–1917 eruptions of Mt. Lassen. There are no records stating that these structures were damaged by the volcanic eruptions.

Active faults are defined as those having had surface displacement within Holocene time (about the last 11,000 years). Potentially active faults are defined as faults having shown surface displacement during Quaternary time (the last 1.6 million years). According to the Fault-Rupture Hazard Zones in California (California Division of Mines and Geology 1999), no Alquist-Priolo Earthquake Fault Zones (i.e., active faults) pass through the Restoration Project area.

Shasta County has a low level of historic seismic activity. In the past 120 years, no substantial property damage or loss of life has been caused by earthquakes occurring within or near Shasta County. According to regional probabilistic ground shaking hazard maps (California Geological Survey 2003), the project area is subject to a 20 to 30% increase in earthquake-induced ground acceleration forces for a 10% probability of being exceeded in 50 years, a low probability relative to that of other portions of California.

Of particular significance to the project area is the regionally extensive, east-northeast trending Battle Creek fault zone. This structural zone comprises a series of down-to-the-south normal faults with a composite length of more than 20 miles between the Sacramento River and Volta Powerhouse. The fault zone has an apparent vertical offset ranging from 130 feet on the west to more than 1,400 feet on the east (LaForge and Hawkins 1986). Battle Creek's channel runs essentially parallel to this fault system.

The Battle Creek fault zone is late Quaternary in age, cutting volcanic flows of the Basalt of Coleman Forebay (younger than 1.08+0.16 million years ago [m.a.]) and its faults are covered by basalt flows of Black Butte (26–12 thousand years ago [k.a.]) and andesite flows of Brokeoff Mountain (<0.45 m.a.) (Helley and Harwood 1985). A site-specific study of the fault, performed by Harlan Miller Tait Associates (1983), indicates the most recent fault movement to be 500 to 550 k.a. For this reason the Battle Creek fault system is considered inactive. Even though this is a major fault system, mapping by USGS shows the position of the faults to be well north of the specific project construction sites. The fault zone comes closest to the North Battle Creek Feeder Diversion Dam site, where it is approximately ½ mile to the north.

Broad open folds are present in local volcanic bedrock. One example of this is within a cliff-forming portion of the Tuscan Formation to the southwest of Coleman Diversion Dam. Here, the contact between two tuff breccia flow members allows the observer to note a broad, open fold with an axis trending to the east-northeast.

Basement rocks within the project area are comprised of Pliocene age (about 2.4 million years) tuff breccia and flow breccia emplaced as volcanic mudflow (lahar) deposits, volcanic derived stream (fluvial) deposits, and minor airfall lapilli tuff. Helley and Harwood (1985) mapped these rocks as Unit D of the Tuscan formation (Ttd). Work by Lydon (1968) indicates that the tuff breccia is at least 500 feet thick within the project area.

Quaternary age volcanic flows, with minor airfall tuff and fluvial deposits, unconformably overlie the Tuscan Formation. In some places, volcanic flows directly cover the Tuscan Formation (i.e., on the plateau above South Powerhouse) and in other places, fluvial sediments formed alluvial fans or streams cut channels into the Tuscan Formation prior to the onset of basaltic volcanism (i.e., on the plateau above Inskip Powerhouse).

The Tertiary/Quaternary Age Red Bluff Formation comprises regionally extensive pediment deposits that unconformably overlie tuff breccia of the Tuscan Formation, and are present as erosional remnants on plateaus and hills flanking the northern Sacramento Valley. Within the project area, the Red Bluff Formation is composed of poorly to well-indurated gravel, cobbles, and boulders in a clayey sand matrix and is locally capped by, or interbedded with, basalt flows.

Recent deposits of colluvium (a mixture of weathered rock, soil, and other usually angular material on a slope) are generally thin. Soil zones across the volcanic plateaus are poorly developed clayey gravel with sand and cobbles, and are generally less than a few feet thick above fresh volcanic bedrock. However, weathering of the underlying basalt locally extends several feet to greater than 10 feet. Colluvium is generally deeper (a few feet to 20 feet) on hillsides and above terrace deposits. The soil is similar to that on the plateaus: poorly developed and composed of clayey gravel with sand, cobbles, and boulders.

There is no geomorphic evidence of landslides of significant size in the vicinity of proposed structure sites along South Fork Battle Creek. Outcrops of tuff breccia along this drainage form stable canyon slopes that are not prone to develop landslides.

Proposed construction sites along North Fork Battle Creek are located in deep canyons incised through several basalt flows. Along the creek there are numerous rockfall sites where 3- to 15-foot-diameter boulders have fallen from the canyon walls or where larger sections of the canyon wall have collapsed. A section of a 24-inch water pipeline from Wildcat Diversion Dam was damaged by such a rockfall in 1995 and was never rebuilt. All project sites within basalt canyons contain a certain risk of significant rockfall danger.

North Battle Creek Feeder Diversion Dam

The North Battle Creek Feeder Diversion Dam is situated in a steep canyon with a width of about 400 feet at the rim, narrowing to a creek bed of about 50 feet wide. The canyon walls are composed of several basalt flows, stacked one upon another. Parts of these flows are thick, hard, and massive while other parts are thin and intensely fractured rubble. All basalt flows from the rim of the canyon to the North Battle Creek Feeder Diversion Dam site are grouped together as Quaternary Basalt Unit 1 (Qb1). The only other significant geologic units in the canyon are Quaternary Colluvium (Qc) on the hillside, Quaternary Alluvium (Qal) in the present-day creek bed, and Quaternary Reservoir Sediment (Qrs) that is impounded behind the dam. Natural rockfall from the sides of the canyon have littered the creek bed and construction area with an abundance of large boulders 3 to 11 feet across. These boulders form an alternating series of rapids and small quiet pools along the river.

Typical joint patterns in local basalt flows create about 15% blocks of hard basalt greater than 6 feet across; about 20% blocks of basalt 3 to 6 feet across; about 30% blocks of basalt 1 to 3 feet across; about 20% cobble-size clasts loose to very loosely held together by finer scoria; about 10% angular to subangular, highly vesicular, fresh to moderately weathered, hard to soft, gravel-size clasts very loosely held together by finer scoria; and about 5% sand and finer material. Soft, red-brown, weathered scoria that can easily break down into fine material by mechanical weathering. Local zones are weathered to clay.

At the dam, the reservoir sediment is estimated to be about 8 feet thick. Beneath the reservoir sediment, the natural creek bed hosts alluvium (Qal) with a much higher percentage of coarse alluvium, with a maximum size of about 10 feet. The depth to bedrock Qb1 basalt beneath reservoir sediment is unknown. It may be a few feet below the top of the natural creek bed, or several feet below. Where present in the creek bed, bedrock is likely to be moderately to slightly fractured, hard basalt.

The reservoir sediment (Qrs), as seen on the surface of the creek bed, is composed primarily of about 20% 3- to 5-inch-diameter, hard, subangular to subrounded cobbles; about 45% 5- to 12-inch-diameter, hard, subangular to subrounded cobbles; about 15% hard, subrounded boulders; and the remainder less than 3 inches in diameter.

Other geologic conditions include a general lack of well-developed soil, large angular boulders within the stream channel, and steep canyon walls. These conditions are similar to those downstream at the Eagle Canyon and Wildcat Diversion Dam sites.

Eagle Canyon and Wildcat Diversion Dams

Located approximately 2 miles apart, Eagle Canyon and Wildcat Diversion Dams are located in the deep canyon of North Fork Battle Creek in geologically similar environments. At each site, there is an approximate 100- to 160-foot elevation difference between the rim of the canyon and the creek channel or dam site. Canyon walls are nearly vertical and several flows of basalt are exposed. All basalt flows from the rim of the canyon to the Eagle Canyon Dam site are grouped together as Quaternary Basalt Unit 2 (Qb2); and from the rim of the canyon to Wildcat Dam are grouped together as Quaternary Basalt Unit 3 (Qb3). The flows are composed of medium gray, vesicular olivine basalt. Most flows exhibit a 2- to 4-foot-thick top zone of highly vesicular, locally fractured basalt with flow textures. The middle zone is generally 6 to 15 feet thick and is composed of massive basalt with medium- to widely-spaced cooling joints and a blocky fracture. Flows near the top of the Eagle Canyon site have a massive (i.e., unfractured) zone up to 40 feet thick. The bottom few feet of each flow are generally composed of variably cemented basalt rubble.

The only other significant geologic units within the canyon are Qal in the present-day creek bed, and minor amounts of Qrs impounded behind each of the dams. Little to no soil is present on near-vertical canyon walls. Shallow soil cover is present on localized, discontinuous benches.

Vertical basalt cliffs or large angular basalt boulders border both sides of the canyon. Angular, 3- to 15-foot-diameter boulders randomly occur in the stream channel. Large boulders that have fallen from the sides of the canyon into the stream channel have not been transported downstream.

South Diversion Dam

Geology at the South Diversion Dam site was not mapped or studied in detail by Reclamation. Geologic site inspections observed Tuscan Formation tuff breccia outcrops on moderately steep canyon walls. The nearest overlying unit is Blue Ridge Rhyolite (Pleistocene age), which crops out along the north and northeast rims of the relatively open canyon. Soils above the tuff breccia and local colluvial deposits are generally shallow and poorly developed.

South Powerhouse and Inskip Diversion Dam

The primary rock type at the South Powerhouse and Inskip Diversion Dam is late Pliocene-age Tuscan Formation tuff breccia. This unit forms the basement rock and is composed of 40 to 60% hard volcanic clasts within a moderately hard to moderately soft tuff matrix. The rock is very durable and exhibits few significant joints or other fractures.

Tuff breccia is overlain near the inlet portal to the tunnel by Pleistocene-age basalt breccia. The basalt breccia consists of monolithologic (i.e., one rock type) basalt clasts and scoria. Small dikes or sills of basalt intrude the tuff breccia locally.

A 10- to 15-foot section of poorly to moderately consolidated terrace deposits overlies bedrock near the fish ladder/fish screen site. These deposits consist primarily of coarse gravel and cobbles, with minor sand and few boulders.

Colluvial deposits cover about 60% of the site. Although most of these deposits are less than 2 to 3 feet thick, deposits from 15 to 20 feet thick are present at the inlet of the proposed tunnel. The deposits are composed of unconsolidated to poorly consolidated sand, gravel, cobbles, and boulders up to 3 feet in diameter. A poorly developed soil zone composed of clayey gravel with sand is present in the upper 1 to 2 feet of colluvium.

Alluvial deposits within South Fork Battle Creek were deposited on a highly irregular bedrock surface. In several locations, bedrock crops out within the active creek channel. At other nearby locations the alluvial deposits are relatively thick, in excess of 20 feet. Active streambed deposits are generally coarse, with an abundance of gravel and cobbles, with minor sand and boulders.

Steep rock slopes and vertical relief from 10 to more than 20 feet are present in the creek channel immediately upstream of the South Powerhouse and downstream from Inskip Diversion Dam.

Inskip Powerhouse and Coleman Diversion Dam

Basement rock at the Inskip Powerhouse and Coleman Diversion Dam is Tuscan Formation tuff breccia that has similar properties to those described for the tuff breccia occurring near the South Powerhouse and Inskip Diversion Dam sites. The tuff breccia is generally very durable and erosion-resistant.

The tuff breccia is locally overlain by terrace deposits and colluvium that have a combined thickness of 5 to 20 feet, averaging less than 15 feet. The terrace deposits form a broad bench on the north side of South Fork Battle Creek and consist primarily of coarse gravel, cobbles, and boulders with minor sand and fines. The colluvium is mostly clayey gravel with sand, cobbles, and boulders. A soil zone rich in organic matter is well developed in the upper 2 to 3 feet of colluvium.

Alluvial deposits within the active creek channel have been deposited on an irregular surface of tuff breccia. A wedge of coarse-grained gravel and cobble deposits, approximately 15 feet thick, is backed up behind Coleman Diversion Dam. The depth of the alluvial deposits in the remainder of the channel has not been investigated.

A hillside sloping at approximately 20 degrees flanks the northern side of this site. Bedrock along the bottom two-thirds of the hillside is tuff breccia, locally covered by thin colluvium. Along the upper one-third of the hillside, the Quaternary-age and Tertiary-age Red Bluff Formation overlies the tuff breccia. The Red Bluff Formation is composed of poorly to moderately indurated gravel, cobbles, and boulders in a clayey sand matrix. The soil zone along this hillside is poorly developed, with an abundance of clayey gravel with sand and cobbles.

Inskip Powerhouse Penstock Bypass Site

The plateau at the Inskip Powerhouse penstock bypass is composed primarily of Basalt of Eagle Canyon, which is present as several thin flows of vesicular olivine basalt of Pleistocene age. The basalt is generally fresh and hard and is traversed by widely to very widely spaced joints, with local zones of moderate to intense weathering and closely to moderately spaced joints.

Along the western portion of the bypass alignment, the basalt flows overlie poorly to moderately indurated gravel, cobble, and boulder deposits of the Red Bluff Formation.

Approximately 60% of the pipeline and chute alignment will encounter shallow deposits of colluvium, 1- to 3-foot-thick overlying basalt. The colluvium consists of red clayey gravel and sand with cobbles and boulders. The soil is poorly developed to nonexistent across the plateau.

Soils

Based on Soil Conservation Service (1967 and 1974) mapping, the soils in the project area are generally underlain by volcanic rock or volcanic breccia. A number of the primary project element sites are mapped as areas of Rock land, which contain only scattered patches of very shallow soils.

Where appreciable soil materials are present, the Toomes and Supan series have been mapped. Toomes soils are on nearly level to very steep slopes, are well drained, and are shallow to very shallow over rock, rocky, and medium-textured. Supan soils are on undulating to steep slopes and are well drained, shallow over a clay subsoil, stony, and medium-textured. (Soil Conservation Service 1967 and 1974).

Because of the steep slopes in the project area, both the Toomes and Supan soils and the soil materials in mapped areas of Rock land are subject to rapid runoff rates. They generally have a moderate to severe hazard of water erosion when the vegetative cover has been removed. (Soil Conservation Service 1967 and 1974) Wind erosion hazard is expected to be low to moderate for the Toomes and Supan soil given the characteristic soil particle sizes.

Table 4.7-1 provides a summary of salient soil properties at the primary project sites.

Table 4.7-1. Summary of Soil Characteristics at Primary Project Sites

Project Element Site	Soil Mapping Unit	Runoff Rate	Wind Erosion Hazard with Vegetation Removed	Water Erosion Hazard with Vegetation Removed	Typical Thickness Over Rock or Restrictive Layer (inches)
Inskip Diversion Dam	Toomes very rocky loam, 30 to 50% slopes and Supan stony loam, 30 to 50% slopes	Rapid	Inferred to be low to moderate	High to Severe	8 to 20
Lower Ripley Creek Feeder	Toomes rocky loam, 10 to 30% slopes	Inferred to be medium	Inferred to be low to moderate	Inferred to be moderate	12 to 24
Soap Creek Feeder	Supan stony loam, 10 to 30% slopes	Medium	Inferred to be low to moderate	Moderate	20
South Diversion Dam	Rock land	Inferred to be high	Inferred to be low	Inferred to be moderate to high	Not applicable

Project Element Site	Soil Mapping Unit	Runoff Rate	Wind Erosion Hazard with Vegetation Removed	Water Erosion Hazard with Vegetation Removed	Typical Thickness Over Rock or Restrictive Layer (inches)
Inskip Powerhouse/ Coleman Diversion Dam	Rock land	Inferred to be high	Inferred to be low	Inferred to be moderate to high	Not applicable
Wildcat Diversion Dam	Rock land	Inferred to be high	Inferred to be low	Inferred to be moderate to high	Not applicable
Eagle Canyon Diversion Dam	Rock land	Inferred to be high	Inferred to be low	Inferred to be moderate to high	Not applicable
North Battle Creek Feeder Diversion Dam	Rock land	Inferred to be high	Inferred to be low	Inferred to be moderate to high	Not applicable
New Access Road for North Battle Creek Feeder Diversion Dam	Rock land	Inferred to be high	Inferred to be low	Inferred to be moderate to high	Not applicable
New Access Road for Inskip Diversion Dam	Toomes very rocky loam, 30 to 50% slopes	Inferred to be rapid	Inferred to be low to moderate	Inferred to be high	12

Source: Soil Conservation Service 1967 and 1974.

Regulatory Setting

The following geology-related regulations apply to the Restoration Project.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was signed into law December 22, 1972, and went into effect March 7, 1973. The Act, codified in the Public Resources Code as Division 2, Chapter 7.5, has been amended 11 times. The purpose of this Act is to prohibit the construction of most structures for human occupancy across the traces of active faults and to thereby mitigate the hazard of fault rupture (Section 2621.5 of the Public Resources Code).

California Surface Mining and Reclamation Act

The California Surface Mining and Reclamation Act (Pub. Res. Code Section 2710 et seq.) establishes statewide mineral conservation policies that are implemented by counties and cities through local surface mining ordinances. The ordinances apply to surface mining operations and would not be applicable to the proposed project. Nonetheless, these policies discourage local governments from allowing new incompatible uses (essentially defined as permanent, urban uses) in areas identified by the state geologist as containing mineral resources that are either locally important or of statewide value.

Uniform Building Code

The Uniform Building Code (UBC) is updated periodically by the International Conference of Building Officials. The UBC is a standard reference in California for earthquake and seismic design measures.

Environmental Consequences

Summary

Significant geology or soils impacts are associated with the No Action Alternative. The Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal) would result in significant water and wind erosion impacts. However, implementing the appropriate mitigation measures described below would reduce these impacts to a less-than-significant level. Disturbance would be limited to areas associated with construction, modification, or removal activities, including streambeds, stream banks, temporary and permanent access roads, staging areas, and Hydroelectric Project dam site facilities, conveyances, and appurtenant facilities. Reclamation will implement mitigation measures to reduce significant impacts to a less-than significant level.

Impact Significance Criteria

Based on Appendix G of the State CEQA Guidelines, the project would have a significant effect on the environment if it would:

- Expose people or structures to major geologic hazards, including earthquakes, ground failure, or similar hazards.
- Result in substantial soil erosion or the loss of topsoil.

- Be located on a geologic unit or soil that is unstable or would become unstable and could potentially result in a landslide, lateral spreading, subsidence, liquefaction, or collapse.

Impact Assessment

As applicable, the General Environmental Protection Measures listed in the introduction to this chapter shall be utilized for this resource. In addition, specific mitigation measures for geology and soils are identified below.

No Action Alternative

No geological or soil impacts are expected to occur from implementation of the No Action Alternative.

Five Dam Removal Alternative (Proposed Action)

Impact 4.7-1 Significant—Potential accelerated water and wind erosion from construction activities.

Extensive vegetation removal and ground disturbance would result from implementation of the Five Dam Removal Alternative. This disturbance would result from clearing, grading, blading, graveling, and related activities needed to facilitate construction of fish screens and ladders, as well as the removal of Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams. Specifically, construction activities would expose soils to erosion at the following types of construction sites and facilities:

- Access roads, which would include intersection and turnout improvements from main roads, the construction of new roads at the North Battle Creek Feeder and Inskip Diversion Dam/South Powerhouse Dam sites, blading and graveling existing unimproved access roads, and other needed improvements at 13 separate sites.
- Staging areas, which include the clearing and grading of 14 to 17 separate sites ranging from 0.5 to 7.5 acres in size. These areas would typically be situated at the rims of canyons overlooking dam sites, near dam sites, or at the terminal points of access roads.
- Conveyances, which would include canals requiring excavation, backfilling, or realignment, overflow wasteways, bypass pipelines, chutes, canals, stilling basins, tailrace connectors, channels, tunnels, sluiceway chutes, and other water conveyances at 10 to 12 sites needed for completing Restoration Project hydraulic improvements.
- Appurtenant facilities, which include screen boxes, channel and gate structures, sediment trap basins, tailrace dikes and wasteways, tailrace access

ramps, borrow areas, and other facilities at 12 to 14 other sites needed to complete Restoration Project hydraulics.

- Dam site facilities, which would include dams to be removed or improved with fish screens and ladders, cofferdams, and other immediate construction activities within or adjacent to the eight dam sites, usually in-water.

These activities are individually and collectively significant because they could result in substantial soil erosion or the loss of topsoil. Because construction would take 3 years to complete and because construction contractors would be allowed a certain level of flexibility regarding construction methods and, to some extent, the locations for some of these activities, the actual extent and severity of these impacts would remain uncertain until construction has begun. Implementing the following mitigation measures would reduce this significant impact to a less-than-significant level.

Mitigation Measure for Impact 4.7-1. The construction contractor will implement an erosion and sediment control plan at each site where soils will be disturbed and or exposed by construction activities. Each plan will include appropriate erosion and sediment control BMPs to control accelerated erosion, slope instability, and sedimentation that could result from clearing, grading, and other ground-disturbing activities during construction. These activities, which would be included in the Storm Water Pollution Prevention Plan, to be prepared by Reclamation, may include but not be limited to:

- minimizing the amount of vegetation removal and soil disturbance to the extent practicable;
- spraying water on exposed soils to minimize wind erosion and dust during construction;
- avoiding the disturbance of steep slopes whenever feasible;
- constructing fill slopes of a 2:1 (i.e., horizontal:vertical) ratio or flatter;
- constructing V-ditches above cut and fill slopes to divert water from newly exposed slope faces, if appropriate;
- using temporary and permanent stabilization practices, such as temporary and permanent seeding, mulching, erosion control blankets, or aggregate surfacing;
- installing fiber rolls or silt fences downslope of disturbed areas to control sediment;
- constructing temporary or permanent sedimentation basins as needed;
- selectively removing, stockpiling, and replacing topsoil as a medium for revegetation (this measure should be implemented where more than 6 inches of topsoil is removed);
- stabilizing drainage channels using rock lining or similar natural materials;

- stabilizing borrow areas with temporary and ultimately permanent vegetation; and
- monitoring the BMPs and making repairs as required so that disturbed areas are adequately stabilized, as defined by the erosion and sediment control plans.

Impact 4.7-2 Less than Significant—Construction workers could be exposed to falling rocks.

Dam removal and potential blasting activities could expose construction workers to safety hazards, including injury or loss of life from falling rocks along North Fork Battle Creek. Construction contractors will enforce applicable federal, state, and local safety standards during all dam removal and construction activities. Accordingly, as part of Restoration Project implementation, Reclamation has committed to the following measures as worded in the construction specifications for the project:

- Do not require anyone employed in performance of the contract (including subcontracts) to work under conditions that are unsanitary, hazardous, or dangerous to the employee's health or safety.
- Under no circumstances will onsite work, including mobilization, be permitted until the safety program has been considered acceptable by the contracting officer's representative.
- Fully participate in a Contractor Safety Program Review meeting, according to the Reclamation's Safety and Health Standards, Section 3.4.1, prior to mobilization. Include subcontractor management representatives.
- The minimum work crew at any time on the construction site will consist of no less than two people and be in accordance with other contractual obligations.
- Develop job hazard analyses for each distinct phase of work under the contract. Work will not begin on the phase of work until a job hazard analysis is acceptable to onsite agency personnel. Activities involving hazardous materials shall have the appropriate Material Safety Data Sheet(s) attached to the job hazard analysis.
- In addition to complying with requirements listed under the clause entitled "Accident Prevention," fully comply with Reclamation's Safety and Health Standards. One copy of this handbook will be provided at no charge for use in connection with the specifications in accordance with the notice titled "Notice of Safety and Health Requirements and Safety Handbook Availability—Reclamation." Additional copies may be obtained from the Superintendent of Documents, item stock No. 024-003-00178-3, phone No. (202) 512-1800. Construction Safety and Health Standards promulgated by the Secretary of Labor may be obtained from any regional or area office of the Occupational Safety and Health Administration of the U.S. Department of Labor.

- Be cognizant of and ensure compliance with requirements set forth in the paragraphs above. Contractor's responsibility applies to all operations, including those of the contractor's subcontractors. When violations of safety and health requirements contained in these specifications or referred standards are called to the contractor's attention by the contracting officer or the contracting officer's representatives, immediately correct the condition. Either oral or written notice shall be deemed sufficient.
- When the contractor fails or refuses to promptly correct a compliance directive, the contracting officer or the contracting officer's representative may issue an order to stop all or any part of the work. When satisfactory corrective action is taken, an order to resume work will be issued. The contractor shall not be entitled to extension of time, nor to claim for damage or to additional compensation by reason of either the directive or the stop order. Failure of the contracting officer or the contracting officer's representative to order discontinuance of any or all of the contractor's operations shall not relieve the contractor of the responsibility for the safety of personnel and property.
- Maintain an accurate record of, and report to the contracting officer's representatives in the manner prescribed by the contracting officer, all cases of death, occupational diseases, or traumatic injury to employees or the public involved, and property damage in excess of $2,500 occurring during the performance of work under this contract.
- The rights and remedies of Reclamation provided in this section are in addition to any other rights and remedies provided by law or under this contract. In the event there is a conflict between requirements contained in Reclamation's Safety and Health Standards, specification paragraphs, contractor's approved safety program, referenced safety and health codes, and standards, or the U.S. Department of Labor Construction Safety and Health Standards, promulgated under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327 et seq), as amended, the more stringent requirement shall prevail.

Implementation of these measures, especially the daily monitoring of rockfall hazards and strict adherence to safety precautions associated with the removal of workers prior to and during all blasting, would not eliminate the potential for a rockfall hazard resulting in injury or loss of life. However, strict implementation of these measures resulting in an awareness of rockfall hazards would reduce this significant impact to a less-than-significant level.

No Dam Removal Alternative

Impact 4.7-3 Significant—Potential accelerated water and wind erosion from construction activities.

Extensive vegetation removal and ground disturbance would result from implementation of the No Dam Removal Alternative. This disturbance would result from clearing, grading, blading, graveling, and related activities needed to facilitate construction of the fish screens and ladders. This impact is similar to Impact 4.7-1 described under the Five Dam Removal Alternative.

Specific construction activities that would expose soils to erosion are listed under Impact 4.7-1. Because construction would take 3 years to complete and because construction contractors would be allowed a certain level of flexibility regarding construction methods and, to some extent, the locations for some of these activities, the actual extent and severity of these impacts would remain uncertain until construction has begun. However, implementing the mitigation measures for Impact 4.7-1 would reduce this significant impact to a less-than-significant level.

Impact 4.7-4 Less than Significant—Construction workers could be exposed to falling rocks.

Installation of fish screens and ladders could expose construction workers to safety hazards, including injury or loss of life from falling rocks along North Fork Battle Creek. This impact is similar to Impact 4.7-2 described above under the Five Dam Removal. Construction contractors will enforce applicable federal, state, and local safety standards during all dam removal and construction activities. Accordingly, as part of Restoration Project implementation, Reclamation has committed to the measures identified above under Impact 4.7-2, as worded in the construction specifications for the project. Implementation of these measures, especially the daily monitoring of rockfall hazards, would not eliminate the potential for a rockfall hazard resulting in injury or loss of life. However, strict implementation of these measures resulting in an awareness of rockfall hazards would reduce this significant impact to a less-than-significant level.

Six Dam Removal Alternative

Impact 4.7-5 Significant—Potential accelerated water and wind erosion from construction activities.

Extensive vegetation removal and ground disturbance would result from implementation of the Six Dam Removal Alternative. This disturbance would result from clearing, grading, blading, graveling, and related activities needed to facilitate construction of the fish screens and ladders, as well as the removal of Eagle Canyon, Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams. This impact is similar to Impact 4.7-1 described under the Five Dam Removal Alternative.

Specific construction activities that would expose soils to erosion are listed under Impact 4.7-1. Because construction would take 3 years to complete and because construction contractors would be allowed a certain level of flexibility regarding construction methods and, to some extent, the locations for some of these activities, the actual extent and severity of these impacts would remain uncertain until construction has begun. However, implementing the mitigation measures for Impact 4.7-1 would reduce this significant impact to a less-than-significant level.

Impact 4.7-6 Less than Significant—Construction workers could be exposed to falling rocks.

Dam removal and potential blasting activities could expose construction workers to safety hazards, including injury or loss of life from falling rocks along North Fork Battle Creek. This impact is similar to Impact 4.7-2 described above under the Five Dam Removal. Construction contractors will enforce applicable federal, state, and local safety standards during all dam removal and construction activities. Accordingly, as part of Restoration Project implementation, Reclamation has committed to the measures identified above under Impact 4.7-2, as worded in the construction specifications for the project. Implementation of these measures, especially the daily monitoring of rockfall hazards and strict adherence to safety precautions associated with the removal of workers prior to and during all blasting, would not eliminate the potential for a rockfall hazard resulting in injury or loss of life. However, strict implementation of these measures resulting in an awareness of rockfall hazards would reduce this significant impact to a less-than-significant level.

Three Dam Removal Alternative

Impact 4.7-7 Significant—Potential accelerated water and wind erosion from construction activities.

Extensive vegetation removal and ground disturbance would result from implementation of the Three Dam Removal Alternative. This disturbance would result from clearing, grading, blading, graveling, and related activities needed to facilitate construction of the fish screens and ladders, as well as the removal of Eagle Canyon, Wildcat, and Coleman Diversion Dams. This impact is similar to Impact 4.7-1 described under the Five Dam Removal Alternative.

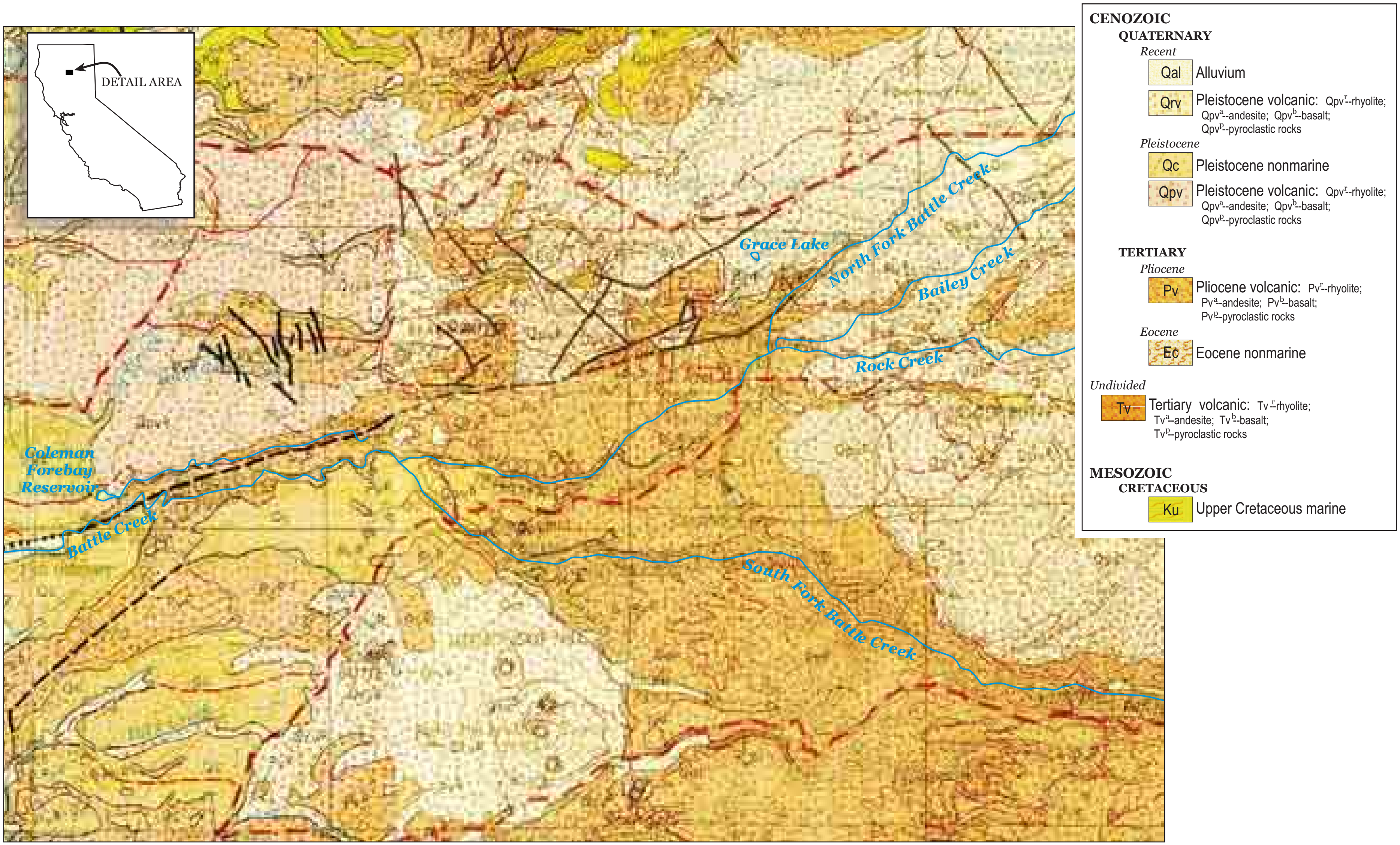
Specific construction activities that would expose soils to erosion are listed under Impact 4.7-1. Because construction would take 3 years to complete and because construction contractors would be allowed a certain level of flexibility regarding construction methods and, to some extent, the locations for some of these activities, the actual extent and severity of these impacts would remain uncertain until construction has begun. However, implementing the mitigation measures for Impact 4.7-1 would reduce this significant impact to a less-than-significant level.

Impact 4.7-8 Less than Significant—Construction workers could be exposed to falling rocks.

Dam removal and potential blasting activities could expose construction workers to safety hazards, including injury or loss of life from falling rocks along North Fork Battle Creek. This impact is similar to Impact 4.7-2 described above under the Five Dam Removal. Construction contractors will enforce applicable federal, state, and local safety standards during all dam removal and construction activities. Accordingly, as part of Restoration Project implementation, Reclamation has committed to the measures identified above under Impact 4.7-2, as worded in the construction specifications for the project. Implementation of these measures, especially the daily monitoring of rockfall hazards and strict adherence to safety precautions associated with the removal of workers prior to and during all blasting, would not eliminate the potential for a rockfall hazard resulting in injury or loss of life. However, strict implementation of these measures resulting in an awareness of rockfall hazards would reduce this significant impact to a less-than-significant level.

Cumulative Impacts

Implementation of the Restoration Project, in combination with other past, present, and reasonably foreseeable projects (including those mentioned in Chapter 6), would not result in cumulative impacts on geologic and soil resources. Engineering feasibility studies and planning for Restoration Project construction have accounted for past impacts to geologic and soil resources and incorporated these considerations into the alternative feasibility planning and subsequent descriptions. There are no other present or reasonably foreseeable projects that would potentially affect geologic and soil resources in areas to be disturbed by Restoration Project construction activities. The impacts associated with the Coleman National Fish Hatchery improvements are unknown at this point. Any future environmental documentation associated with Coleman National Fish Hatchery improvements would disclose environmental impacts.



Source: Geologic Map of California, Olaf P. Jenkins Edition, Westwood and Redding Sheets

Figure 4.7-1

Regional Geology

4.8 Aesthetics and Visual Resources

Affected Environment

Regional Setting

The Restoration Project encompasses a portion of the larger Battle Creek watershed and is located on the western volcanic slopes of Mt. Lassen in southeastern Shasta and northeastern Tehama Counties. Descending from Mt. Lassen, the Restoration Project slopes gradually westward toward the Sacramento Valley. To the west, panoramic views of the foothills, Sacramento Valley, Trinity Alps, and Coast Range are available. To the east, distant views of Lassen Peak and adjacent mountains are available from many locations within the region.

Local Setting

The western portion of the Restoration Project is composed of a gradually sloping bluff surrounded on the north and south by higher and more steeply sloping areas. From the north, panoramic views overlooking the lower portion of the Restoration Project are available from Wilson Hill Road as it descends the slopes on the north side of the Restoration Project, just south of Shingletown and Highway 44 (Figure 4.8-1).

Figure 4.8-1
Battle Creek Watershed

The eastern portion of the Restoration Project is composed of steeply sloping areas, where creek drainages are deeply incised and views are characterized by enclosed landscapes. The steep topography limits panoramic or distant views, while surrounding ridgelines restrict views within any particular drainage to views of that drainage.

Battle Creek Visual Sensitivity

The scenic quality of the Restoration Project is defined by the character of the landscape at each facility location as well as dominant elements in the landscape, such as distant views of Lassen Peak and adjacent mountains. Landscape character varies from panoramic landscapes in the western portion of the Restoration Project area to more enclosed landscapes in the eastern portion. The landscape character in the immediate vicinity of most Restoration Project facilities is considered to include enclosed landscapes. Enclosed landscapes are normally defined by “wall” and “floor” characteristics, such that the floor, composed of a creek, lake, or meadow, is surrounded by walls of trees or earth forms. As wall definition is lost because of distance, views become more panoramic in character (U.S. Department of Agriculture, Forest Service 1973).

Although scenic quality is high in the vicinity of all Restoration Project facilities, the visual sensitivity of each facility must be determined to assess impacts on visual resources. The visual sensitivity of each facility was evaluated by determining visibility of each facility from the following receptors (U.S. Department of Agriculture, Forest Service 1974):

- Primary and secondary roads and trails, including scenic highways, or roads leading directly to major areas of interest (national parks, national recreation areas, wilderness, dedicated wild areas, major recreation composites, historic sites and areas, and botanical sites);
- Fishing, swimming, and boating areas and other active or passive recreational areas located adjacent to water bodies such as creeks or lakes;
- Recreation areas, such as vista points, campgrounds, picnic grounds, visitor centers, or trail camps;
- Resorts and winter sports areas;
- Geological and botanical areas;
- Historical sites;
- Areas of primary importance for observation of wildlife;
- Tracts of primarily summer homes; and
- Highly sensitive communities, such as one where a large portion of the population is not directly related to performing land management activities.

North Fork Battle Creek Key Observation Points

Within the Restoration Project, North Fork Battle Creek traverses privately owned lands. Views of the North Fork Battle Creek channel are limited by topography. Roads providing direct access to North Fork Battle Creek are private and gated, limiting public access. The creek channel is deeply incised, with creek banks rising 100 to 200 feet from the creek channel at near-vertical slopes in some sections. Since public access to lands adjacent to the creek channel is restricted, there are few locations where North Fork Battle Creek is visible from public viewing or recreational areas.

Public Roadways

Public roadways in the North Fork Battle Creek vicinity include Highway 44, Wilson Hill Road, Battle Creek Bottom Road, Wildcat Road, and Manton Road (Figure 4.8-2). Highway 44 is a regional road that serves as one of the primary access roads to Lassen Volcanic National Park. This highway is located north of the Restoration Project. North Fork Battle Creek is not visible from this roadway. South of Highway 44 and Shingletown, panoramic views of the Battle Creek watershed are available from a section of Wilson Hill Road located north of the Restoration Project. However, the intervening distance (3 miles or more) and topography restrict visibility of Restoration Project facilities from distant and nearby areas. Hydroelectric Project facilities are located within or adjacent to the North Fork Battle Creek channel, which is lower in elevation than surrounding areas. This limits visibility of North Fork Battle Creek to the areas immediately adjacent to the channels. The creek is visible where Wildcat Road crosses the creek in the western portion of the Restoration Project. North Fork Battle Creek is not visible from Battle Creek Bottom Road, Wildcat Road, or Manton Road. No Hydroelectric Project facilities are located where North Fork Battle Creek is visible.

Recreational Receptors

Visual sensitivity of the Restoration Project is limited by the absence of public recreational or viewing areas (e.g., swimming areas and vista points) along North Fork Battle Creek and its adjacent upland areas. Recreational activities that occur in and around North Fork Battle Creek are performed primarily by people who are fishing at public access locations and who have purchased trespass rights along Battle Creek. Since sport fishermen purchasing trespass rights are viewing features from specific locations, visibility of Restoration Project facilities by these receptors at any key observation point cannot be determined. Camp Latieze, located in Manton, is the only campground in the Restoration Project area. However, North Fork Battle Creek is not visible from this camp.

Residential Neighborhoods or Communities

North Fork Battle Creek and the Hydroelectric Project facilities in this creek are not visible from any nearby communities. Views from the southernmost residential areas of Shingletown (south of Highway 44) are panoramic, overlooking Battle Creek and the surrounding watersheds. However, the distance between Hydroelectric Project facilities and these residences (3 miles or more) limits the potential visibility of North Fork Battle Creek and the Hydroelectric

Project facilities. In addition, intervening topography further restricts visibility of Hydroelectric Project facilities from distant and nearby areas.

South Fork Battle Creek Key Observation Points

Most lands along South Fork Battle Creek are in private ownership. However, the private lands are interspersed with small areas of public lands. Because of the area's remote nature and the abundance of privately owned lands, public access to South Fork Battle Creek is fairly limited.

Public Roadways

Highway 36 is located south of South Fork Battle Creek and is one of the primary access roads to Lassen Volcanic National Park. This highway is located south of the Restoration Project. No Hydroelectric Project facilities are visible from this roadway. Manton Road connects Highways 36 and 44 and could be considered a secondary access road to Lassen Volcanic National Park. South Fork Battle Creek is visible at the Manton Road Bridge, approximately one-half mile downstream of Coleman Diversion Dam. However, the dam is not visible from this bridge. Approximately 2,000 feet east of this bridge, there is a short section of Manton Road, just east of its intersection with the dam's access road, where brief views of South Fork Battle Creek and Coleman Diversion Dam are available. However, these views are mostly screened by intervening trees (Figure 4.8-2) and their visibility is further reduced by the distance and elevation change.

Recreational Receptors

There are more recreational uses along South Fork Battle Creek than North Fork Battle Creek, but the extent of such uses is still limited. Recreational uses include fishing, hunting, kayaking, and one lodging facility. Public access for fishing is also available near Inskip Powerhouse. Hydroelectric Project facilities could also be visible to those who have purchased trespass rights along South Fork Battle Creek for hunting and fishing. However, because these receptors are not location-specific, the visibility of Hydroelectric Project facilities cannot be determined. South Fork Battle Creek within the Restoration Project area (from approximately 0.75 mile downstream of the South Diversion Dam to the Coleman National Fish Hatchery) has been used for kayaking, although it is not listed in any official river rafting guidebooks (see Section 4.14, "Recreation," for more discussion). For kayakers, Inskip Diversion Dam and Coleman Diversion Dam are visible.

Figure 4.8-2
Inskip Powerhouse and Coleman Diversion Dam from Manton Road

Inskip Diversion Dam and Coleman Diversion Dam make these two sections of South Fork Battle Creek unrunnable; kayakers must leave the water and portage around these facilities. The Oasis Springs Lodge, a fly-fishing lodge and dude ranch, is located adjacent to Inskip Diversion Dam on South Fork Battle Creek. Existing views of Inskip Diversion Dam from the Oasis Springs Lodge are shown in Figure 4.8-3.

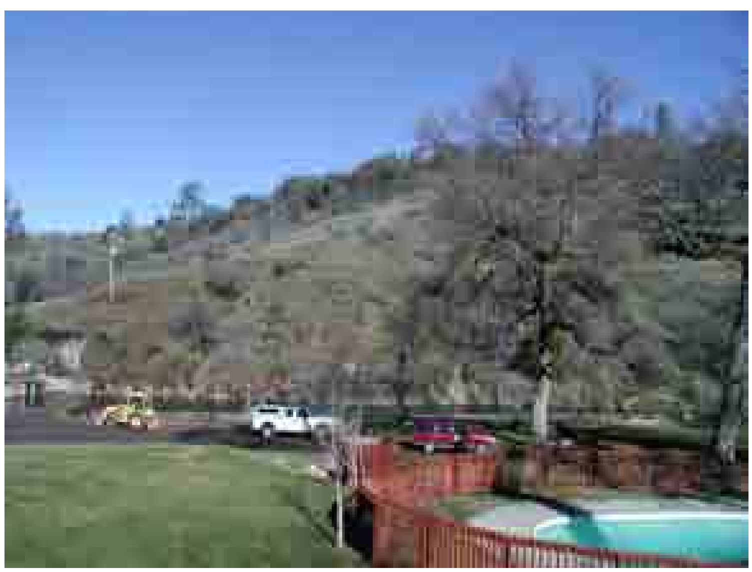


Figure 4.8-3
Inskip Diversion Dam from Oasis Springs Lodge

Public Lands

Public lands managed by the BLM are located adjacent to or near South Diversion Dam on South Fork Battle Creek. Recreational use of these public lands is limited by their inaccessibility, but could include hunting, which is permitted on BLM lands, and kayaking. Ponderosa Way provides public access to BLM lands, but steep terrain and intervening vegetation limit the visibility of South Diversion Dam to the slopes immediately above the creek. Visual sensitivity of the section of South Fork Battle Creek is limited by the area's inaccessibility and steep terrain.

Other Key Observation Points

Darrah Springs Hatchery is located at Darrah Springs on Baldwin Creek, a tributary to mainstem Battle Creek. This hatchery is located at the western extent of the Restoration Project. Public access for fishing on Baldwin Creek is available at this location. The Asbury Diversion Dam and pump station are located on Baldwin Creek, where public access for fishing is available. These facilities are visible from Baldwin Creek where the access road crosses over Baldwin Creek (Figure 4.8-4).

Figure 4.8-4
Asbury Pump Station

Regulatory Setting

The following laws, regulations, or policies are related to aesthetics and visual resources.

Redding Resource Management Plan

Public lands within the Restoration Project area are managed by the BLM. The Restoration Project is located within the BLM's Ishi Management Area. The Redding Resource Management Plan provides guidelines for managing and allocating resources within this area and identifies Battle Creek as having regional recreational, fisheries, and biological values with the most important segment located on South Fork Battle Creek below Manton Road. The plan indicates that this segment of Battle Creek contains the majority of chinook salmon spawning habitat, generally adequate water flows for recreational pursuits, and nesting raptors including bald eagle. The Coleman National Fish Hatchery is also located on this segment.

The plan calls for consolidation of public lands along the segment of Battle Creek below Manton Road and active BLM management of this area (e.g., improving semiprimitive recreational opportunities, enhancing anadromous fisheries, maintaining and improving riparian vegetation, protecting wildlife habitat, and maintaining the area's scenic quality). The plan also states that the Battle Creek corridor (below Manton Road) should be managed as Visual Resource Management Class II, which is described as follows:

> The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

Hydroelectric Project facilities on South Fork Battle Creek are located upstream of Manton Road and outside BLM-managed lands. Therefore, Restoration Project conformance with these management objectives and actions would not be required. However, these objectives provide useful guidelines for evaluating the Restoration Project's visual impacts on this section of South Fork Battle Creek.

National Wild and Scenic Rivers System

Map 3 of the Ishi Management Area of the Redding Resource Management Plan designates South Fork Battle Creek as eligible for inclusion in the National Wild and Scenic Rivers System. Battle Creek has not been included in the system nor is it currently under study for inclusion. The plan indicates that continued BLM administration of public lands above Manton Road hinges on a conclusive determination that this portion of South Fork Battle Creek is suitable for inclusion in the National Wild and Scenic Rivers System. Until that determination is made, the plan states that the BLM should manage these lands in a manner that does not impair any outstandingly remarkable values.

The Wild and Scenic Rivers Act of 1968 (16 USC 1271 et seq.) selects certain rivers that possess remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values; preserves them in a free-flowing condition; and protects their local environments. The Act establishes three classes of river areas:

- **Wild.** Free from impoundments, generally inaccessible except by trail, with essentially primitive watersheds or shorelines and unpolluted waters.
- **Scenic.** Free from impoundments, accessible in places by road, and with shorelines or watersheds still largely undeveloped.
- **Recreational.** Readily accessible by road or railroad, may have some development along the shoreline, and may have undergone some impoundment or diversion in the past.

According to the Redding Resource Management Plan, South Fork Battle Creek between Ponderosa Way and Manton Road Bridge is classified as “recreational.” Five Hydroelectric Project facilities (i.e., South Diversion Dam, South Powerhouse, Inskip Diversion Dam, Inskip Powerhouse, and Coleman Diversion Dam) are located within this section of South Fork Battle Creek. The segment between Manton Road Bridge and ¼ mile upstream of Coleman Powerhouse is classified as “scenic.” No Hydroelectric Project facilities are located along this segment of South Fork Battle Creek.

The Wild and Scenic Rivers Act requires that the rivers and streams included or proposed for inclusion into the system be considered during project planning and that project impacts be identified in an environmental assessment or environmental impact statement. The impacts on scenic quality along North Fork and South Fork Battle Creek are evaluated below.

Environmental Consequences

Summary

No significant aesthetics or visual resources impacts are associated with the No Action Alternative. Significant and unavoidable impacts are associated with all Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal) in the vicinity of the Oasis Springs Lodge. Disturbance would be limited to areas associated with construction, modification, or removal activities, including streambeds, stream banks, short-term and long-term access roads, staging areas, Hydroelectric Project dam site facilities, conveyances, and appurtenant facilities. Reclamation will implement mitigation measures where appropriate to reduce significant impacts to less-than-significant levels. For significant and unavoidable impacts to the Oasis Springs Lodge, mitigation is recommended but it would not reduce aesthetic or visual resource impacts to less-than-significant levels.

Impact Significance Criteria

According to Appendix G of the State CEQA Guidelines, impacts for this analysis would be considered significant if implementation of the Restoration Project would:

- have a substantial adverse effect on a highly visible scenic vista;
- substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings along a scenic corridor;
- block, disrupt, or reduce public viewing opportunities; or
- violate visual quality objectives adopted by federal, state, or local government agencies.

A reduction in mountainous, rural, and open space aesthetics, scenic vistas, and surrounding visual resources would represent significant environmental consequences. Short-term activities associated with construction were not considered potentially significant. However, visible scarring of landscape that would require more than 3 years to naturally restore views was considered significant.

Impact Assessment

As applicable, the General Environmental Protection Measures listed in the introduction to this chapter shall be utilized for this resource. In addition, specific mitigation measures for this resource are identified below.

No Action Alternative

The No Action Alternative would not affect aesthetic and visual resources. It would not alter existing views of Hydroelectric Project facilities or affect any scenic vistas. Therefore, the No Action Alternative would not adversely affect aesthetics or visual quality in the Restoration Project area.

Five Dam Removal Alternative (Proposed Action)

The following facilities within the Restoration Project could be affected by the implementation of the Five Dam Removal Alternative:

- Wildcat Diversion Dam,

- Eagle Canyon Diversion Dam,
- North Battle Creek Feeder Diversion Dam,
- Coleman Diversion Dam (including Inskip Powerhouse bypass facility and tailrace connector),
- Inskip Diversion Dam (including South Powerhouse tailrace connector tunnel),
- South Diversion Dam,
- Soap Creek Feeder,
- Lower Ripley Creek Feeder, and
- Asbury Diversion Dam.

Each site is on private land or land owned by PG&E, and public access is restricted to these facilities, limiting visual sensitivity.

Impact 4.8-1 Significant and Unavoidable—Construction of tailrace connectors, new fish screens and fish ladders, and associated facilities would reduce scenic quality at the Oasis Springs Lodge. Existing views from the Oasis Springs Lodge's main building include:

- South Fork Battle Creek;
- Inskip Diversion Dam and appurtenant facilities (i.e., headworks, power lines, access path railings, and access stairs on the north side of the creek);
- Orange buoy markers that extend across the creek; and
- wooded, undeveloped hillsides to the north of the creek (Figure 4.8-5).

Existing views of the creek and dam would not be altered by this alternative. Although the Five Dam Removal Alternative would include upgrading the headworks and relocating power lines, such improvements would not significantly alter the existing scenic quality from the lodge's main building since appurtenant facilities are already visible from this location.

However, existing views of the wooded, undeveloped hillsides to the north would be substantially altered by construction of a new access road proposed to be constructed from South Powerhouse to Inskip diversion dam and canal. The access road would be visible from the Oasis Springs Lodge, its facilities, and its creek bank frontage. Figure 4.8-5 presents existing views of the north bank of South Fork Battle Creek from the lodge's creek bank vicinity (northwest of the lodge between the tennis court and pool). Figure 4.8-6 is a photo simulation depicting views of the proposed access road.

Figure 4.8-5
View of the North Bank of South Fork Battle Creek from Oasis Springs Lodge

Figure 4.8-6
Photo Simulation of the View of the Proposed Access Road from Oasis Springs Lodge

Views of the road's cut slope from most of the lodge's main building would be screened by existing mature trees located north of the pool and along the southern creek bank. However, the cut slope would be visible from the lodge's westernmost rooms, lawn area, and tennis court because of the lack of tree screens in this vicinity. Although the cut slope would be hydromulched and revegetated with grasses within 3 years of construction, the change in views resulting from proposed grading and tree removal would require more than 3 years before wooded hillside views could be restored. Therefore, visual impacts on the Oasis Springs Lodge resulting from proposed road construction would be significant.

Downstream of Inskip Diversion Dam, views from the lodge's main building of the existing fish ladder and Inskip Canal are mostly obscured by the tennis court, trees, and the dam. Under this alternative, proposed facilities located downstream of the dam include a new fish ladder proposed on the north side of the creek and an access path extending northward from the fish screen and ladder. The tennis court, trees, and the dam would obscure views of these facilities from the lodge's main building. Topography and trees on the northern creek bank would also help block or screen most views of the west end of the access road, parking lot, and fish ladder facilities from the lodge's main building and tennis court. Nevertheless, there could be limited views of cut slopes resulting from grading along the northern creek bank to accommodate the proposed access road and parking lot.

Although views of these facilities from the lodge's main building would be screened, patrons fishing along the lodge's creek frontage would view most proposed facilities along this section of the creek. This is because the lodge's fishing rights extend beyond the main building vicinity (downstream of the Inskip Diversion Dam and upstream of South Powerhouse). These facilities would also be visible to kayakers using this section of the creek. The cut slope above the proposed access road, the proposed fish ladder facilities, the South Powerhouse tailrace connector, and the potential borrow site and staging area located east of the South Powerhouse would be visible from the lodge's creek bank frontage. Proposed tree removal would further increase the visibility of Restoration Project construction (primarily associated with road, parking lot, and tailrace connector facilities) from locations along the lodge's creek bank frontage.

Changes in creek bank views resulting from the construction of the fish ladder and tailrace connector tunnel facilities would not significantly reduce the scenic quality of this section of the creek because creek bank views near the proposed facilities already include Inskip Diversion Dam, South Powerhouse, and their appurtenant facilities. Scenic quality in the vicinity of the proposed facilities has already been reduced by these facilities. Although scenic quality could be temporarily reduced by the construction of the proposed South Powerhouse borrow site and staging area, it is anticipated that this temporary impact would be mitigated by proposed regrading, hydromulching, and revegetation of this area after construction has been completed. Since the proposed facilities are located on private land with restricted public access, this change in views would be limited to patrons of Oasis Springs Lodge using the southern creek bank in this vicinity and a small number of kayakers who could use this section of South Fork Battle Creek. This impact is significant. Implementing the following mitigation measure would reduce this impact, but not to a less-than-significant level.

Mitigation Measures for Impact 4.8-1. Upon completing installation of the proposed access road, Reclamation will be responsible for revegetating the area along the road to improve its aesthetic quality to the patrons of Oasis Springs Lodge. Reclamation will implement the following revegetation plan:

- Broadcast native seed with native straw mulch, at sufficient concentration to ensure even coverage and germination, to revegetate the area above the road's cut slope. The native seed mix shall consist of a mixture of grasses, forbs, and wild flowers native to the region and appropriate for site conditions.

- Apply rock-aging compound to the cut slope of the hill before native seed application. Because soil conditions are poor and little vegetation would grow on the cut slope, the rock-aging compound will improve the germination rate of the broadcasted seeds.
- Plant trees along the downhill side of the proposed access road at random intervals to simulate natural distributions to eventually screen views of this cut slope from the Oasis Springs Lodge. Trees will consist of a mixture of native oak species and grey pine in keeping with existing vegetation on the slope. Trees will be planted in augured holes that are approximately 36 inches deep and 12 inches in diameter. Plastic plant-protection tubes will be installed around all oak and pine seedlings. Watering basins for all seedlings will be approximately 36 inches in diameter and 4 inches high.
- Monitor all tree-planting sites. A qualified biologist will visit all tree-planting sites biannually for the first 5 years after road installation to determine seedling survival rates. Planting sites will be recorded as being dead if there is no viable aboveground growth visible. For example, if all the leaves on a tree are brown, but an examination of the stems and branches showed viable stem vigor, the plant will be considered to be alive with a poor vigor rating. Where a tree is determined not to be alive, it shall be replaced.
- Plant native oak or grey pine trees in the vicinity of the proposed parking lot to reduce its visibility from the creek.

In addition to implementing a revegetation plan, Reclamation will apply an acid wash to the rock face along the proposed access road to break up the appearance of the cut in the hillside and improve its aesthetic quality to the patrons of Oasis Springs Lodge.

Impact 4.8-2 Less than Significant—Proposed construction of tailrace connector, bypass chute, and fish screen and fish ladders would alter views from adjacent area.

Coleman Diversion Dam and Inskip Powerhouse Vicinity. Construction of the Inskip Powerhouse tailrace connector and bypass pipeline/chute facilities would not significantly alter the scenic quality of surrounding areas. Although South Fork Battle Creek and the Coleman Diversion Dam vicinity can be seen from a short section of Manton Road, these views are screened by trees on the south side of this road. The proposed tailrace connector, staging area, lower bypass chute and basin, and appurtenant facilities would be located on the northern creek bank east of Coleman Diversion Dam. These trees would also screen views of these facilities from Manton Road, and therefore, visual impacts to this public roadway would be less than significant. Since screened views of this area from Manton Road already include Coleman Diversion Dam, the Inskip Powerhouse, and their appurtenant facilities, the addition of proposed facilities adjacent to these existing facilities would not significantly reduce scenic quality.

Similarly, these facilities would be visible to only a limited number of kayakers using this section of the creek. The scenic quality of this section for kayakers has already been reduced by the Inskip Powerhouse, Coleman Diversion Dam, and its penstock and, therefore, the addition of proposed facilities would not substantially alter this section's scenic quality.

Development of the proposed overflow wasteway and bypass facilities would not substantially alter the scenic quality of this area. Restricted access, distance, and topography would preclude the presence of any sensitive receptors and no visual impacts would result. Specifically, the area above the Inskip Powerhouse would be developed with the proposed bypass facility. The proposed overflow wasteway would be located farther uphill at the forebay inlet to the Inskip Powerhouse penstock. Wasteway facilities would be located on private land where public access is restricted, limiting the potential for visual impacts to sensitive receptors. Distant views of portions of this area are available from Manton Road, but distance and topography limit the visibility of existing facilities. The proposed overflow wasteway also would not be visible from Manton Road because of distance and topography. Visual impacts associated with the upper pipeline section of the bypass facility (between the forebay inlet and the chute above Inskip Powerhouse) would be limited to temporary visual impacts resulting from vegetation removal, since this facility is proposed to be buried. In addition to distance, topography, and the limited visibility of proposed vegetation removal, trees located between Manton Road and the proposed facilities would screen views from sections of Manton Road, further reducing the potential for visual impacts. These impacts are considered to be less than significant.

Other Facilities. Construction of new fish screens and fish ladders at North Battle Creek Feeder and Eagle Canyon Diversion Dams would not substantially alter scenic resources. Proposed construction at these two locations would include not only instream facilities but also the improvement of the access path at Eagle Canyon Diversion Dam and development of a new access road at North Battle Creek Feeder. Both of these features are located on private land where public access is restricted. In addition, the steep terrain in the vicinity of these facilities would limit the visibility of proposed construction from adjacent areas. The creek banks drop steeply from surrounding areas to the creek, limiting visibility of proposed facilities and associated vegetation removal to areas immediately adjacent to the site. Therefore, scenic quality from public viewing areas would not be affected by facility construction. This impact is considered to be less than significant.

To monitor the increased instream flow releases at Asbury Diversion Dam on Baldwin Creek, a new gauging station would be required just below the dam. No structural changes to the existing spill gates would be required. Since construction would be limited to this gauging station below the dam, no substantial visual changes would occur at the public access to Baldwin Creek, which is located just above Asbury Diversion Dam.

Impact 4.8-3 Less than Significant—Removal of diversion dams and associated construction would not substantially reduce scenic quality from public viewing areas.
The proposed removals of Wildcat, South, Coleman, Soap Creek Feeder, and Lower Ripley Creek Feeder Diversion Dams and their appurtenant facilities would improve scenic quality within the immediate vicinity of these facilities. However, there would be no change in scenic quality from public viewing areas such as public roads, scenic vistas, recreational facilities, or communities, since Hydroelectric Project facilities are not visible from these locations. The removal of Coleman Diversion Dam would improve scenic quality for the limited number of kayakers and fishermen (those purchasing trespass rights) who could use this section of South Fork Battle Creek, assuming that those recreationists prefer natural vistas over dams and appurtenant facilities.

The proposed dam removals would require the construction of staging areas and access road improvements at some locations. The proposed construction would involve vegetation removal in staging areas, grading (including blading and widening), placing gravel on access roads, and on-site wasting of excavated materials. Any reduction in scenic quality resulting from these activities would be less than significant because they would not be visible from any public viewing areas. In addition, most on-site visual changes resulting from this construction would be restored within 3 years by the proposed revegetation of staging areas and areas affected by on-site wasting. The proposed improvements (widening and gravel placement) at access road intersections with public roadways would not significantly alter existing scenic resources since public views already include existing roadway intersections, gates, and fencing. This impact is considered to be less than significant.

No Dam Removal Alternative

Under the No Dam Removal Alternative, fish screens and fish ladders would be constructed at North Battle Creek Feeder, Wildcat, Eagle Canyon, South, Inskip, and Coleman Diversion Dams. No dams would be removed under this alternative, and no changes are proposed at Soap Creek Feeder and Lower Ripley Creek Feeder.

Impact 4.8-4 Significant and Unavoidable—Construction of new fish screens and fish ladders and associated facilities would reduce scenic quality at the Oasis Springs Lodge.
Construction at the Inskip Diversion Dam would avoid the less-than-significant visual impacts associated with the construction of the South Powerhouse tailrace connector tunnel and bypass features at the Inskip Diversion Dam site, as described under the Five Dam Removal Alternative, because these facilities would not be constructed under the No Dam Removal Alternative. However, the proposed access road, a significant and unavoidable aesthetic impact visible from Oasis Springs Lodge, and associated facilities would still be constructed to maintain the fish screen and fish ladder at Inskip Diversion Dam. This impact for the No Dam Removal Alternative is similar to Impact 4.8-1 described under

the Five Dam Removal Alternative and is considered significant. Implementing mitigation measures for Impact 4.8-1 would reduce this significant impact, but not to a less-than-significant level.

Impact 4.8-5 Less than Significant—Proposed construction of fish screen and fish ladders would alter views from adjacent area. Proposed construction of fish screens and fish ladders at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, and Coleman Diversion Dams would result in less-than-significant visual impacts since these facilities are located on private lands where public access is restricted. Construction at these sites would not alter scenic quality from public viewing areas such as public roads, scenic vistas, recreational facilities, or communities, since the proposed facilities would not be visible from such locations. Although public lands (managed by BLM) are located near South Diversion Dam, the dam can be seen only from the slopes immediately above the creek because of the location's steep terrain and intervening vegetation. Because of these limited viewing opportunities, this impact is considered less than significant.

Impact 4.8-6 Less than Significant—Construction of fish screens and fish ladders and associated project activities would substantially reduce scenic quality from public viewing areas. No dams would be removed under this alternative because fish screens and fish ladders would be constructed instead at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams (no construction activities are proposed at Soap Creek Feeder and Lower Ripley Creek Feeder under this alternative under the No Dam Removal Alternative). Construction of the fish screens and fish ladders would require the construction of staging areas and access road improvements at some locations. The proposed construction would involve vegetation removal in staging areas, grading (including blading and widening), placing gravel on access roads, and on-site wasting of excavated materials. Any reduction in scenic quality resulting from these activities would be less than significant because Hydroelectric Project facilities are not visible from any public viewing areas. In addition, most on-site visual changes resulting from this construction would be restored within 3 years by the proposed revegetation of staging areas and areas affected by on-site wasting. The proposed improvements (widening and gravel placement) at access road intersections with public roadways would not significantly alter existing scenic resources since public views already include existing roadway intersections, gates, and fencing. This impact is considered to be less than significant.

Six Dam Removal Alternative

Facility modifications under the Six Dam Removal Alternative would be essentially the same as the Five Dam Removal Alternative at all sites, with the addition of impacts associated with removing Eagle Canyon Diversion Dam.

Impact 4.8-7 Significant and Unavoidable—Construction of tailrace connectors, new fish screen and fish ladder and associated facilities would reduce scenic quality at the Oasis Springs Lodge.

The Six Dam Removal Alternative would undertake the same improvements to the Inskip Diversion Dam and South Powerhouse vicinity as the Five Dam Removal Alternative. The proposed access road between South Powerhouse and Inskip Diversion Dam, a significant and unavoidable aesthetic impact visible from Oasis Springs Lodge, and associated facilities would be constructed to maintain the fish screen and fish ladder at Inskip Diversion Dam. This impact is similar to Impact 4.8-1 described under the Five Dam Removal Alternative and is considered significant. Implementing mitigation measures for Impact 4.8-1 would reduce this impact, but not to a less-than-significant level.

Impact 4.8-8 Less than Significant—Proposed construction of tailrace connector, bypass chute, and fish screen and fish ladders would alter views from adjacent area.

The Six Dam Removal Alternative would involve the same construction features as the Five Dam Removal Alternative, except that it would result in the removal of Eagle Canyon Diversion Dam rather than construction of a new fish ladder and fish screen at this location. Constructing fish screens and fish ladders at North Battle Creek Feeder and Inskip Diversion Dams, as proposed by the Six Dam Removal Alternative, would result in less-than-significant visual impacts since these facilities are located on private lands where public access is restricted. This impact is similar to Impact 4.8-2 described under the Five Dam Removal Alternative and is considered less than significant.

Impact 4.8-9 Less than Significant—Removal of diversion dams and associated construction would substantially reduce scenic quality from public viewing areas.

This impact is similar to Impact 4.8-3 described under the Five Dam Removal Alternative, except that an additional dam, the Eagle Canyon Diversion Dam, would be removed under this alternative. Eagle Canyon Diversion Dam is located on private land where public access is limited and steep terrain in the vicinity of the dam would limit the visibility during dam removal activities and upgrading of the access path. The removal of Eagle Canyon, Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams would not reduce the scenic quality of the surrounding area because these facilities are not visible from any public viewing areas. In the long-term, scenic quality would be improved by the removal of the dams from the natural landscape. As a result, visual impacts at these diversion dams are considered less than significant.

Three Dam Removal Alternative

The Three Dam Removal Alternative would undertake the same removal activities at North Battle Creek Feeder, Wildcat, Inskip, and Coleman Diversion Dams (including the Inskip tailrace and bypass facilities located near Coleman Diversion Dam) as the Five Dam Removal Alternative. South Diversion Dam would not be removed under this alternative and would have a new fish ladder and fish screen installed. No construction is proposed at Soap Creek Feeder and Lower Creek Feeder Diversion Dams, which would remain as they are currently under this alternative. Eagle Canyon Diversion Dam would be removed under this alternative rather than receive installation of a new fish ladder and fish screen as under the Five Dam Removal Alternative.

Impact 4.8-10 Significant and Unavoidable—Construction of new fish screen and fish ladder and associated facilities would reduce scenic quality at the Oasis Springs Lodge.

The Three Dam Removal Alternative would undertake the same work on the Inskip Diversion Dam and South Powerhouse vicinity as identified under the Five Dam Removal Alternative for the proposed tailrace connector, fish ladder, access road, power line, and waste area facilities. Therefore, the Three Dam Removal Alternative would have a similar impact on the visual scenic quality at the Oasis Springs Lodge as the Five Dam Removal Alternative. This impact is similar to Impact 4.8-1 and is considered significant. Implementing the mitigation measures identified for Impact 4.8-1 under the Five Dam Removal Alternative would reduce this impact, but not to a less-than-significant level.

Impact 4.8-11 Significant and Unavoidable—Construction of the channel with armoring or revetment would alter views of the South Fork creek bank.

The Three Dam Removal Alternative proposes the use of an open channel rather than a tunnel for the tailrace connector between South Powerhouse and Inskip Canal. Because the river side of the channel would be protected with riprap, views from the Oasis Springs Lodge's creek bank frontage would change from a wooded, undeveloped slope to a developed channel with a rock-filled armored revetment above and riprap revetment below the channel. In addition, channel construction would require tree removal along the entire northern creek bank between the South Powerhouse and Inskip Canal. Such a change in scenic quality along this section of the creek is considered to be significant, particularly when combined with the significant visual impacts resulting from the proposed cut slope and tree removal associated with access road construction. This significant visual impact would be unavoidable and irreversible because it cannot be mitigated to a less-than-significant level. Mitigation by planting tree screens, as required for the proposed access road, would not be feasible since the river side of the revetment would be covered with geomembrane fabric and riprap.

Impact 4.8-12 Less than Significant—Proposed construction of fish screens and fish ladders would alter views from adjacent area.

Construction of new fish screens and fish ladders at North Battle Creek Feeder and South Diversion Dams would not significantly alter the scenic quality of surrounding areas because this facility is located on private land where public access is restricted. In the vicinity of the North Battle Creek Feeder site, the steep terrain would limit the visibility of proposed construction from adjacent areas. Although public lands (managed by BLM) are located near South Diversion Dam, the dam can be seen only from the slopes immediately above the creek because of the location's steep terrain and intervening vegetation. This impact is similar to Impact 4.8-2 described under the Five Dam Removal Alternative. Visual impacts at North Battle Creek Feeder and South Diversion Dam are less than significant.

Impact 4.8-13 Less than Significant—Removal of diversion dams and associated construction would substantially reduce scenic quality from public viewing areas.

The Three Dam Removal Alternative proposed to remove Eagle Canyon, Wildcat, and Coleman Diversion Dams. The removal of Wildcat and Coleman Diversion Dams would not reduce the scenic quality of the surrounding area because these facilities are not visible from any public viewing areas. Eagle Canyon Diversion Dam is located on private land where public access is limited and steep terrain in the vicinity of the dam would limit the visibility during dam removal activities and upgrading of the access path. Therefore, visual impacts at these diversion dams are considered less than significant.

Cumulative Impacts

Cumulative aesthetics and visual quality impacts associated with the Proposed Action and past, present, or probable future projects would not occur in the Battle Creek watershed because no other projects (including related projects described in Chapter 6) are known to change the visual quality of the Battle Creek watershed. Panoramic views overlooking most of the Battle Creek watershed are available from areas to the north (near Shingletown). However, distance and topography limit visibility of Restoration Project facilities to only a few sensitive receptors. Although construction of the new access road between South Powerhouse and Inskip Diversion Dam would be an unavoidable significant impact, the Proposed Action would generally improve aesthetics by removing existing diversion dams (i.e., Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams).

4.9 Transportation

Affected Environment

The following section contains a discussion of the existing transportation infrastructure in the Restoration Project area. Transportation routes include federal highways, state routes, and county and private roads that provide access to or could potentially be affected by the construction, modification, or removal of facilities in the Restoration Project area. A discussion of nearby railroads and airports is also included. The major transportation corridors and state highways within the area are shown on Figure 4.9-1.

Regional Roadways

The area of potential effect for transportation resources within the Restoration Project area includes portions of northern Tehama and southern Shasta Counties. The Restoration Project area can be generally characterized as predominately rural, with agricultural and timber production the primary activities in the area. The area is transected by a number of primary transportation corridors of regional importance. Those major transportation corridors that are either within or that may be used to access the Restoration Project area include Interstate 5, Highway 99, Highway 36, and Highway 44. These corridors would be used by construction workers to access the local roadway system, which in turn provides access to the Restoration Project sites.

Local Roadways

As stated above, the Restoration Project area is transected by an extensive local roadway system providing access to the Restoration Project sites. This system includes county roads, most of which are paved, and private roads, which are of varying quality. Additional information on the local roads associated with access to a particular Restoration Project site that may be affected by construction, modification, or removal activities is provided below under the appropriate site-specific discussions.

County Roads

County roads expected to carry traffic for the project are listed in Table 4.9-1. The project would include intersection modifications to county roads at three locations: at Hazen and Manton Roads; at the new access road over BLM land located on Manton Road about 1,000 feet east of the existing PG&E access to Coleman Diversion Dam; and at the existing Manton Road access points to Eagle Canyon Diversion Dam. Reclamation is working to obtain road encroachment permits for this work from Tehama County Public Works. The county roads would be used to access the private roads that provide access to the worksites.

Private Roads

The access roads to the sites include numerous private roadways, which accommodate localized traffic (Tehama County Road Department 1997). Many of the access roads are unpaved and would need to be modified or upgraded before construction begins. PG&E has easements for access to the hydroelectric project sites over the private roads that they don't own. These private roads would require improvements and maintenance to allow construction to proceed safely and efficiently. Road work would include clearing vegetation, regrading, gravelling, limited paving, fencing, and limited drainage improvements, such as culverts.

Other Area Transportation Facilities

Other transportation facilities in the area include railroads and airports. The Southern Pacific Railway's main line, which runs to the west of the Restoration Project area, is its primary rail line from Sacramento, California, to Portland, Oregon. Rail services focusing primarily on freight-hauling services are available at various locations in Tehama County, including Red Bluff, Corning, Richfield, Tehama, Gerber, Vina, and Los Molinos. Rail spurs at these locations could be used to transport materials and supplies to the area.

There are four publicly operated airports in Shasta County: Redding Municipal Airport and Benton Airport, which are operated by the City of Redding; Fall River Mills Airport, which is owned by Shasta County; and Shingletown Airport, which is leased by Shasta County. There are two publicly owned airports in Tehama County: Red Bluff Municipal Airport and Corning Municipal Airport, both of which are owned by their respective cities.

As discussed in detail in Chapter 3, "Project Alternatives," the use of helicopters would likely be necessary to transport materials to and from some of the more remote sites (Reclamation 1999).

Restoration Project Site Access

The following section provides information on access routes to the Restoration Project sites. The eight Restoration Project sites included in the Five Dam, No Dam, Six Dam, and Three Dam Removal Alternatives are accessible by 13 major federal, state, local, and private roadways (Table 4.9-1). The roadways shown on Figure 4.9-1 are the state and local routes; Figure 4.9-2 identifies Restoration Project site access roads. Additional details on the removal and construction activities at each site are included in Chapter 3, "Project Alternatives," and Section 4.2, "Botanical, Wetland, and Wildlife Resources," of this EIS/EIR.

Table 4.9-1. Access Routes to Restoration Project Sites

Federal	State	Local
Interstate 5	SR 36	Ash Creek Road (Road A17)
	SR 44	Battle Creek Bottom Road
	SR 99	Forward Road
		Hazen Road
		Lanes Valley Road
		Manton Road (Road A6)
		Manton School Road
		Ponderosa Way
		Rock Creek Road
		Manton School Road
		Spring Branch Road
		Wildcat Road
		Wilson Hill Road

North Fork Battle Creek

The Restoration Project sites located on North Fork Battle Creek include Wildcat, Eagle Canyon, and North Battle Creek Feeder Diversion Dams. Although minor increases in traffic are expected, Battle Creek Bottom Road, Wilson Hill Road, Wildcat Road, Manton Road, Highway 36, Highway 99, and Interstate 5 would be affected. Ash Creek Road and Highway 44 are less likely to be affected. Not included are the private roads that would be impacted by construction vehicles accessing these sites after vehicles leave the public roadways. Access to the construction sites located on North Fork Battle Creek is described below.

Wildcat Diversion Dam

Wildcat Diversion Dam is located about 6 miles west of Manton and about 1 mile south of Battle Creek Bottom Road. The site is accessed by traveling west along Battle Creek Bottom Road to an unpaved private road and then traveling down the private road for approximately 1 mile. This road terminates on the north rim above the dam. A long, narrow foot trail provides access from the north rim to the right abutment of the dam. The unimproved road leading to the north rim above the dam terminates in a 100- by 50-foot parking area that would be used for parking by workers who would then get to the site via the foot trail. Smaller equipment and tools would be hand-carried down the access trail.

All contractor access would be from the north side. PG&E would concurrently work on the south rim to remove power lines in association with the Restoration

Project. PG&E has legal access to private roads accessing the south rim under existing easements.

Wildcat Diversion Dam is reached by driving north from the PG&E Manton Service Center along Wilson Hill Road to Battle Creek Bottom Road. At about 3.5 miles southwest of their junction an unimproved private road leads to a parking/turnaround area about 1 mile south of Battle Creek Bottom Road at the top of the plateau. There is no vehicle access to the site from the north plateau.

A narrow, steep 500-foot-long path descends approximately 110 feet and provides access to the dam and diversion facilities on the right abutment. There is no foot or vehicle access from the top of the left abutment down to the dam even though PG&E owns the land.

The overhead powerlines and poles that drop down to the dam can be reached along an access road that turns off of Manton Road about 1 mile east of Wildcat Road. The pipeline portions of Wildcat Canal on both the north and south sides of the creek have no vehicle access except at the transition structure. The pipeline is reached by walking in from the diversion dam or the transition structure.

Wildcat Canal is reached by driving west from the PG&E Manton Service Center along Manton Road about 6.5 miles to Wildcat Road. About 1 mile north of their junction, an unimproved private road parallels the canal to the east for about 0.5 mile and leads to a parking/turnaround area near the transition structure. The section of canal to the west of Wildcat Road has no developed access road adjacent to the canal.

Eagle Canyon Diversion Dam

Eagle Canyon Diversion Dam is located about 3 miles west of Manton and about 1 mile north of Manton Road. The site is accessed by traveling down Manton Road from SR 36 to an unpaved private road and then traveling along the private road for about 1 mile to the south rim trailhead. This area would serve as a parking lot for workers, all of whom would access the site via a foot trail. The intersection of Manton Road and the private road would be improved for safety purposes and the private road graded and gravelled to prepare them for construction traffic.

The worksites associated with the spring collection improvement work would be reached from three foot trails located along the south canyon rim within 3,000 feet downstream of the diversion dam. These trailheads are reached over unimproved roads that spur off of the main access road to the diversion dam. These roads may be graded, but would not be graveled, to prepare them for construction traffic.

Because there is no road down to the Eagle Canyon site, all heavy equipment would be flown by helicopter from the staging areas to the site. Equipment would be transported by truck to the parking area, where it would be off-loaded and then lifted by helicopters to the dam site. Smaller equipment and tools would be hand-carried down the access trail.

Eagle Canyon Diversion Dam is primarily reached by driving southwest from the PG&E Manton Service Center along Manton Road about 3 miles to a turnoff onto private property. An unimproved road proceeds northerly about 1 mile to a small parking area at the southern top of the plateau. A steep, 900-foot-long footpath including stairs, descends approximately 160 feet and provides access to the dam and diversion facilities. Three additional unimproved roads split off the main access road and lead to turnaround areas along the top of the plateau where trails with stairs are used to descend to points along the tunnels, flumes, and spring collection facilities of Eagle Canyon Canal.

The northern top of the plateau above the dam can be reached by driving north from the PG&E Manton Service Center along Wilson Hill Road to Battle Creek Bottom Road. At about 1.5 miles southwest of their junction, an unimproved private road leads to a parking/turnaround area about 1 mile south of Battle Creek Bottom Road at the top of the plateau. There is no vehicle or foot access to the site from the north plateau. However, the area has been used to stage construction operations for performing various maintenance activities.

Eagle Canyon Canal is reached off of its intersection with Manton Road. To the north (upstream) of Manton Road the canal banks are narrow and limited to foot or small vehicle access. To the south of Manton Road a 0.7-mile-long access road parallels the canal to its termination at the Inskip Powerhouse penstock headworks.

North Battle Creek Feeder Diversion Dam

North Battle Creek Feeder Diversion Dam is the northeastern-most dam in the Restoration Project area. The dam is reached from private roads leading from Wilson Hill Road. Wilson Hill Road is reached by traveling Battle Creek Bottom Road from Wildcat Road. A lightly paved road runs from Wilson Hill Road to Volta Powerhouse 1, a gravel road leads from Volta Powerhouse 1 to the existing paved road to Volta Powerhouse 2, and an unpaved road leads Volta Powerhouse 2 to the west rim above the dam. From here, the work site is accessed via a footpath that leads from Volta Powerhouse 2, across a footbridge over the North Fork of Battle Creek, and along about 700 feet of platform running down the centerline of the existing flume. While providing access for personnel and light hand tools, the footpath does not provide sufficient access for construction equipment.

To provide access for heavy equipment, a new asphalt-paved access road is proposed to be installed. It would be used both for construction access and for long-term operation and maintenance. The road would originate at the terminus of the existing private road and would run down the face of the canyon wall. Although helicopters would not land here, they may be used to lift equipment from the west rim area and deliver it to the dam site.

North Battle Creek Feeder Diversion Dam is reached by driving north from the PG&E Manton Service Center on Wilson Hill Road about 1 mile to a turnoff to the Volta 1 and 2 Powerhouses. A private road consisting of paved and unpaved sections about 0.8 mile long leads to a sediment basin at the top of the plateau above Volta 2 Powerhouse. A steep, paved section of access road incorporating one switchback then descends to a parking area at Volta 2 Powerhouse. A footpath begins at Volta 2 Powerhouse and leads across a footbridge over North Fork Battle Creek to the energy dissipation box. The dam is reached by walking upstream along approximately 700 feet of walkway running down the centerline of the flume. There is no vehicle access to the dam or feeder canal.

South Fork Battle Creek

The Restoration Project sites located on South Fork Battle Creek include Coleman, Inskip, South, Soap Creek, and Lower Ripley Creek Feeder Diversion Dams. Although minor increases in traffic are expected, Ponderosa Way, Forward Road, Hazen Road, Manton School Road, Manton Road, Highway 36, Highway 99, and Interstate 5 would be most likely affected. Not included are the private roads that would be impacted by the construction vehicles accessing these sites after the vehicles leave the public roadways. Access routes to the construction sites located on South Fork Battle Creek are described below.

Coleman Diversion Dam Site

The Coleman Diversion Dam site includes the Inskip Powerhouse bypass facility, Inskip Powerhouse tailrace connector, Coleman Diversion Dam, and their appurtenant facilities. Coleman Diversion Dam is located about 6 miles west of Manton. It is accessed from Manton Road about 0.4 mile east of Wildcat Road on an existing PG&E road that leads to the right abutment of the dam and Inskip powerhouse.

Construction equipment would be transported to the site along existing access roads. Access to the Inskip Powerhouse bypass facility and tailrace connector would be provided by separate routes. The penstock bypass work requires access to the upper and lower plateau areas. The plateau area would be reached by an existing road located approximately 1,000 feet east of the Coleman Dam access road. The plateau road would require development of a new intersection with Manton Road to assure safe and efficient construction access. This intersection connects to an existing unpaved road to the edge of the plateau. The upper end of the plateau would be accessed only by light vehicles from the existing road to the penstock headworks area (this road parallels Eagle Canyon Canal about 4,000 feet east of the Coleman Diversion Dam access road). Access to the tailrace connector site is the same as for the Coleman Diversion Dam.

The Coleman Diversion Dam/Inskip Powerhouse site is reached by driving west from the PG&E Manton Service Center along Manton Road for 6 miles (about 0.5 mile east of the intersection of Manton Road and Wildcat Road). A private, paved road descends in an easterly direction about 0.4 mile to the dam and powerhouse area. This relatively large and flat area was the site of the original construction camp and powerhouse operator residences. There is vehicle access to dam and powerhouse. However, there is no vehicle access from this area adjacent to the creek up the steep hillside to the penstock header box area.

The penstock header box area is reached from an access road at the intersection of Manton Road and Eagle Canyon Canal about 1.7 miles east of the dam/powerhouse access road. This dirt and gravel road parallels the canal for about 0.6 mile to the Inskip Powerhouse penstock headworks area. The canal overflow wasteway is reached by crossing a bridge over Eagle Canyon Canal and another bridge that crosses the inlet forebay immediately upstream of the header box. A primitive road continues east 500 feet to the north bank of the wasteway channel about 100 feet from the gunite-lined overflow structure, which cannot be reached by vehicle. There is an unimproved access road along the south side of the penstock that extends to the edge of the plateau. From the end of this road the Willow Springs pipeline intake area can be reached by foot. The majority of this 1-mile-long pipeline can be reached only by foot. Between Manton Road and the penstock there is a rough road that follows the pipeline for a few hundred feet. This road begins off of Manton Road about 0.2 mile east of the dam/powerhouse access road.

Inskip Diversion Dam Site

The Inskip Diversion Dam site includes the South Powerhouse bypass tunnel, South Powerhouse tailrace connector, Inskip Diversion Dam and Canal, and their appurtenant facilities. Currently, PG&E accesses the Inskip Diversion Dam site via the paved South Powerhouse Road and a private road leading south from the South Powerhouse/Hazen Road intersection. A portion of this access route passes close to a residence and the speed limit is restricted. For the Project, access instead would be either along Manton School Road, which parallels South Powerhouse Road from Forward Road to Hazen Road, or via a constructed road that would connect Manton School Road with the private road described above.

From the intersection of Manton School Road and Hazen Road, a private road (“Old Ranch Road”) proceeds south another mile to the top of the canyon. From the top of the canyon, a steep, narrow, winding, paved road continues down the hillside for about another mile to a parking area at the South Powerhouse. Access to the right (north) side of the dam is by a 1,400-foot-long foot trail above South Fork Battle Creek. The left (south) side of the dam can be accessed by four-wheel-drive vehicle over a concrete, low-water crossing of the creek adjacent to the powerhouse. A private dirt road parallels the creek for about 1,000 feet and terminates at the dam. There is no vehicle access across the creek at the dam site. Personnel can cross the dam crest on foot if the water levels are low enough.

During construction, a temporary access road would be established along the presently abandoned Old Ranch Road located about 2,000 feet east of the residential area south of South Powerhouse Road. This temporary road would allow construction equipment to safely bypass the residential area near South Powerhouse Road. Some grading, graveling, and installation of drainage features would be performed to allow efficient construction access while minimizing disturbance to the environment. The remainder of the road to the South Powerhouse parking area would be maintained and repaired as needed during construction.

The Inskip Diversion Dam/South Powerhouse site is reached by driving south from the PG&E Manton Service Center along Manton Road, then south for approximately 1.2 miles on Manton School Road. From this intersection of Manton School Road and Hazen Road, a private dirt and graveled road proceeds south another mile to the top of the canyon. A portion of this stretch passes close to a residence and the speed limit is restricted. From the top of the canyon a steep, narrow, winding, paved road continues down the hillside for about another mile to a parking area at the South Powerhouse. This section of private road from Hazen Road to South Powerhouse is called the South Powerhouse Access Road.

Access to the right (north) side of the dam is by a 1,400 foot long foot trail above the South Fork Battle Creek. The left (south) side of the dam can be accessed by four-wheel-drive vehicle over a concrete, low-water crossing of the creek adjacent to the powerhouse. A private, dirt road parallels the creek for about 1000 feet and terminates at the dam. There is no vehicle access across the creek at the dam site. Personnel can cross the dam crest on foot if the water levels are low enough.

South Diversion Dam

South Diversion Dam is the southernmost facility in the Restoration Project area. The site is accessed by traveling from Manton Road at the town of Manton about 4 miles along the paved Forward Road to Ponderosa Way, then continuing along the gravel and dirt road for about 2.8 miles to a locked gate at the PG&E facility access road. The access road is about 2.5 miles long and terminates at a switchback turn and parking area. From the parking area, a footpath extends along the canal bank about 1,000 feet to the dam. Access road improvements would be necessary. Small access roads in the area may also be used to transport both personnel and small equipment to various locations along South Canal.

South Diversion Dam is reached by driving east from the PG&E Manton Service Center about 4 miles along Forward Road to Ponderosa Way. At about 3 miles south of their junction, an unimproved private road continues south another 2 miles to a parking/turnaround area adjacent to South Canal and 0.2 mile downstream of the dam. Road conditions vary seasonally but are generally steep, narrow, and heavily rutted, and require the use of four–wheel-drive vehicles.

There is no vehicle access to the dam site. The dam is reached by walking along the canal bank to the outlet of Tunnel 1. At this point a steep, narrow trail rises above the tunnel and ends at the top of a 25-foot-tall ladder that descends to the right abutment of the dam. The left abutment area could be reached by construction equipment and four-wheel-drive vehicles if an abandoned low-water crossing of the South Fork located near the parking/turnaround area is reestablished.

South Canal is reached over several private roads that branch off of Ponderosa Way and South Powerhouse Road. The first private access road is the route described above that branches off of Ponderosa Way and provides access to the dam and the easterly most reaches of the canal.

A second private access road branches off of Ponderosa Way near the Bluff Springs area about 1.8 miles south of Forward Road. This road splits into 2 branches that provide access to the middle and western portions of South Canal. The southerly branch extends 1.5 miles to the outlet of Tunnel 5 and to Soap Creek Diversion Dam. This road then continues westerly approximately 1.2 miles along the canal (some portions are well above the canal, other portions are along the canal bank) to the inlet of Tunnel 6 where it reaches a dead end. The westerly branch travels along the plateau above the South Fork and several hundred feet north of South Canal. This westerly branch rejoins the South Canal 2.5 miles to the west. An access point down to the area around the outlet of Tunnel 6 begins about 1.3 miles west of the Bluff Springs branch and heads south about 0.4 miles where it dead ends. Vehicle access does not exist between the outlet of Tunnel 6 and 600 feet downstream of the outlet of Tunnel 9. The remaining 1.2-mile stretch of the westerly branch that joins the private South Powerhouse Access Road is along the South Canal bank. Continuing along the canal alignment (actually above Tunnel 10) to the west of the private South Powerhouse Access Road, an access road extends 0.1 mile to the outlet of Tunnel 10 and the South Canal junction with Union Canal.

The third private access road is named the South Powerhouse Access Road. It extends south from the intersection of South Powerhouse Road and Hazen Road approximately 0.9 mile and provides access to the westerly portions of South Canal. The South Powerhouse Access Road is described in more detail below for the South Powerhouse site. The corridor along the canal banks is not fenced. The corridor along the main access road branches is usually fenced and has several gates along its route.

Soap Creek Diversion Dam

Soap Creek Diversion Dam is located on Soap Creek about 5 miles southeast of Manton and 1 mile upstream of the creek’s confluence with South Fork Battle Creek. Access to the dam is provided by traveling east from the town of Manton on both paved and unpaved roads, including Forward Road and Ponderosa Way, for about 5 miles to a locked gate near Bluff Springs. One then travels about 1.1 miles south along a narrow, unpaved road to a foot trail, which leads to the right abutment of the dam. Access road improvements necessary to the Five Dam Removal Alternative may be installed at the contractor’s discretion.

Soap Creek Diversion Dam is reached as described above for South Canal along the southerly branch of access road from Bluff Springs. The access road ends at a parking/turnaround area about 50 feet above the dam. A 200-foot-long narrow trail and stairs descend to the right abutment of the dam. There is no access trail along the pipeline. There is an access road about 50 feet above and parallel to the pipeline. A rough trail, often wet from springs, leads down from the road to the stilling well area and Flume 3, which are about 100 feet downstream of the outlet of Tunnel 5. The corridor along the pipeline is not fenced.

Lower Ripley Creek Feeder Diversion Dam

The Lower Ripley Creek Feeder Diversion Dam is located on Ripley Creek about 3.5 miles southwest of Manton and 1 mile upstream of the creek's confluence with South Fork Battle Creek. Access to the dam is provided by traveling Manton Road to the Eagle Canyon Canal crossing and then in an easterly direction for about 2 miles along an unpaved road, passing through several gates to a foot trail leading to the dam. No improvements to the access roads should be necessary.

The Lower Ripley work site can also be reached from the access road to South Powerhouse. From the top of the canyon, an unpaved road on private property can be taken in a westerly direction about 3 miles to the work site. The road is rough and may require minor grading. There is also one small bridge that may limit equipment access.

The Lower Ripley Creek site is reached by driving southwest from the PG&E Manton Service Center about 4.5 miles along Manton Road to the Eagle Canyon Canal crossing. The access road parallels the canal for about 0.6 mile to the Inskip Powerhouse penstock headworks area. A dirt access road then turns easterly and proceeds 1.7 miles to the site. The Lower Ripley work site can also be reached from the South Powerhouse Access Road. From the top of the canyon, an unimproved road on private property can be taken in a westerly direction about 3 miles to the work site. For both routes road conditions vary seasonally but are generally flat, narrow, heavily rutted, and require the use of four–wheel-drive vehicles. The dam is about 50 feet off of the road and can be reached easily by foot and construction equipment. The corridors along the access roads, dam, and feeder canal are not fenced but there are a few gates along the routes. There is a bridge of unknown load-carrying capacity that crosses Union Canal for the road that approaches from the east.

Asbury Pump

The Asbury Pump Diversion Dam site is reached by driving west from the PG&E Manton Service Center along Manton Road for 6.5 miles to Wildcat Road, then proceeding north about 2 miles to the turnoff for the Darrah Springs facility. An unimproved road heads in a westerly direction about 1.4 miles past the hatchery facility to the dam and pump station area, which provides vehicle access to the left side of the facility. Foot access to the right abutment area is possible over the walkway. Vehicle access to the right abutment and pump station area is off of Wildcat Road about 1.3 miles north of the Darrah Springs turnoff. An unimproved road then proceeds 1.7 miles west and south to the pump station.

Traffic Counts

The California Department of Transportation, Office of Traffic Data compiles traffic volume and annual average daily traffic (AADT) count information on

California's state highways. Information on available AADT counts for state highways that could be used to access the Restoration Project area is included in Table 4.9-2. Traffic is typically counted at several intervals along a roadway, and as such, the same car would be counted by every counting instrument. Therefore, the AADT values in Table 4.9-2 are an average of the AADT counts taken for the stretch of roadway that could be impacted by the Restoration Project.

Table 4.9-2. Traffic Counts for State Highways within the Restoration Project Area

Roadway and Location	AADT*	Peak Hourly Counts
Interstate 5 (heading north from the Glenn County line through Tehama County to the Shasta County line)	29,700	3,400
Highway 5 (heading south from the junction of eastbound Route 299 to the Tehama/ Shasta County line)	44,375	4,379
Highway 99 (heading south from the junction of Route 36 in Red Bluff to the Butte County line)	8,633	837
Highway 99 (heading north from the Butte/Tehama County line to the junction of Route 36)	8,283	922
Highway 36 (heading northeast from the junction of Interstate 5 in Red Bluff to Milepost 75.2 on Manton Road)	13,283	1,337
Highway 36 (heading southwest Milepost 75.2 on Manton Road to the junction of Interstate 5 in Red Bluff)	9,650	992
Highway 44 (heading southeast from Interstate 5 junction to Shingletown)	18,050	1,804
Highway 44 (heading northwest from Shingletown to the junction of Interstate 5)	19,350	1,924

Source: Caltrans 2003.

*AADT is the total volume of traffic for the year divided by 365 days.

County regional transportation planning agencies compile similar information on some county roadways. Information on available AADT counts for county roadways that could be used to access the Restoration Project area is included in Table 4.9-3. Traffic count information is not readily available for private roadways.

Regulatory Setting

Federal

The Federal Highway Administration addresses the transportation of goods and materials in Title 49 of the Code of Federal Regulations. Federal laws that may be applicable to the project include the Commercial Motor Carrier Safety Assistance Program (49 CFR 350-399) and Appendices A through G of the Federal Motor Carrier Safety Regulations (Federal Motor Carrier Safety

Regulations 2001), which address safety considerations for the transportation of goods, materials, and substances over public highways.

Table 4.9-3. Traffic Counts for County Roadways within the Restoration Project Area

Roadway and Location	AADT*	Peak Hourly Counts
Shasta County		
Battle Creek Bottom Road, 100 feet east of Wildcat Road	35	NA
Battle Creek Bottom Road, 300 feet west of Wilson Hill Road	44	NA
Rock Creek Road, 200 feet east of Wilson Hill Road	311	NA
Rock Creek Road, 200 feet south of Highway 44	42	NA
Rock Creek Road, at Tehama County line	600	NA
Tehama County		
Manton Road, north of Highway 36, northbound lane	263	31
Manton Road, south of Shasta County line, northbound lane	257	41
Manton Road, north of Wildcat Road, northbound lane	290	61
South Powerhouse Road, ½ mile south of Manton Road	160	NA
Forward Road, ¼ mile east of intersection with Manton Road	496	NA
Forward Road, east of Graham Road	224	NA
Forward Road, east of Ponderosa Way	85	NA
Forward Road at the Shasta-Tehama County line	57	NA

* Annual Average Daily Traffic (AADT) is the total volume of traffic for the year divided by 365 days.

NA = Not available.

Sources: Cathey pers. comm.; Henley pers. comm.

State

The California Vehicle Code and Streets and Highways Code contain requirements that may be applicable to the Restoration Project, including the licensing of drivers and vehicles, the transportation of hazardous materials, and rights-of-way.

The applicable requirements of the California Streets and Highways Code contains requirements include:

- Sections 117 and 660-672 require permits for the use of oversized trucks on county roads.

- Sections 660, 670, 1450, 1460 *et seq*., 1470, and 1480 regulate right-of-way encroachment and the granting of permits for encroachment on state and county roads.

Local

According to Section 655302(b) of the California Government Code, a countywide Circulation Element is required to address the general location and extent of existing and proposed major thoroughfares, transportation routes, terminals, and public transit systems. The Circulation Element is also correlated with the Land Use Element of a county's general plan.

Shasta County

The transportation planning process in Shasta County is a complex program involving millions of dollars; the coordination of local, state, and federal agencies; and the meshing of various planning reports, studies, goals, objectives, and policies. The Circulation Element for Shasta County is just one part of the process (Shasta County 1998). The overall goal of the Shasta County Circulation Element is to develop a balanced, integrated, and diversified transportation system that addresses the regional needs (both urban and rural) of its citizens for a convenient, affordable, safe, and efficient transportation system to move goods and people.

Tehama County

The plans and policies of the Circulation Element of the Tehama County General Plan (Tehama County Community Development Group 1983) are to:

- Serve to coordinate the transportation and circulation system with planned land uses.
- Promote the efficient transport of goods and the safe and effective movement of all segments of the population.
- Make efficient use of existing transportation facilities.
- Provide existing and future residents and the development community with information concerning constraints, requirements, and conditions of the existing and future circulation system.
- Provide environmental quality and promote the wise and equitable use of economics and natural resources.

Environmental Consequences

Summary

No significant transportation impacts are associated with the No Action Alternative. The impacts are associated with all of the Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal) are less than significant as a result of the specific traffic-related safety standards that would be required as part of the project.

Impact Significance Criteria

The environmental consequences of the Restoration Project on transportation were assessed for two conditions:

- Construction-related impacts—short-term effects resulting from activities undertaken to support Restoration Project construction.
- Operation and maintenance impacts—long-term impacts resulting from operations and maintenance after completion of the Restoration Project.

During construction of the project, the existing roads would be subjected to an increase in traffic volume on and off the Restoration Project sites because of the movement of workers, heavy equipment, construction materials, and solid waste (removed from the project sites). Construction-related impacts on existing traffic conditions were evaluated for the effects that both construction worker commute traffic and the transport and removal of materials and equipment could have on potentially affected roadways. The construction, modification, or removal of facilities at the Restoration Project sites that would occur under the action alternatives would cause increased traffic on roadways used to transport equipment, materials, and construction workers to and from construction areas. Construction personnel would likely travel to the Restoration Project sites from I-5, which is west of the Restoration Project area, and follow SR 36 to Manton Road before proceeding along county and private roads to each site. The proposed access routes to each of the Restoration Project sites are discussed above.

During long-term operation of the project, traffic volumes would be much less than during construction. Traffic would consist primarily of light trucks and occasional construction equipment, such as backhoes or small cranes.

Based on Appendix G and Section 15065 of the State CEQA Guidelines and professional experience in assessing transportation impacts associated with water resource engineering projects, this analysis considers adverse impacts to be significant if the action alternatives could:

- Substantially increase the Average Daily Trip (ADT) volumes so that they could potentially exceed capacities and consequently reduce the level of service along a roadway.
- Cause significant road closures or traffic delays along area roadways. For the purposes of this analysis, a significant delay is defined as a delay of at least 15 minutes.
- Cause delays in emergency vehicle response times or require emergency vehicles to use alternative routes during emergencies.
- Result in unrepaired damage to the existing transportation infrastructure caused by heavy truck traffic or equipment use associated with facility construction, modifications, or removal.

Impacts were identified by comparing the proposed facility changes for the action alternatives to the above-listed impact criteria. The significance of the impact was then assessed. Activities that would not meet the above-listed criteria would be considered to have no impact. Activities that would decrease the likelihood for adverse impacts to occur could be considered to have beneficial impacts.

The traffic analysis is based on the following assumptions:

1. Essentially all workers and materials, and all disposal trips, will originate and end in (or pass through) Red Bluff. The primary access to the Restoration Project would be from Red Bluff along SR 36 to Manton Road.
2. Project-related traffic from Redding by way of SR 44 will be minimal because of the relatively poor conditions of connecting roads.
3. All construction activities will occur simultaneously. This will not necessarily be the case, but making this assumption illustrates the maximum expected project-related traffic on the affected roads.
4. The following roads will serve the project sites:
    - **SR 36 and Manton Road**, to its intersection with the Coleman Diversion Dam access road, will carry the traffic from all portions of the project.
    - **Manton Road**, from its intersection with the Coleman Diversion Dam access road to its intersection with the Eagle Canyon Diversion Dam access road, will serve Eagle Canyon Diversion Dam, Inskip Diversion Dam, South Powerhouse, Soap Creek Feeder, and South Diversion Dam.
    - **Manton Road**, from its intersection with the Eagle Canyon Diversion Dam access road to Manton, will serve Inskip Diversion Dam, South Powerhouse, Soap Creek Feeder, and South Diversion Dam..
    - **Wildcat Road**, from its intersection with Manton Road, carries traffic to the Wildcat Diversion Dam and North Battle Creek Feeder Diversion Dam sites.

- **Battle Creek Bottom Road**, from its intersection with Wildcat Road to its intersection with the road to Wildcat Diversion Dam, carries traffic to the Wildcat Diversion Dam and North Battle Creek Feeder Diversion Dam.
- **Battle Creek Bottom Road**, from its intersection with the road to Wildcat Diversion Dam, carries traffic to the North Battle Creek Feeder Diversion Dam (this includes the Wilson Hill Road as well).
- **Manton School Road**, south of Manton, carries the traffic for Inskip Diversion Dam and South Powerhouse.
- **Forward Road/Ponderosa Way**, south of Manton, carries the traffic for the Soap Creek Feeder and South Diversion Dam. This analysis assumes that, because of the distance and road conditions, that Manton School Road would provide little or no access to these sites.

5. Trips will be distributed along the roads during work days based on the number of trips generated by each project site served by each road. The total number of trips assigned to each road in Tables 4.9-5, 4.9-7, 4.9-9, and 4.9-11 is the sum of the trips generated by the construction sites served by that road.

Impact Assessment

No Action Alternative

Under the No Action Alternative, it is assumed that there would be no construction, modification, or removal of any facilities at the Hydroelectric Project sites. The No Action Alternative would also not result in the construction of any new access roads or improvements to any existing access roads, other than those already planned as a part of the existing operation and maintenance plan for the Hydroelectric Project. The No Action Alternative is not expected to impact transportation routes in the Restoration Project area and, therefore, would also not impact transportation resources.

Five Dam Removal Alternative (Proposed Action)

Table 4.9-4 provides a list of the assumptions used to determine the construction-related impacts associated with the Five Dam Removal Alternative. As shown in Table 4.9-4, the estimated number of daily round trips for the sites affected by this alternative ranges from six at the Coleman and Lower Ripley Diversion Dam sites, to 18 at the Inskip Powerhouse site, and 22 at the South Powerhouse and Inskip Diversion Dam work site. Table 4.9-5 illustrates the estimated amount of new traffic that would be generated by construction activities, by average daily round trips. For comparison to the AADT numbers listed in Tables 4.9-2 and 4.9-3, the average number of daily round trips in Tables 4.9-4 and 4.9-5 should be multiplied by 2 (i.e., 12 daily round trips would be 24 ADT).

Once construction is completed, the new fish facilities will require frequent monitoring and attendance to ensure the requirement for "fail-safe" operation is met. This will involve more trips to the sites than currently occur. This increase over existing levels is expected to be minor and would not result in an adverse impact.

Table 4.9-4. Summary of Construction Impact Assumptions Associated with the Five Dam Removal Alternative

Restoration Project Sites	Construction Duration (months)	Average Daily Number of Construction Workers[1]	Total Number of Truck Round Trips[2]	Estimated Average Number of Daily Round Trips
Wildcat Diversion Dam (dam, pipe and canal removal)	4	10	200	12
Eagle Canyon Diversion Dam (fish screen and ladder)	8	10	248	11
North Battle Creek Feeder Diversion Dam (fish screen and ladder)	8	10	200	11
Inskip Powerhouse (penstock bypass and tailrace connector)	9	15	600	18
Coleman Diversion Dam (removal)	2	5	40	6
South Powerhouse and Inskip Diversion Dam (tunnel tailrace connector, fish screen and ladder)	19	20	1000	22
South Diversion Dam (dam and canal removal)	5	10	485	14
Lower Ripley Creek Diversion Dam (dam and canal removal)	1	5	19	6
Soap Creek Diversion Dam (dam and pipe removal)	1	5	97	9

[1] Assumes all workers would drive to the site parking areas in their own vehicles.

[2] Truck trips are total round trips to deliver construction materials and equipment, such as concrete, rebar, riprap, gravel, mechanical and electrical materials, earthmoving equipment, etc. and truck trips for transporting materials to be disposed or salvaged, over the entire construction period (not daily).

Table 4.9-5. Summary of Traffic Impact Assumptions Associated with the Five Dam Removal Alternative

Road Segment	Average Daily Round Trips
Hwy. 36/Manton Rd.—Red Bluff to Wildcat Rd.	109
Manton Rd.—from Wildcat Rd. to Eagle Canyon Diversion Dam access road	56
Manton Rd.—Eagle Canyon Diversion Dam access road to town of Manton	45
Wildcat Rd.—Manton Rd. to Battle Creek Bottom Rd.	23
Battle Creek Bottom Rd.—Wildcat Rd. to Wildcat Diversion Dam turnoff	11
Wilson Hill Rd.	11
Manton School Rd.	22
Forward Rd./Ponderosa Way	23

Impact 4.9-1 Less than Significant—Construction and removal activities at the Restoration Project sites would result in increased traffic volumes on state, county, and private roadways.

Activities proposed under the Five Dam Removal Alternative would result in increased traffic levels on state, county, and private roads used to transport construction workers, equipment, and materials to and from the Restoration Project sites. Construction workers and equipment would likely travel along a series of state, county, and private roads to access the individual Restoration Project sites. The specific roads used to access the sites are described above. As shown in Table 4.9-4, the estimated number of daily round trips for the sites affected by this alternative ranges from six at the Coleman and Lower Ripley Diversion Dam sites, to 18 at the Inskip Powerhouse site, and 22 at the South Powerhouse and Inskip Diversion Dam work site.

Even if all activities were to occur simultaneously, it is not expected that increased traffic on state highways would result in significant impacts to traffic volumes. The increases in construction-related traffic counts (i.e., a worst-case maximum of 109 round trips daily during the construction period) would be very low when compared to the existing and average ADT counts shown in Table 4.9-2. Because of the relatively minor number of construction-related trips added to state roads, and temporary nature of construction traffic, the Five Dam Removal Alternative is not expected to result in significant increases in traffic volumes. The impact to increased traffic volumes on state highways is considered less than significant.

Traffic would also increase on those county and private roadways used to access the individual Restoration Project sites. Average ADT counts are not available for all of the county roads that provide access to the sites. Roads that may be used to access the Restoration Project sites and that have available traffic count data are provided in Table 4.9-3. It is also assumed that access roads with no traffic count information available have traffic volumes too low to warrant counting. This conclusion is further supported by the fact the Restoration Project sites are located in very remote areas and are not in proximity to more than a few residential areas.

Many of the private access roads have locked gates and do not provide access to areas that would be subject to large numbers of visiting public. Further, the purpose of many of these roads is specifically to provide access to the Restoration Project sites. Because of the small existing traffic volumes on the private roads, the Five Dam Removal Alternative is expected to result in less-than-significant increases in traffic volumes. Increased traffic is not expected to result in traffic delays longer than 15 minutes because Reclamation contractors would be required to keep delays below 15 minutes' duration or provide a suitable detour.

The impact of increased traffic volumes on county and private roads would be less than significant as a result of improvements being installed as part of the project and compliance with *Reclamation Safety and Health Standards*. Specifically, the following intersection improvements would improve traffic flow and safety during construction:

- Improvement of the intersection of Manton Road and the private road accessing the Eagle Canyon Diversion Dam.
- Improvement of the intersection of Manton Road and the private road accessing the Inskip powerhouse bypass facility (called the "plateau road" above).
- Improvement of the intersection of Battle Creek Bottom Road and the private road accessing the Wildcat Diversion Dam and Canal.

The *Reclamation Safety and Health Standards* consist of specific requirements for contractors working on Reclamation jobs. Topics covered include hazard assessment, medical services and first aid, emergency plans, occupational health, personal protective equipment, signs, fire prevention and protection, standards for materials handling, and use of tools and equipment. As part of the *Standards*, these requirements are made a part of the contracts entered into by Reclamation and its contractors. Reclamation undertakes regular inspections during construction projects to ensure contractor compliance with the *Standards*.

The following sections of the *Standards* exemplify the requirements that will reduce potential traffic impacts below a level of significance:

- Section 3.3 requires the contractor to submit a comprehensive written safety program to Reclamation for its review and approval that covers "all aspects of onsite and applicable offsite operations and activities associated with the contract." This includes signs and road flagging procedures.
- Section 9.1.10 provides requirements for traffic signs and barricades, including design and use of signs, visibility, and traffic controls.
- Section 9.4 establishes standards for flag persons directing traffic.

- Section 20.14 requires all roads to be designed to safely accommodate the movement of vehicles or equipment at appropriate speeds. This includes sight lines around curves, posted speed limits based on vehicles' stopping abilities, traffic control devices, and road maintenance. Single-lane haul roads with two-way traffic must be provided with adequate turnouts or a traffic control system to prevent accidents. Roads must be maintained in a safe condition and dust must be controlled.

The contract specifications imposed by Reclamation for work on this project include traffic control measures intended to reduce the impact of construction traffic. These specifications will be enforced by Reclamation as part of the contracts. These specifications include:

- submitting a traffic control plan for Reclamation's approval;
- limiting speeds to a maximum of 15 miles per hour, except near residences where a lower speed may be required;
- informing affected residents along the routes about changes in traffic levels and providing reasonable accommodations to ensure traffic safety, such as fencing or lower speed limits;
- providing a hot line for public input regarding traffic concerns through the community of Manton;
- providing necessary traffic control devices and flag persons to prevent accidents and damage or injury to passing traffic;
- delaying work along public and private roads until proper traffic control devices are in place;
- providing unobstructed, smooth, and dustless passageway for one lane of traffic through construction operations; and
- maintaining traffic flow to minimize obstruction and inconvenience to public traffic.

Impact 4.9-2 Less than Significant—Construction traffic could damage county and private roadways.

Reclamation contractors will be required not to exceed legal load limits for the county roads accessing the sites. Other measures, including improvements to three intersections, will help avoid damage from occurring. Some private access roads to the Restoration Project sites would require initial improvements before construction activities begin. These activities would include regrading and gravelling of existing roadways and on-going maintenance during construction. Post-construction repairs would be coordinated with landowners to ensure that the roads would be left in a condition equal to or better than the existing, preconstruction condition. The impact of construction traffic on county and private roads is considered to be less than significant.

Impact 4.9-3 Less than Significant—Construction traffic or activities could delay emergency vehicle response times.
It may be necessary for emergency response vehicles to access construction sites or residences along private roads accessing the project area. It is not, however, expected that construction traffic would substantially delay emergency vehicle response times. Emergency vehicles would likely be needed to respond to an incident at a site when workers are on site and not during morning and afternoon commute times, when traffic is heaviest.

It is assumed that emergency vehicles would follow the construction routes identified earlier in this section. Access routes used by construction and truck traffic should also be suitable for emergency response vehicles. In some cases, roadway improvements would be completed prior to construction activities. In cases where the sites are inaccessible by vehicles, such as Wildcat Diversion Dam and Eagle Canyon Diversion Dam, the sites would be accessed by foot. In this case, sites may also be accessed by helicopters transporting paramedics, or by foot, whichever is faster. The impact of construction traffic and activities on emergency vehicle response times is considered to be less than significant.

In addition, the *Reclamation Safety and Health Standards* require preparation and contractor's adherence to an emergency plan for each job. *Standards* Section 6.2 mandates that the emergency plan include requirements for emergency equipment, rescue, and medical duties. These requirements are carried over into the contract specifications that will be imposed by Reclamation on its contractors.

No Dam Removal Alternative

Table 4.9-6 provides a list of the assumptions used to determine the impacts associated with the No Dam Removal Alternative. It also provides the estimated total number of truck trips for each of the potentially affected construction sites. Table 4.9-7 illustrates the estimated average daily round trip traffic on selected roads. For comparison to the AADT numbers listed in Tables 4.9-2 and 4.9-3, the average number of daily round trips in Tables 4.9-6 and 4.9-7 should be multiplied by 2 (i.e., 11 daily round trips would be 22 ADT).

Table 4.9-6. Summary of Construction Impact Assumptions Associated with the No Dam Removal Alternative

Restoration Project Sites	Construction Duration (months)	Average Daily Number of Construction Workers[1]	Total Number of Truck Round Trips[2]	Estimated Average Number of Daily Round Trips
Wildcat Diversion Dam (fish screen and ladder)	8	10	100	11
Eagle Canyon Diversion Dam (fish screen and ladder)	8	10	248	11
North Battle Creek Feeder Diversion Dam (fish screen and ladder)	8	10	200	11
Inskip Powerhouse (no bypass or connector)	-	-	-	-
Coleman Diversion Dam (fish screen and ladder)	9	13	150	14
South Powerhouse and Inskip Diversion Dam (fish screen and ladder, no bypass/connector)	17	17	950	20
South Diversion Dam (fish screen and ladder)	8	10	450	13
Lower Ripley Creek Diversion Dam (No action)	-	-	-	-
Soap Creek Diversion Dam (No action)	-	-	-	-

[1] Assumes all workers would drive to the site parking areas in their own vehicles.

[2] Truck trips are total round trips to deliver construction materials and equipment, such as concrete, rebar, riprap, gravel, mechanical and electrical materials, earthmoving equipment, etc. and truck trips for transporting materials to be disposed or salvaged over the entire construction period (not daily).

Table 4.9-7. Summary of Traffic Impact Assumptions Associated with the No Dam Removal Alternative

Road Segment	Average Daily Round Trips
SR 36/Manton Rd.—Red Bluff to Wildcat Rd.	80
Manton Rd.—from Wildcat Rd. to Eagle Canyon Diversion Dam access road	44
Manton Rd.—Eagle Canyon Diversion Dam access road to town of Manton	33
Wildcat Rd.—Manton Rd. to Battle Creek Bottom Rd.	22
Battle Creek Bottom Rd.—Wildcat Rd. to Wildcat Diversion Dam turnoff	11
Wilson Hill Rd.	11
Manton School Rd.	20
Forward Rd./Ponderosa Way	13

There would be some variation between the specific roads affected under the No Dam Removal Alternative and those affected under the Five Dam Removal Alternative because the No Dam Removal Alternative would not result in any activities at the Soap Creek Feeder and Lower Ripley Creek Feeder Diversion Dams. In addition, this alternative would require fewer workers (70 workers vs. 90 workers) and less solid waste removal, thereby generating less overall traffic than the Five Dam Removal Alternative. The one exception is the Coleman Diversion Dam, where installation of the fish screen and ladder would involve more workers (and truck trips) over a longer period in comparison to the Five Dam Removal Alternative. The estimated daily round trips would be 14, rather than the six estimated under the Five Dam Removal Alternative.

Impact 4.9-4 Less –than Significant—Construction and removal activities at the Restoration Project sites would result in increased traffic volumes on state, county, and private roadways.

This alternative would result in a smaller traffic increase than the Five Dam Removal Alternative and would avoid increases in traffic on the private roads accessing the Soap Creek Feeder and Lower Ripley Creek Feeder Diversion Dams. Therefore, the impacts of this alternative would be less than the Five Dam Removal Alternative.

The very low volumes of traffic extant on the other private access roads serving the sites would be subject to a substantial increase as a result of this alternative. However, the impact of increased traffic volumes on county and private roads would be less than significant as a result of improvements being installed as part of the project, compliance with *Reclamation Safety and Health Standards*, and the Reclamation contract specifications, as described above.

Impact 4.9-5 Less than Significant—Construction traffic could damage county and private roadways.

This alternative would result in less traffic than the Five Dam Removal Alternative because it would employ fewer workers, require fewer truck trips to remove solid waste, and affect fewer facilities (and private roads accessing those facilities). At the same time, it would contain the same Reclamation requirements for improvements and postconstruction repair of roadways as described for the Five Dam Removal Alternative. Therefore, the impacts of this alternative on the physical condition of area roads would be similar to, but less than, that of the Five Dam Removal Alternative. The impact of construction traffic on county and private roads is considered less than significant.

Impact 4.9-6 Less than Significant—Construction traffic or activities could delay emergency vehicle response times.

This alternative would result in a smaller traffic increase than the Five Dam Removal Alternative. This alternative would contain the same Reclamation requirements for avoiding traffic delays as described for the Five Dam Removal Alternative. In addition, it would avoid work at two remote sites. Therefore, the impact of this alternative would be expected to be less extensive than, but otherwise similar to, that of the Five Dam Removal Alternative. The requirements of the *Reclamation Safety and Health Standards* and contract specifications described above would apply to this alternative as well. This impact is considered less than significant.

Six Dam Removal Alternative

The major difference between the Six Dam Removal Alternative and the Five Dam Removal Alternative is the removal of Eagle Canyon Diversion Dam and appurtenant facilities. Table 4.9-8 provides a list of the assumptions used to determine the traffic impacts associated with the Six Dam Removal Alternative.

Table 4.9-8. Summary of Construction Impact Assumptions Associated with the Six Dam Removal Alternative

Restoration Project Sites	Construction Duration (months)	Average Daily Number of Construction Workers1	Total Number of Truck Round Trips2	Estimated Average Number of Daily Round Trips
Wildcat Diversion Dam (dam, pipe and canal removal)	4	10	200	12
Eagle Canyon Diversion Dam (dam and flume removal, plug canal)	4	10	247	13
North Battle Creek Feeder Diversion Dam (fish screen and ladder)	8	10	200	11
Inskip Powerhouse (penstock bypass and tailrace connector)	9	15	590	18
Coleman Diversion Dam (removal)	2	5	40	6
South Powerhouse and Inskip Diversion Dam (tunnel tailrace connector, fish screen and ladder)	19	20	1,000	22
South Diversion Dam (dam and canal removal)	5	10	485	14
Lower Ripley Creek Diversion Dam (dam and canal removal)	1	5	19	6
Soap Creek Diversion Dam (dam and pipe removal)	1	5	97	9

[1] Assumes all workers would drive to the site parking areas in their own vehicles.

[2] Truck trips are total round trips to deliver construction materials and equipment, such as concrete, rebar, riprap, gravel, mechanical and electrical materials, earthmoving equipment, etc. and truck trips for transporting materials to be disposed or salvaged over the construction period (not daily).

Table 4.9-9. Summary of Traffic Impact Assumptions Associated with the Six Dam Removal Alternative

Road Segment	Average Daily Round Trips
SR 36/Manton Rd.—Red Bluff to Wildcat Rd.	111
Manton Rd.—from Wildcat Rd. to Eagle Canyon Diversion Dam access road	58
Manton Rd.—Eagle Canyon Diversion Dam access road to town of Manton	45
Wildcat Rd.—Manton Rd. to Battle Creek Bottom Rd.	23
Battle Creek Bottom Rd.—Wildcat Rd. to Wildcat Diversion Dam turnoff	11
Wilson Hill Rd.	11
Manton School Rd.	22
Forward Rd./Ponderosa Way	23

As shown in Table 4.9-8, the estimated number of daily round trips for the sites affected by this alternative ranges from six at the Coleman and Lower Ripley Diversion Dam sites, to 18 at the Inskip Powerhouse site, and 22 at the South Powerhouse and Inskip Diversion Dam work site. Table 4.9-9 illustrates the estimated average daily round trip traffic on selected roads. For comparison to the AADT numbers listed in Tables 4.9-2 and 4.9-3, the average number of daily round trips in Tables 4.9-8 and 4.9-9 should be multiplied by 2 (i.e., 12 daily round trips would be 24 ADT).

Impact 4.9-7 Less than Significant—Construction and removal activities at the Restoration Project sites would result in increased traffic volumes on state, county, and private roadways.

The Six Dam Removal Alternative would employ the same number of workers, require approximately the same amount of solid waste to be removed, and would involve activities at all of the same facilities as the Five Dam Removal Alternative. Accordingly, with the exception of the Eagle Canyon Diversion Dam, where the estimated number of daily round trips would be 13, rather than the 11 estimated for the Five Dam Removal Alternative, anticipated traffic would be the same as for the Five Dam Removal Alternative. The very low volumes of traffic extant on the other private access roads serving the sites would be subject to a substantial increase as a result of this alternative. However, the impact of increased traffic volumes on county and private roads would be less than significant as a result of improvements being installed as part of the project, compliance with the Bureau's *Reclamation Safety and Health Standards*, and contract specifications, as described above. Therefore, this alternative's level of impact would be the same as that of the Five Dam Removal Alternative. This impact is considered less than significant.

Impact 4.9-8 Less than Significant—Construction traffic could damage county and private roadways.

This alternative would employ the same number of workers and require approximately the same amount of solid waste to be removed as the Five Dam Removal Alternative. It would also involve activities at all of the same facilities as the Five Dam Removal Alternative. The operational measures intended to avoid significant effects on roads accessing the project sites would be the same as well. Therefore, the Six Dam Removal Alternative's level of impact would be the same (i.e., less than significant) as that of the Five Dam Removal Alternative.

Impact 4.9-9 Less than Significant—Construction traffic or activities could delay emergency vehicle response times.

The Six Dam Removal Alternative would employ the same operational measures intended to avoid significant effects on roads accessing the project sites as the Five Dam Removal Alternative. Therefore, this alternative's level of impact would be the same (i.e., less than significant) as that of the Five Dam Removal Alternative.

Three Dam Removal Alternative

Table 4.9-10 provides a list of the assumptions used to determine the impacts associated with the Three Dam Removal Alternative. As shown in Table 4.9-10, the estimated number of daily round trips for the sites affected by this alternative ranges from six at the Coleman Diversion Dam site to 23 at the South Powerhouse and Inskip Diversion Dam work site. Table 4.9-11 illustrates the estimated average daily round trips for selected roads. For comparison to the AADT numbers listed in Tables 4.9-2 and 4.9-3, the average number of daily round trips in Tables 4.9-10 and 4.9-11 should be multiplied by 2 (i.e., 12 daily round trips would be 24 ADT).

This alternative would employ fewer workers (77 workers vs. 90 workers) and would require the removal of a slightly smaller volume of solid waste (2,900 cubic yards vs. 3,000 cubic yards) than the Five Dam Removal Alternative. The Three Dam Removal Alternative would not include improvements to the Soap Creek Feeder and Lower Ripley Creek Feeder Diversion Dams, both of which are slated for removal under the Five Dam Removal Alternative. The Three Dam Removal Alternative would remove the Eagle Canyon Diversion Dam, slated for installation of a new fish screen and ladder under the Five Dam Removal Alternative (resulting in an increase in estimated trips from 11 under the Five Dam Removal Alternative to 13 under this alternative), and install a new fish screen and ladder at the South Diversion Dam rather than removing that dam as under the Five Dam Removal Alternative. The estimated daily round trips to and from the Inskip Powerhouse site would be 14, rather than the 18 estimated for the Five Dam Removal Alternative. Otherwise, traffic volumes are estimated to be nearly the same as for the Five Dam Removal Alternative. The Three Dam Removal Alternative would affect six of the eight facilities slated for improvement under the Five Dam Removal Alternative.

Table 4.9-10. Summary of Construction Impact Assumptions Associated with the Three Dam Removal Alternative

Restoration Project Sites	Construction Duration (months)	Average Daily Number of Construction Workers1	Total Number of Truck Round Trips2	Estimated Average Number of Daily Round Trips
Wildcat Diversion Dam (dam, pipe and canal removal)	4	10	200	12
Eagle Canyon Diversion Dam (dam and flume removal, plug canal)	4	10	247	13
North Battle Creek Feeder Diversion Dam (fish screen and ladder)	8	10	200	11
Inskip Powerhouse (no penstock bypass, smaller tailrace connector)	8	12	292	14
Coleman Diversion Dam (removal)	2	5	40	6
South Powerhouse and Inskip Diversion Dam (tailrace flow separator, fish screen and ladder)	19	20	1100	23
South Diversion Dam (fish screen and ladder)	8	10	450	13
Lower Ripley Creek Diversion Dam (No action)	-	-	-	-
Soap Creek Diversion Dam (No action)	-	-	-	-

[1] Assumes all workers would drive to the site parking areas in their own vehicles.

[2] Truck trips are round trips to deliver construction materials and equipment, such as concrete, rebar, riprap, gravel, mechanical and electrical materials, earthmoving equipment, etc. and truck trips for transporting materials to be disposed or salvaged.

Table 4.9-11. Summary of Traffic Impact Assumptions Associated with the Three Dam Removal Alternative

Road Segment	Average Daily Round Trips
SR 36/Manton Rd.—Red Bluff to Wildcat Rd.	92
Manton Rd.—from Wildcat Rd. to Eagle Canyon Diversion Dam access road	49
Manton Rd.—Eagle Canyon Diversion Dam access road to town of Manton	36
Wildcat Rd.—Manton Rd. to Battle Creek Bottom Rd.	23
Battle Creek Bottom Rd.—Wildcat Rd. to Wildcat Diversion Dam turnoff	11
Wilson Hill Rd.	11
Manton School Rd.	23
Forward Rd./Ponderosa Way	13

Impact 4.9-10 Less than Significant—Construction and removal activities at the Restoration Project sites would result in increased traffic volumes on state, county, and private roadways.
This alternative would result in a smaller traffic increase than the Five Dam Removal Alternative because it would employ fewer workers and would not result in traffic increases on the unpaved private roads accessing the Soap Creek Feeder and Lower Ripley Creek Feeder Diversion Dams. Nonetheless, the very low volumes of traffic extant on the other private access roads serving the sites would be subject to a substantial increase as a result of this alternative. Therefore, the impacts of this alternative would be less than those of the Five Dam Removal Alternative. The impact of increased traffic volumes on county and private roads would be less than significant as a result of improvements being installed as part of the project, compliance with *Reclamation Safety and Health Standards*, and contract specifications, as described above.

Impact 4.9-11 Less than Significant—Construction traffic could damage county and private roadways.
This alternative would generate less traffic than the Five Dam Removal Alternative because it would employ fewer workers and would require the removal of a slightly smaller volume of solid waste. It would also avoid changes to traffic levels on the unpaved private roads accessing Soap Creek Feeder and Lower Ripley Creek Feeder Diversion Dams. At the same time, it would contain the same Reclamation requirements for improvements and postconstruction repair of roadways as described for the Five Dam Removal Alternative. Therefore, the impacts of this alternative on the physical condition of area roads would be expected to be less than those of the Five Dam Removal Alternative, but otherwise similar. This impact is considered less than significant.

Impact 4.9-12 Less than Significant—Construction traffic or activities could delay emergency vehicle response times.
The Three Dam Removal Alternative would result in a smaller traffic increase than the Five Dam Removal Alternative. This alternative would contain the

same Reclamation requirements for avoiding traffic delays and providing emergency plans as described for the Five Dam Removal Alternative. In addition, it would avoid work at two remote sites. Therefore, the impact of this alternative would be expected to be less extensive than, but otherwise similar to, that of the Five Dam Removal Alternative. This impact is considered less than significant.

Cumulative Impacts

Cumulative impacts are the combined impacts of past, present, and reasonably foreseeable future projects (including those mentioned in Chapter 6) on traffic. The area roads are not currently subject to significant levels of traffic. There are no other known future projects that would contribute substantial amounts of traffic to the road system serving the Restoration Project. Implementation of any of the action alternatives is not expected to result in any cumulative impacts to roadways in or around the Restoration Project area. Roadways would be more heavily used during construction activities; however, this would occur only for the duration of such activities. Access during long-term operation and maintenance of the Restoration Project would not result in a substantial increase in vehicular traffic over current, pre-action levels. The Restoration Project is not anticipated to result in substantial increases in public access to the area because many of the sites are remotely located (away from large numbers of sensitive receptors) and are accessed by private roads closed to the general public. Therefore, no significant increase in recreation-related traffic would occur under any of the alternatives.

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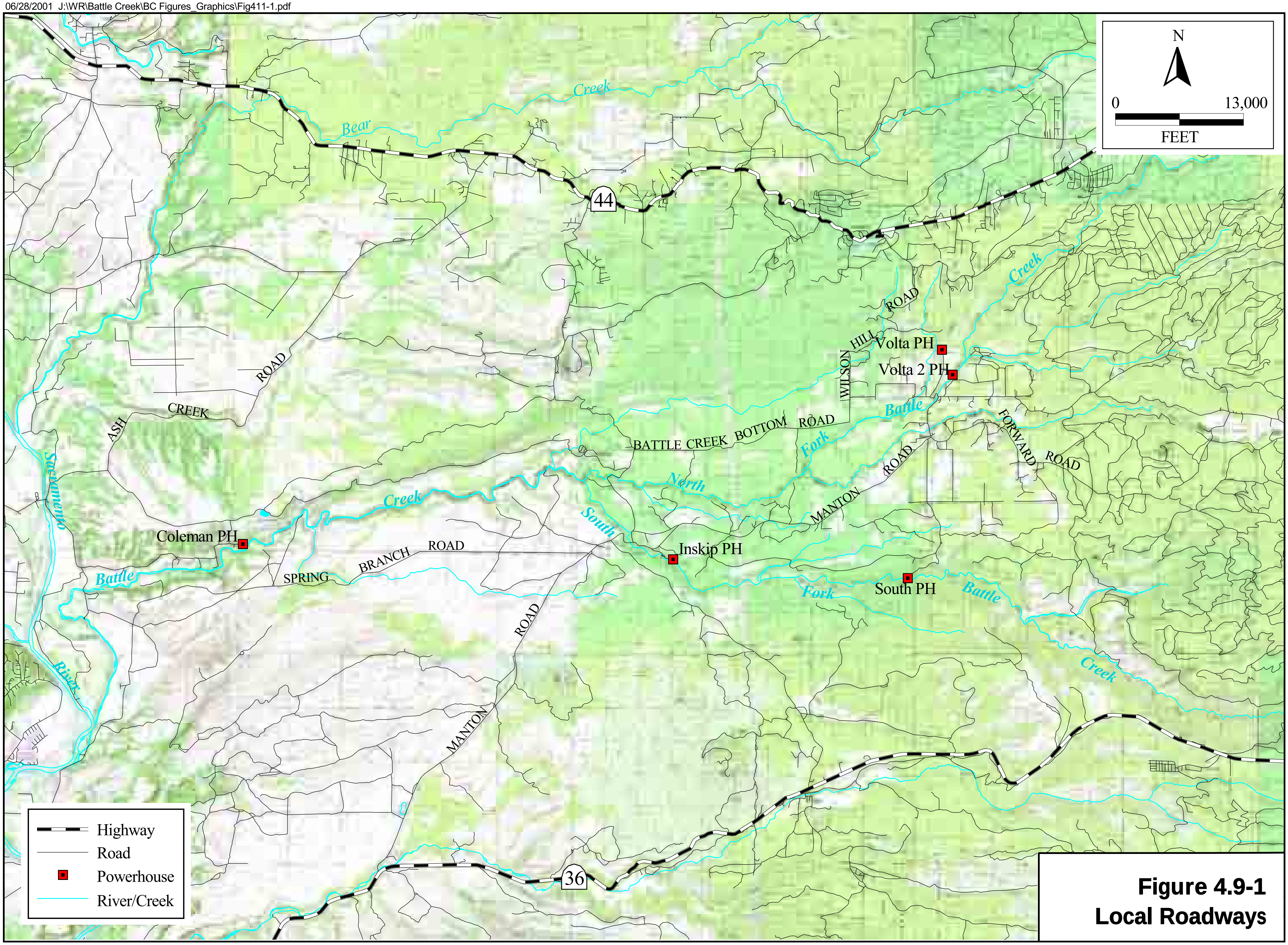


Figure 4.9-1
Local Roadways

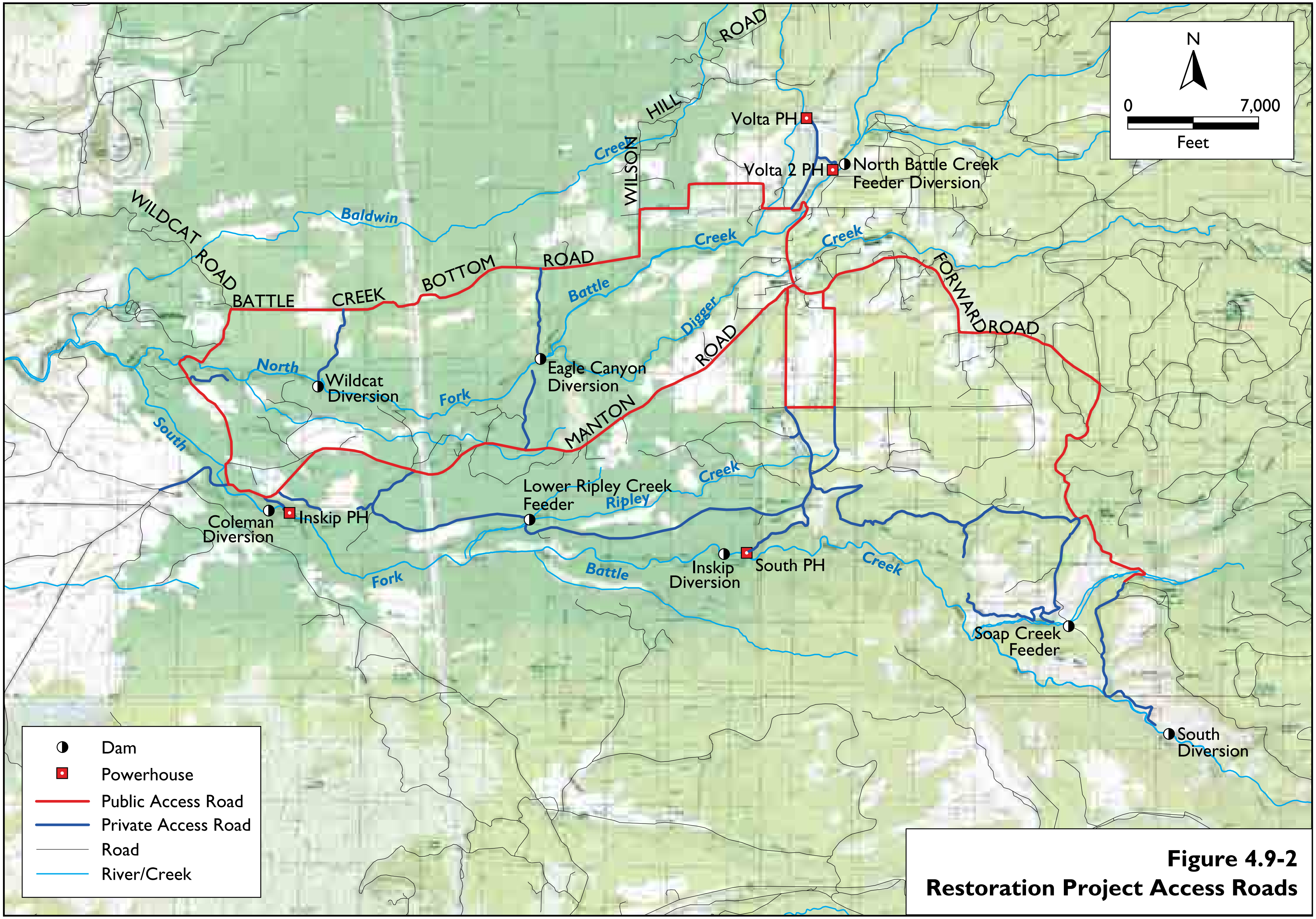


Figure 4.9-2
Restoration Project Access Roads

4.10 Noise

Affected Environment

Regional Setting

The Battle Creek watershed lies on the volcanic slopes of Mt. Lassen in southeastern Shasta and northeastern Tehama Counties. The Restoration Project is a portion of the larger Battle Creek watershed and is located in southern Shasta and northern Tehama Counties. The Restoration Project is located south of Shingletown and SR 44 and north of Paynes Creek and SR 36.

Area of Potential Noise Impacts

Land in the Restoration Project is primarily privately owned with some areas of public land. The Restoration Project is in the unincorporated areas of the counties and is devoid of large residential areas. Because most of the land in the Restoration Project is privately owned and remote, public access for recreational activities, including fishing, is rather limited. Public access is discussed further in Section 4.14, "Recreation." As discussed in Section 4.9, "Transportation," the Restoration Project is located away from major transportation corridors. Access to the Restoration Project sites will be primarily along many unpaved, unimproved county- or privately owned access roads. Areas located away from major transportation corridors, including the Restoration Project sites, are much less affected by noise generated by human activities. Based on the nature of the Restoration Project, predominant noise sources at the Restoration Project sites result primarily from operation of the Hydroelectric Project, wildlife (e.g., birds chirping), and wind in the trees.

A number of sites may be subject to construction, modification, or removal activities under one or more of the Restoration Project alternatives. These sites include Wildcat Diversion Dam, Eagle Canyon Diversion Dam, North Battle Creek Feeder, Coleman Diversion Dam (including the Inskip Powerhouse bypass facility and tailrace connector), Inskip Diversion Dam (including the tailrace connector and connector tunnel), South Diversion Dam, Soap Creek, and Lower Ripley Creek Feeder. More information on these sites is provided in Chapter 3, "Project Alternatives."

Characteristics of Noise

Noise often is defined simply as the presence of unwanted or undesirable sound in one's community or environment and, thus, is a subjective reaction to the characteristics of a physical phenomenon. What is a pleasing sound to one can be a severe irritant to another. Most environmental sound includes a conglomeration of distant sources that create a relatively steady “background noise” in which no particular source is identifiable. These distant sources of sounds could include traffic, wind in the trees, or industrial activities. Community noise is commonly described in terms of an *ambient* noise level, which is defined as the all-encompassing noise level associated with a given noise environment. Sound levels in this report are measured in terms of A-weighted sound pressure levels, or decibels (dBA). A-weighting de-emphasizes very low and very high frequencies of sound in a manner similar to the human ear. Most community noise standards use A weighting because it provides a high correlation with human annoyance and health effects. Table 4.10-1 illustrates some common noise sources and their dBA levels.

Table 4.10-1. Noise Levels from Common Sources

Source	dBA
Jet takeoff at 200 feet	130
Pile driver at 50 feet	100
Subway train at 20 feet	90
Pneumatic drill at 50 feet	80
Light traffic at 100 feet	50
Soft whisper at 5 feet	30
Rustling leaves	20

Source: Shasta County 1998.

Note: The distances indicated above are the distances between the noise source and the listener.

A common statistical tool to measure the ambient noise level is the average or equivalent sound level (L_{eq}), which is the sound level corresponding to a steady-state sound level containing the same total energy as a time-varying signal over a given time period (usually 1 hour). The L_{eq} is the foundation of the composite noise descriptors. These descriptors include the community noise equivalent level (CNEL), day-night noise level (L_{dn}), and sound exposure level (SEL). The CNEL is the average A-weighted noise level during a 24-hour day, obtained after adding 5 decibels (dB) to sound levels between 7 p.m. and 10 p.m. and adding 10 dB to sound levels between 10 p.m. and 7 a.m. The addition of dB during the evening and night hours accounts for a person’s higher sensitivity to noise during periods of rest and sleep. The CNEL and L_{dn} descriptors are virtually identical because each was developed to evaluate the community noise environment. However, L_{dn} does not differentiate between day and evening noise levels.

In general a change in a noise level of 3 dB is considered to be a barely perceptible change. A 5 dB change is considered to be a distinctly perceptible change, and a 10 dB change is perceived as being twice or half as loud.

Blasting may be required as part of the construction process. The two primary environmental effects of blasting are airborne noise and groundborne vibration. A brief discussion of each of these effects and standards commonly used to assess the impacts of blasting follows.

Airblast

Energy released in an explosion creates an air overpressure (commonly called an airblast) in the form of a propagating wave. If the receiver is close enough to the blast, the overpressure can be felt as the pressure front of the airblast passes. The accompanying booming sound lasts for only a few seconds. The explosive charges used in mining and mass grading typically are wholly contained in the ground, resulting in an airblast with frequency content below about 250 cycles per second, or Hz.

Because an airblast lasts for only a few seconds, use of L_{eq} (a measure of sound level averaged over a specified period of time) to describe blast noise is inappropriate. Airblast is properly measured and described as a linear peak air overpressure (i.e., an increase above atmospheric pressure) in pounds per square inch (psi). Modern blast monitoring equipment is also capable of measuring peak overpressure data in terms of unweighted dB. Decibels, as used to describe airblast, should not be confused with or compared to dBA, which are commonly used to describe relatively steady-state noise levels. An airblast with a peak overpressure of 130 dB can be described as being mildly unpleasant, whereas exposure to jet aircraft noise at a level of 130 dBA would be painful and deafening.

Ground Vibration

Blasting creates seismic waves that radiate along the surface of the earth and downward into the earth. These surface waves can be felt as ground vibration. Airblast and ground vibration can result in effects ranging from annoyance of people to damage of structures. Varying geology and distance will result in different vibration levels containing different frequencies and displacements. In all cases, vibration amplitudes and high frequency content will decrease with increasing distance from the blasting source.

As seismic waves travel outward from a blast, they excite the particles of rock and soil through which they pass and cause them to oscillate. The actual distance that these particles move is usually only a few ten-thousandths to a few thousandths of an inch. The rate or velocity (in inches per second) at which these particles move is the commonly accepted descriptor of the vibration amplitude, referred to as the peak particle velocity (ppv).

Human Response to Airblast and Vibration

Human response to blast vibration and airblast is difficult to quantify. Vibration and airblast can be felt or heard well below the levels that produce any damage to structures. The duration of the event has an effect on human response, as does blast frequency. Blast events are relatively short, on the order of several seconds for sequentially delayed blasts. Generally, as blast duration and vibration frequency increase, the potential for adverse human response increases. Studies have shown that a few blasts of longer duration will produce a less adverse human response than short blasts that occur more often.

Table 4.10-2 summarizes the average human response to vibration and airblast that may be anticipated when a person is at rest in quiet surroundings. If the person is engaged in any type of physical activity, the level required for the responses indicated is increased considerably.

It is important to understand that the foregoing describes the responses of average individuals. Individual responses can fall anywhere within the full range of the human response spectrum. At one extreme are those people who receive some tangible benefit from the blasting operation and probably would not be disturbed by any level of vibration and airblast, as long as it does not damage their property. At the opposite extreme are people who would be disturbed by even barely detectable vibration or airblast. Individuals at either of these two extremes were not considered in the listing of average human response or in the impact conclusions that follow.

Table 4.10-2. Human Response to Airblast and Ground Vibration from Blasting

Response	Ground Vibration Range ppv (inches per second)	Airblast Range (dB)
Barely to distinctly perceptible	0.02–0.10	50–70
Distinctly perceptible to strongly perceptible	0.10–0.50	70–90
Strongly perceptible to mildly unpleasant	0.50–1.00	90–120
Mildly unpleasant to distinctly unpleasant	1.00–2.00	120–140
Distinctly unpleasant to intolerable	2.00–10.00	140–170

Source: Bender 1996

Sensitive Receptors

For the purpose of this noise analysis, the potential effect is generally defined by the number and nature of "sensitive receptors" that could be affected by noise generated during the implementation of the Restoration Project. Sensitive receptors for noise can be defined as people at various locations who are participating in activities for which low noise levels are important (e.g., activities conducted at residences, hospitals, schools, libraries, recreational areas, and places of worship).

Noise at sensitive receptor locations is often cited as a health problem, not in terms of actual physiological damage such as hearing impairment, but in terms of inhibiting general well-being and contributing to undue stress and annoyance. The health effects of noise arise from its interference with sleep, speech, recreation, and tasks demanding concentration or coordination. When community noise interferes with human activities or contributes to stress, public annoyance with noise sources increases and the acceptability decreases. This decrease in acceptability and the threat to public well-being are the bases for land use planning policies to prevent exposure to excessive community noise levels at sensitive receptor locations.

The Restoration Project sites are very remote and not heavily populated with either residences or other sensitive receptors. In addition, most of the Restoration Project sites and the access roads to these sites are either on property owned by PG&E or on other privately owned property. Public access to the sites is further discouraged by locked gates at most access road entry points. Public access to many of the Restoration Project sites (specifically including Wildcat, Eagle Canyon, and South Diversion Dams) is limited by the remote nature of the area, the rough terrain of the roads used to access the sites, and the sites' inaccessibility by vehicles.

The Oasis Springs Lodge, a 3,000-acre fly-fishing lodge and dude ranch along South Fork Battle Creek, is located immediately upstream of Inskip Diversion Dam and just downstream of the South Powerhouse. The lodge is the largest noise-sensitive receptor in the Restoration Project. In addition, residences are located along Manton School Road and the access road to the Inskip Diversion Dam and South Powerhouse. The Oasis Springs Lodge and the residential area are the closest sensitive receptors to any of the Restoration Project sites or access routes and would be the only noise-sensitive uses potentially affected by project-related activity.

Noise levels in this type of remote area are typically in the range of 25 to 45 dBA.

Regulatory Setting

A number of federal, state, and local laws, regulations, and policies relate to noise within the Restoration Project area. The following is a summary of those that relate to this assessment:

U.S. Bureau of Mines

Conventional noise criteria (for steady-state noise sources) and limits established for repetitive impulsive noise (such as for gun-firing ranges) do not apply to air overpressures from blasting. U.S. Bureau of Mines (USBM) Report of Investigations 8485 (USBM 1980a) and the regulations issued more recently by the U.S. Office of Surface Mining and Reclamation Enforcement specify a maximum safe overpressure of 0.013 psi (133 dB) for impulsive airblast when recording is accomplished with equipment having a frequency range of response of at least 2–200 Hz.

USBM Report of Investigations 8507 (USBM 1980b) contains blasting-level criteria that can be appropriately applied to keep ground vibration well below levels that might cause damage to neighboring structures. At low-vibration frequencies, velocities of ground vibration are restricted to low levels. As vibration frequency increases, higher velocities are allowed up to a maximum of 2.00 inches per second. As discussed earlier, high frequencies are attenuated with increasing distance from the blast source. Figure 4.10-1 depicts blasting-level criteria as a function of frequency.

To determine the velocity limit from Figure 4.10-1 that would apply to the neighboring properties, the dominant frequency ranges of the vibration must first be determined. The distribution of explosives, distance from the blast, and the nature of the transmitting medium (soil and rock) between the blast site and the affected structure all play a part in determining the dominant frequency of the blast vibration. Timing between the detonation of charges also affects the frequency but only in relatively close proximity to the blast.

At a distance of 500–1,000 feet from the blast, vibration frequency would be 25–100 Hz. At a distance of 1,000–2,500 feet, the frequency would be 10–40 Hz. At a distance of 2,500–5,000 feet, the frequency would be 4–35 Hz. The ppv limits specified in Figure 4.10-1 range from 0.50 inch per second at 4 Hz to 2.00 inches per second at 40 Hz and above.

Bureau of Reclamation Standard Construction Specifications

Construction specifications developed by Reclamation for this project limit noise-generating construction activity to the hours between 7:00 a.m. and 9:00 p.m. The specifications require that noise not exceed 70 dBA (L_{10}) at the nearest noise-sensitive land use during daytime hours and 50 dBA (L_{10}) during nighttime hours.

Tehama County General Plan Noise Element

The Tehama County noise element (Tehama County Community Development Group 1983) generally identifies the range of desired levels for residential areas as being from 40 to 50 dBA for rural-suburban residential areas and from 50 to 60 dBA for medium- and high-density residential areas. These ranges could increase to 60 and 70 dBA, respectively, in areas where transportation noise is a significant factor. Noise in the Tehama County general planning area that is at or approaching problem magnitudes is typically concentrated in urban areas, at certain industrial operations, and along the corridors of transportation routes.

Shasta County General Plan Noise Element

Shasta County applies an interior noise level criterion of 45 dBA, which is consistent with the interior noise level criterion suggested by the State Office of Noise Control and Office of Planning and Research for interior spaces of noise-sensitive uses affected by transportation noise sources. The Shasta County General Plan (Shasta County 1998) noise element identifies recommended maximum noise levels for sensitive receptors within the county as shown in Table 4.10-3.

Table 4.10-3. Shasta County General Plan Maximum Allowable Noise Exposure from Transportation Noise Sources

Land Use	Outdoor Activity (L_{dn}/CNEL, dB)	Interior Spaces (L_{dn}/CNEL, dB)
Residential	60–65	45
Transient lodging	60	45
Hospitals, nursing homes	60–65	45
Theaters, auditoriums, music halls	NA	NA
Churches, meeting halls	60–65	NA
Office buildings	NA	NA
Schools, libraries, museums	NA	NA
Playgrounds, parks	70	NA

Source: Shasta County 1998
NA = Not applicable

Shasta and Tehama County Noise Ordinances

The Shasta and Tehama County general plan policies discussed above relate to long-term noise compatibility and not noise from construction activity. They are not used for noise enforcement. Noise ordinances are normally the legal mechanism for limiting noise from construction activity. However, neither Shasta County nor Tehama County has adopted a noise ordinance.

Environmental Consequences

Summary

No significant noise impacts are anticipated to occur under the No Action Alternative. Significant noise impacts are anticipated to occur with implementation of any of the Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal). These impacts are predicted to occur at the Oasis Springs Lodge and the small residential area located along the access road to the Inskip Diversion Dam/South Powerhouse site as a result of proposed construction activity. Reclamation will implement mitigation measures to reduce significant impacts to a less-than-significant level.

Impact Significance Criteria

In general, noise impacts are considered significant if implementation of the Restoration Project would result in the following (criteria taken from Appendix G of the State CEQA Guidelines):

- exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
- exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels; or
- substantial permanent increase or substantial temporary or periodic increase in ambient noise levels in the Restoration Project vicinity above levels existing without the Restoration Project.

Shasta and Tehama Counties have not adopted noise standards that can be applied to noise from construction activity. Noise limits specified in Reclamation’s standard construction specifications, USBM guidelines, and the commonly accepted threshold for a distinctly perceptible change in noise (5 dB) are used to assess the significance of construction noise impacts. Accordingly, a construction noise impact is considered significant if:

- airblast from blasting exceeded 133 dB at a noise-sensitive land use,
- vibration from blasting exceeded USBM vibration standards,
- noise from general construction activity exceeded noise limits in Reclamation noise standard specifications, or

- noise from general construction activity exceeded the ambient noise level by more than 5 dB at any time.

Consideration is given to the duration of construction noise impacts. Noise exceeding the thresholds above that occurs for a short period of time may not be considered significant.

Impact Assessment

As applicable, the General Environmental Protection Measures listed in the introduction to this chapter shall be used for this resource. In addition, specific mitigation measures for this resource are identified below.

No Action Alternative

The No Action Alternative would not increase noise levels above existing levels in the vicinity of the Restoration Project or at the locations of nearby sensitive receptors. Under the No Action Alternative, the Hydroelectric Project would continue to generate noise related to operations and maintenance at current levels.

Five Dam Removal Alternative (Proposed Action)

The activities proposed under the Five Dam Removal Alternative would entail the use of various types of construction equipment and site access routes and could result in temporary noise impacts. While noise impacts could result throughout construction activities, they would be most severe during discrete phases of construction. These phases include initial access road improvements and earth-moving activities during which noise levels may be heightened.

Impact 4.10-1 Significant—Exposure of noise-sensitive uses to noise and vibration from blasting.

It is anticipated that blasting using chemical expansion agents, explosives, or drill-and-shoot techniques would be required at some of the Restoration Project sites. The Oasis Lodge is located within 200 feet of the Inskip Diversion Dam/South Powerhouse site and is the only noise-sensitive area that would be potentially exposed to noise and vibration from blasting. Details on the blasting methods to be used are not known at this time; however, it is known that some blasting would be conducted completely underground with no disturbance of the ground surface. Noise will not be an issue for this type of blasting. Some surface blasting may be required. Accordingly, there is potential for noise from blasting to exceed 133 dB and vibration to exceed USBM vibration criteria at the Oasis Springs Lodge. This impact is therefore considered to be significant. Implementation of the following mitigation measure would reduce this impact to a less-than significant level.

Mitigation Measure for Impact 4.10-1. Implement a blast noise and vibration mitigation and notification plan. Reclamation will implement a blast noise mitigation and notification plan that will include, but is not limited to, the following measures.

- Blasting notification identifying the date and time of blasting will be provided to nearby residents, local law enforcement, newspapers, and sensitive receptors located within 1,000 feet of blasting.
- Pre-blast alarms will be sounded. Immediately before blasting, the construction contractor will be required to sound a signal announcing the blast. Construction contractors will follow the construction safety plan that will provide for these measures.
- Best available practices will be employed to limit airblast from blasting to 135 dB and vibration to USBM limits at the nearest noise-sensitive land uses.
- Noise and vibration monitoring will be performed at nearby residences and sensitive receptors to ensure that airblast from blasting is limited to 135 dB and that vibration is limited to USBM criteria.

Impact 4.10-2 Significant—Exposure of noise-sensitive land uses to noise from on-site construction activities.

Numerous pieces of large equipment, including those listed in Table 4.10-4, would be used during the demolition of existing facilities and construction of project components such as fish screens, fish ladders, and access road improvements. Also, because of the remote nature of and limited access to many of the Restoration Project sites, helicopters may be used both to remove construction debris from sites and to deliver material and equipment to sites. No more than five helicopter flights to each construction site are anticipated for the Inskip Diversion Dam/South Powerhouse site.

Table 4.10-4. Noise Levels Associated with Typical Construction Activities

Equipment	Noise Level Ranges at 50 Feet from Source (dBA, L_{max})
Trucks	82–94
Concrete mixer trucks	74–88
Bulldozers	72–96
Front loaders	71–84
Scrapers/graders[1]	79–92
Water trucks	82–94
Cranes	75–87
Backhoes	71–93
Saws/vibrators	68–82

Equipment	Noise Level Ranges at 50 Feet from Source (dBA, L_{max})

Source: Colusa Basin Drainage District and Bureau of Reclamation 2000.

L_{max} = maximum noise output level.

[1] Could include the Cat 311 excavator equipped with a hoe-ram.

The Oasis Springs Lodge is the only noise-sensitive land use that would be exposed to noise from on-site construction activity. Noise from a construction site typically drops off at a rate of 6 dB per doubling of distance. This indicates that the Oasis Springs Lodge, which is located within several hundred feet of construction areas, would be exposed to construction noise that could exceed Reclamation noise thresholds. Noise also could exceed the ambient noise level by more than 5 dB. This impact is therefore considered to be significant.

Noise from helicopters could also exceed the significance thresholds. However, because no more than five helicopter events are anticipated at the Inskip Diversion Dam/South Powerhouse site and the noise impact would only last a short period of time, the noise impact from helicopter operations is not considered significant.

Implementation of the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measure for Impact 4.10-2. Employ noise-reducing construction practices. Reclamation will implement noise-reducing construction practices such that construction noise at the Oasis Lodge does not exceed Reclamation noise standards or the ambient noise level by more than 5 dB. These practices include but are not limited to the following:

- Residents and other sensitive receptors within the areas affected by noise generated during construction activities will be notified of the approximate dates of construction and the potential resulting increases in noise at least 2 weeks before construction begins.
- When near sensitive receptors and whenever practicable, noise-generating construction equipment will be turned off or left running at the lowest setting possible when not in use.
- Construction equipment will be properly outfitted and maintained to reduce noise output.
- Whenever practicable, noise-generating construction equipment will be shielded from nearby sensitive receptors by acoustical enclosures, berms, or temporary construction noise barriers.

Additional mitigation measures will be developed during the construction design phase before construction activities begin. If physical measures to reduce noise to the limits specified above are infeasible, Reclamation will purchase the use of the lodge during the construction period. If purchasing for the use is not feasible, this impact would be significant and unavoidable.

Impact 4.10-3 Significant—Exposure of noise-sensitive land uses along site access roads to construction-related truck noise.

Implementation of the Five Dam Removal Alternative would require extensive hauling of materials to and from the Inskip Diversion Dam/South Powerhouse site. Reclamation estimates that up to 40 truck trips per day averaging five trips per hour could occur. Table 4.10-5 summarizes the estimated number of truck trips as a function of the construction activity.

Table 4-10.5. Estimated Construction Truck Trips

Activity	Number of truck trips
South Powerhouse Trailrace Connector	973
Inskip Canal Wasteway	93
Inskip Diversion Dam Fish Screen Ladder	521
Access Roads	1,717
Total	3,304

Reclamation is proposing to use Manton School Road as the primary haul route into the site. Residences are located along this road. Assuming five heavy-truck round trips per hour, or a total of 10 truck pass-bys per hour, the estimated 1-hour average sound level at 50 feet for trucks traveling at 25 miles per hour would be 58 dBA (based on the FHWA traffic noise prediction model FHWA-RD-77-108). The maximum sound level during a pass-by would be 78 dBA at 50 feet (Hoover 1995). Because the truck noise level would exceed both the daytime and nighttime construction noise standards of 70 and 50 dBA, respectively, used by Reclamation and because truck noise would exceed the ambient noise level by more than 5 dBA, this impact is considered to be significant. Implementation of the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measure for Impact 4.10-3. Construct an alternative haul route and limit the hours of trucking operations. Reclamation will construct an alternative haul route that is at least 750 feet from the nearest occupied residences and limit trucking operations to the hours of 7:00a.m. to 9:00p.m.

Impact 4.10-4 Less than Significant—Exposure of noise-sensitive land uses to noise from operation of the Restoration Project facilities.

The operation of the Restoration Project facilities after implementation of the Five Dam Removal Alternative would generate noise. Periodic monitoring and maintenance activities would require PG&E staff to continue to visit the sites by truck. It is not expected that the frequency of monitoring and maintenance activities would increase over current similar activities. Therefore, it is also not expected that the post-implementation noise levels would increase over the current noise levels. In some cases, the construction of new facilities and the upgrading of access roads would result in a reduction in noise associated with routine operation and maintenance activities, thereby resulting in less traffic- and maintenance-related noise than that produced by the current operation and maintenance activities. This impact is therefore considered to be less than significant.

No Dam Removal Alternative

Noise impacts would be similar to those described for the Five Dam Removal Alternative. Each impact is described briefly below. With the implementation of the proposed mitigation measures, these potential impacts would be mitigated to a less-than-significant level.

Impact 4.10-5 Significant—Exposure of noise-sensitive uses to noise and vibration from blasting.

It is anticipated that blasting using chemical expansion agents, explosives, or drill-and-shoot techniques would be required at some of the Restoration Project sites under the No Dam Removal Alternative. Only one noise-sensitive receptor, the Oasis Springs Lodge, is located near the Inskip Diversion Dam/South Powerhouse and potentially would be exposed to noise and vibration from blasting. Noise levels could exceed 133 dB and vibration could exceed USBM vibration criteria at the Oasis Springs Lodge. This impact is therefore considered to be significant. This impact is similar to Impact 4.10-1. Implementing the Mitigation Measures for Impact 4.10-1 would reduce this impact to a less-than-significant level.

Impact 4.10-6 Significant—Exposure of noise-sensitive land uses to noise from on-site construction activities.

Numerous pieces of large equipment, including those listed in Table 4.10-4, would be used during the demolition of existing facilities and construction of project components such as fish screens, fish ladders, and access road improvements under the No Dam Removal Alternative. Because of the remote nature of and limited access to many of the Restoration Project sites, helicopters may also be used both to remove construction debris from sites and to deliver material and equipment to sites. The Oasis Springs Lodge is the only noise-sensitive land use that would be exposed to noise from on-site construction activity. Noise levels at Oasis Springs Lodge could exceed Reclamation noise thresholds. Noise also could exceed the ambient noise level by more than 5 dB. This impact is therefore considered to be significant. This impact is similar to Impact 4.10-2. Implementing the Mitigation Measures for Impact 4.10-2 would reduce this impact to a less-than-significant level.

Impact 4.10-7 Significant—Exposure of noise-sensitive land uses along site access roads to construction-related truck noise.

Implementation of the No Dam Removal Alternative would require hauling of materials to and from the Inskip Diversion Dam/South Powerhouse site.

Reclamation estimates that up to 40 truck trips per day averaging five trips per hour could occur. Table 4.10-5 summarizes the estimated number of truck trips as a function of the construction activity. This impact is similar to Impact 4.10-3. Implementing the Mitigation Measure for Impact 4.10-3 would reduce this impact to a less-than-significant level.

Impact 4.10-8 Less than Significant—Exposure of noise-sensitive land uses to noise from operation of the Restoration Project facilities.
The operation of the Restoration Project facilities after implementation of the No Dam Removal Alternative would generate noise. Periodic monitoring and maintenance activities would require PG&E staff to continue to visit the sites by truck. It is not expected that the frequency of monitoring and maintenance activities would increase over current similar activities. Therefore, it is also not expected that the post-implementation noise levels would increase over the current noise levels. In some cases, the construction of new facilities and the upgrading of access roads would result in a reduction in noise associated with routine operation and maintenance activities, thereby resulting in less traffic- and maintenance-related noise than that produced by the current operation and maintenance activities. This impact is therefore considered to be less than significant.

Six Dam Removal Alternative

Noise impacts would be the same as those described for the Five Dam Removal Alternative. Each impact is described briefly below. With the implementation of the proposed mitigation measures, these potential impacts would be mitigated to a less-than-significant level.

Impact 4.10-9 Significant—Exposure of noise-sensitive uses to noise and vibration from blasting.
It is anticipated that blasting using chemical expansion agents, explosives, or drill-and-shoot techniques would be required at some of the Restoration Project sites under the Six Dam Removal Alternative. Only one noise-sensitive receptor, the Oasis Springs Lodge, is located near the Inskip Diversion Dam/South Powerhouse and potentially would be exposed to noise and vibration from blasting. Noise levels could exceed 133 dB and vibration could exceed USBM vibration criteria at the Oasis Springs Lodge. This impact is therefore considered to be significant. This impact is similar to Impact 4.10-1. Implementing the Mitigation Measures recommended for Impact 4.10-1 would reduce this impact to a less-than significant level.

Impact 4.10-10 Significant—Exposure of noise-sensitive land uses to noise from on-site construction activities.
Numerous pieces of large equipment, including those listed in Table 4.10-4, would be used during the demolition of existing facilities and construction of project components such as fish screens, fish ladders, and access road improvements under the Six Dam Removal Alternative. Because of the remote

nature of and limited access to many of the Restoration Project sites, helicopters also may be used both to remove construction debris from sites and to deliver material and equipment to sites. The Oasis Springs Lodge is the only noise-sensitive land use that would be exposed to noise from on-site construction activity. Noise levels at Oasis Springs Lodge could exceed Reclamation noise thresholds. Noise could also exceed the ambient noise level by more than 5 dB. This impact is therefore considered to be significant. This impact is similar to Impact 4.10-2. Implementing the Mitigation Measures for Impact 4.10-2 would reduce this impact to a less-than-significant level.

Impact 4.10-11 Significant—Exposure of noise-sensitive land uses along site access roads to construction-related truck noise.
Implementation of the Six Dam Removal Alternative would require hauling of materials to and from the Inskip Diversion Dam/South Powerhouse site. Reclamation estimates that up to 40 truck trips per day averaging five trips per hour could occur. Table 4.10-5 summarizes the estimated number of truck trips as a function of the construction activity. This impact is similar to Impact 4.10-3. Implementing the Mitigation Measure for Impact 4.10-3 would reduce this impact to a less-than-significant level.

Impact 4.10-12 Less than Significant—Exposure of noise-sensitive land uses to noise from operation of the Restoration Project facilities.
The operation of the Restoration Project facilities after implementation of the Six Dam Removal Alternative would generate noise. Periodic monitoring and maintenance activities would require PG&E staff to continue to visit the sites by truck. It is not expected that the frequency of monitoring and maintenance activities would increase over current similar activities. Therefore, it is also not expected that the post-implementation noise levels would increase over the current noise levels. In some cases, the construction of new facilities and the upgrading of access roads would result in a reduction in noise associated with routine operation and maintenance activities, thereby resulting in less traffic- and maintenance-related noise than that produced by the current operation and maintenance activities. This impact is therefore considered to be less than significant.

Three Dam Removal Alternative

Noise impacts would be the same as those described for the Five Dam Removal Alternative. Each impact is described briefly below. With the implementation of the proposed mitigation measures, these potential impacts would be mitigated to a less-than-significant level.

Impact 4.10-13 Significant—Exposure of noise-sensitive uses to noise and vibration from blasting.
It is anticipated that blasting using chemical expansion agents, explosives, or drill-and-shoot techniques would be required at some of the Restoration Project sites under the Three Dam Removal Alternative. Only one noise-sensitive

receptor, the Oasis Springs Lodge, is located near the Inskip Diversion Dam/South Powerhouse and potentially would be exposed to noise and vibration from blasting. Noise levels could exceed 133 dB and vibration could exceed USBM vibration criteria at the Oasis Springs Lodge. This impact is therefore considered to be significant. This impact is similar to Impact 4.10-1. Implementing the Mitigation Measure for Impact 4.10-1 would reduce this impact to a less-than-significant level.

Impact 4.10-14 Significant—Exposure of noise-sensitive land uses to noise from on-site construction activities.

Numerous pieces of large equipment, including those listed in Table 4.10-4, would be used during the demolition of existing facilities and construction of project components such as fish screens, fish ladders, and access road improvements under the Three Dam Removal Alternative. Because of the remote nature of and limited access to many of the Restoration Project sites, helicopters also may be used both to remove construction debris from sites and to deliver material and equipment to sites. The Oasis Springs Lodge is the only noise-sensitive land use that would be exposed to noise from on-site construction activity. Noise levels at Oasis Springs Lodge could exceed Reclamation noise thresholds. Noise also could exceed the ambient noise level by more than 5 dB. This impact is therefore considered to be significant. This impact is similar to Impact 4.10-2. Implementing the Mitigation Measure for Impact 4.10-2 would reduce this impact to a less-than-significant level.

Impact 4.10-15 Significant—Exposure of noise-sensitive land uses along site access roads to construction-related truck noise.

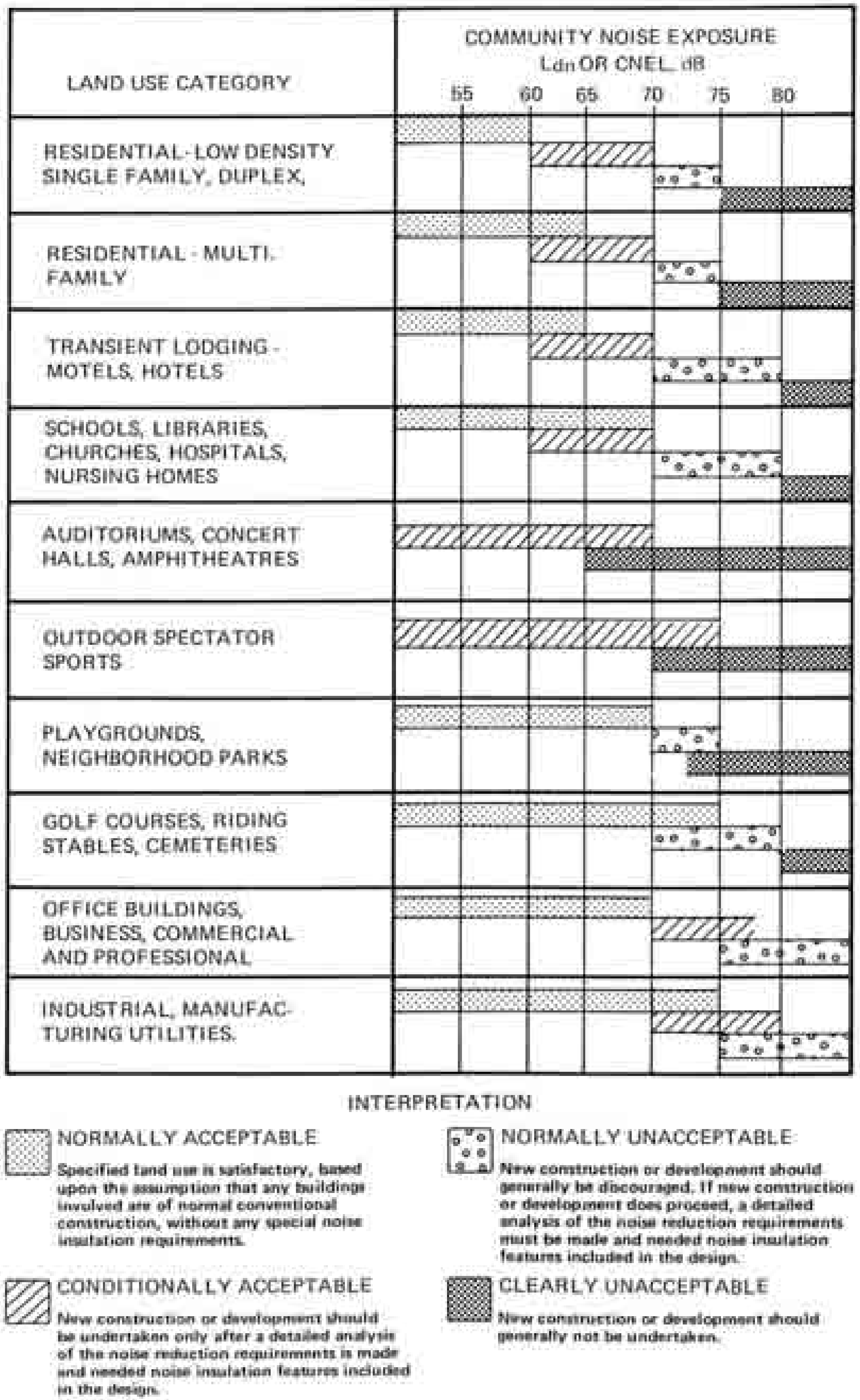
Implementation of the Three Dam Removal Alternative would require hauling of materials to and from the Inskip Diversion Dam/South Powerhouse site. Reclamation estimates that up to 40 truck trips per day averaging five trips per hour could occur. Table 4.10-5 summarizes the estimated number of truck trips as a function of the construction activity. This impact is similar to Impact 4.10-3. Implementing the Mitigation Measure for Impact 4.10-3 would reduce this impact to a less-than-significant level.

Impact 4.10-16 Less than Significant—Exposure of noise-sensitive land uses to noise from operation of the Restoration Project facilities.

The operation of the Restoration Project facilities after implementation of the Three Dam Removal Alternative would generate noise. Periodic monitoring and maintenance activities would require PG&E staff to continue to visit the sites by truck. It is not expected that the frequency of monitoring and maintenance activities would increase over current similar activities. Therefore, it is also not expected that the post-implementation noise levels would increase over the current noise levels. In some cases, the construction of new facilities and the upgrading of access roads would result in a reduction in noise associated with routine operation and maintenance activities, thereby resulting in less traffic- and maintenance-related noise than that produced by the current operation and maintenance activities. This impact is therefore considered to be less than significant.

Cumulative Impacts

Cumulative noise impacts associated with the Proposed Action and past, present, and probable future projects (including those mentioned in Chapter 6) would not occur in the Battle Creek Watershed area because the Restoration Project is not expected to result in any cumulative impacts on noise levels at the project sites. All impacts on noise levels in the area during construction generally would be temporary and short-term in nature and would not contribute to any cumulative noise level increases in the Restoration Project area. There are no expected increases in noise levels associated with routine operation and maintenance activities above existing noise levels associated with current similar activities.



Adapted from: State of California General Plan Guidelines. Governor's Office of Planning and Research. 1998. Sacramento, California.

03035.03-004

Figure 4.10-1
Land Use Compatibility for Community Noise Environments

4.11 Air Quality

Affected Environment

Regional Setting

Battle Creek and its tributaries lie within the northern Sacramento Valley Air Basin (SVAB) in the Shasta County Air Quality Management District (SCAQMD) and the Tehama County Air Pollution Control District (TCAPCD).

Climate

The climate in the SVAB is Mediterranean, with average maximum and minimum temperatures of 97°F and 58°F, respectively. The sun shines approximately 75% of the annual daytime hours, and annual precipitation ranges from approximately 15 inches in the northwest to 60 inches in the northeast. Prevailing winds in the air basin originate offshore of the San Francisco Bay area and flow through the Carquinez Strait, then north through the Sacramento Valley. Elevations of the broad valley floor range from 60 feet to 500 feet above mean sea level (msl). The valley is bordered to the north by the Sierra Cascade Mountains, to the east by the Sierra Nevada, and to the west by the Coast Ranges.

The topography and climate of the air basin create a high potential for air inversions (i.e., when air of one temperature is contained beneath a layer of air of another temperature and air circulation is impeded). Inversions occur frequently within the air basin during all seasons. The most stable of these inversions occurs in the late summer and early fall, when cool coastal air is trapped beneath a warm air mass. Photochemical smog (i.e., ozone) trapped in these inversions is often exacerbated when preceded by sunny days with relatively high temperatures. During late fall and winter, air inversions occurring at ground level often result in low-lying fog when valley air becomes trapped and does not mix with coastal air. It is during these periods that the air basin experiences the highest concentrations of carbon monoxide (CO), nitrogen oxides (NO_x), and airborne particulate matter.

Most air pollutants in the vicinity of the Restoration Project are associated with either urban or agricultural land uses. Pollutants commonly associated with agricultural land uses include CO, NO_x, ozone precursors, and particulate matter of 10 microns or less in mean diameter (PM10). PM10 results from field burning, farm operations such as tilling and plowing, the operation of farm equipment on loose earth, entrained road dust releases, and fuel combustion in vehicles and farm equipment. Particulate emissions may also occur when fallow fields do not have a cover crop to inhibit wind erosion. CO is released to the atmosphere during field burning and fuel combustion in farm equipment. NO_x is also released during field burning. Ozone precursors are released in farm equipment emissions and during the application of pesticides and fertilizers. The effect of these practices on air quality may be influenced by meteorological conditions, the variability of emission controls, and the adoption and enforcement of emission regulations. In undeveloped areas, hydrocarbon emissions result primarily from wildfires, and particulate emissions result from windblown dust and wildfires. No clear relationship exists between agricultural acres and the occurrence or resulting concentrations of ozone and PM10 in the atmosphere (Reclamation and USFWS 1999). Several variables other than land uses can affect air quality conditions, and these variables may change over time.

Regional Air Pollutants

The federal and state governments have established ambient air quality standards for six criteria pollutants: ozone, CO, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), PM10, and lead. Ozone and PM10 are generally considered to be “regional” pollutants because these pollutants or their precursors affect air quality on a regional scale. Pollutants such as CO, NO_2, SO_2, and lead are considered to be local pollutants that tend to accumulate in the air locally. PM10 is considered to be a localized pollutant as well as a regional pollutant. In the area where the Restoration Project is located, PM10 and ozone are of particular concern.

Ozone

Ozone is a respiratory irritant and an oxidant that increases susceptibility to respiratory infections and can cause substantial damage to vegetation and other materials. Ozone is a severe eye, nose, and throat irritant. Ozone also attacks synthetic rubber, textiles, plants, and other materials. Ozone causes extensive damage to plants by leaf discoloration and cell damage.

Ozone is not emitted directly into the air, but is formed by a photochemical reaction in the atmosphere. Ozone precursors, which include reactive organic gases (ROG) and NO_x, react in the atmosphere in the presence of sunlight to form ozone. Because photochemical reaction rates depend on the intensity of ultraviolet light and air temperature, ozone is primarily a summer air pollution problem. The ozone precursors, ROG and NO_x, are emitted by mobile sources and by stationary combustion equipment.

State and federal standards for ozone have been set for a 1-hour averaging time. The state 1-hour ozone standard is 0.09 parts per million (ppm), not to be exceeded. The federal 1-hour ozone standard is 0.12 ppm, not to be exceeded more than three times in any 3-year period.

Carbon Monoxide

CO is essentially inert to plants and materials but can have significant effects on human health. CO is a public health concern because it combines readily with hemoglobin and thus reduces the amount of oxygen transported in the bloodstream. Effects on humans range from slight headaches to nausea to death.

Motor vehicles are the dominant source of CO emissions in most areas. High CO levels develop primarily during winter when periods of light winds combine with the formation of ground level temperature inversions (typically from the evening through early morning). These conditions result in reduced dispersion of vehicle emissions. Motor vehicles also exhibit increased CO emission rates at low air temperatures.

State and federal CO standards have been set for both 1-hour and 8-hour averaging times. The state 1-hour standard is 20 ppm by volume, and the federal 1-hour standard is 35 ppm. Both state and federal standards are 9 ppm for the 8-hour averaging period.

PM10

Health concerns associated with suspended particulate matter focus on those particles small enough to reach the lungs when inhaled. Particulates can damage human health and retard plant growth. Particulates also reduce visibility, soil buildings and other materials, and corrode materials.

PM10 emissions are generated by a wide variety of sources, including agricultural activities, industrial emissions, dust suspended by vehicle traffic, and secondary aerosols formed by reactions in the atmosphere.

The state PM10 standards are 50 micrograms per cubic meter as a 24-hour average and 20 micrograms per cubic meter as an annual geometric mean. The federal PM10 standards are 150 micrograms per cubic meter as a 24-hour average and 50 micrograms per cubic meter as an annual arithmetic mean.

Existing Air Quality Conditions

The existing air quality conditions in the Restoration Project area can be characterized by monitoring data collected in the region. PM10, CO, and ozone concentrations are measured at several north bay monitoring stations. These are the pollutants of greatest concentration within the SVAB and are the pollutants of most concern from the Restoration Project. Air quality monitoring data for the last 3 years are presented in Table 4.11-1. The closest monitoring stations are located at the Lassen Volcanic National Park–Manzanita Lake monitoring station in Shasta County and Tuscan Butte monitoring stations in Tehama County.

These air monitoring stations monitor only ozone, as the counties are in nonattainment for ozone only.

Table 4.11-1. Ambient Air Quality Monitoring Data from the Lassen Volcanic National Park–Manzanita Lake and Tuscan Butte Monitoring Stations

Pollutant Standards	1999	2000	2001
Ozone (O_3)- Lassen Volcanic National Park			
Maximum 1-hour concentration (ppm)	0.109	0.091	0.084
Number of days standard exceeded			
CAAQS 1-hour (>0.09 ppm)	3	0	0
NAAQS 1-hour (>0.12 ppm)	0	0	0
Ozone (O_3)- Tuscan Butte			
Maximum 1-hour concentration (ppm)	0.128	0.094	0.094
Number of days standard exceeded			
CAAQS 1-hour (>0.09 ppm)	16	0	0
NAAQS 1-hour (>0.12 ppm)	1	0	0

Notes: CAAQS = California Ambient Air Quality Standards.
NAAQS = National Ambient Air Quality Standards.

[a] Calculated exceedances based on measurements taken every 6 days.

Sources: CARB 2002, EPA 2002

Regions in which the National Ambient Air Quality Standards (NAAQS) or the California Ambient Air Quality Standards (CAAQS) are currently met for a given pollutant, as determined by air monitoring, are considered attainment areas for that pollutant. Regions in which NAAQS or CAAQS are not met are considered nonattainment areas for a given pollutant. These classifications are determined by comparing actual monitored air pollutant concentrations to state and federal standards. Because of the difference between some NAAQS and CAAQS, it is possible for an area to be an attainment area for a federal standard while being a nonattainment area for a state standard. The CAAQS are more stringent than the NAAQS for ozone, CO, NO_2, SO_2, PM10, and lead. The pollutants of greatest concern in this valley are ozone and inhalable particulate matter. As seen from Table 4.11-1, the Restoration Project area has experienced violations of the state and federal ozone standards during the last 3 years, although the counties have not experienced any violations in the last 2 years. Table 4.11-1 also indicates that the federal and state CO standards have not been exceeded.

The State of California has designated Shasta and Tehama Counties as being in moderate nonattainment for ozone and in nonattainment for PM10. The counties are designated as unclassified for CO. The EPA has designated Shasta and

Tehama Counties as being unclassified/attainment for ozone and CO, and unclassified for PM10. Table 4.11-2 summarizes the various attainment statuses for Shasta and Tehama Counties.

Table 4.11-2. Ambient Air Quality Standards Attainment Status

Pollutant	Shasta County	Tehama County
State		
Ozone	Moderate Nonattainment	Moderate Nonattainment
Particulate matter (PM10)	Nonattainment	Nonattainment
Carbon monoxide	Unclassified	Unclassified
Federal		
Ozone	Unclassified/Attainment	Unclassified/Attainment
Particulate matter (PM10)	Unclassified	Unclassified
Carbon monoxide	Unclassified/Attainment	Unclassified/Attainment

Sensitive Land Uses

Sensitive land uses are generally defined as locations where people reside or where the presence of air emissions could adversely affect the use of the land. Typical sensitive receptors include residents, school children, hospital patients, the elderly, etc. Within the Restoration Project area, the only sensitive land use is Oasis Springs Lodge, a 3,000-acre fly-fishing lodge located along South Fork Battle Creek just upstream of Inskip Diversion Dam.

Regulatory Setting

Air quality in the state of California is regulated by the Federal Clean Air Act and the California Clean Air Act. Descriptions of the Federal and California Clean Air Acts can be found in Chapter 5, "Consultation and Coordination."

Air quality is regulated through both the federal and California Ambient Air Quality Standards. The California Air Resources Board (CARB), an agency within the California Environmental Protection Agency, regulates air quality within California. In conjunction with its associated regional air quality districts (discussed below), CARB is responsible for monitoring and regulating air emissions within the state for compliance with both the CAAQS and NAAQS.

Concentrations of criteria air pollutants are monitored by CARB at various locations within California. Both NAAQS and CAAQS have been developed for certain air pollutants. Federal and state agencies have developed these health- and welfare-based ambient air quality standards for outdoor air to identify the maximum acceptable average concentrations of criteria air pollutants during a specified period of time. Both NAAQS and CAAQS apply to criteria air pollutants. Table 4.11-3 lists the federal and state standards.

California has been divided into 15 air basins for the purpose of managing the state's air resources on a regional basis. Areas within each air basin are considered to share the same air masses and are, therefore, expected to have similar ambient air quality. Battle Creek and its tributaries lie within the northern SVAB.

Air quality management districts and air pollution control districts have been developed within each air basin to regulate stationary, indirect, and area sources of air pollution within their respective jurisdictions. Air pollution control districts have the authority to regulate stationary, indirect, and area sources of air pollution such as power plants, highway construction, and housing developments in a given county. The districts issue air emission permits and control emissions from stationary sources of air pollution. They also implement transportation control measures for their respective regions. Each district adopts its own rules and regulations to combat the particular air quality problems in its region.

SCAQMD and the TCAPCD have jurisdiction over the area in which Battle Creek and its tributaries are located. The California Clean Air Act of 1988 (Health & Safety Code §44300 *et seq.*) requires that each air pollution control district or air quality management district designated as a nonattainment area for a specified criteria air pollutant prepare a triennial Air Quality Management Plan, the implementation of which would bring the district into compliance with the requirements of the NAAQS and CAAQS for that pollutant. These plans are incorporated into the State Implementation Plan (SIP) prepared by the State of California in accordance with the Federal Clean Air Act, as amended (42 USC 7401-7661).

Environmental Consequences

Summary

No significant air quality impacts are associated with the No Action Alternative. Significant impacts are associated with all Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal). Air quality impacts would be limited to areas associated with construction, modification, or removal activities, including streambeds, stream banks, short-term and long-term access roads, staging areas, and Hydroelectric Project dam site facilities, conveyances, and appurtenant facilities. Reclamation will implement mitigation measures to reduce significant impacts to a less-than-significant level.

Impact Significance Criteria

Based on specific project concerns and professional judgment, impacts were considered significant for this analysis if implementation of the Restoration Project would:

- contribute substantially to the violation of an existing or projected air quality standard within the Restoration Project area during construction from emissions of PM10 and ozone precursors (i.e., ROGs and NO_x);
- expose sensitive receptors (those most responsive to or most easily affected by the type of air pollution in question) to substantial pollutant concentrations;
- produce emissions of criteria air pollutants during construction that would lead to an exceedence of NAAQS or CAAQS in attainment areas for a given pollutant; or
- produce emissions of criteria air pollutants during operation that would lead to an exceedence of NAAQS or CAAQS in attainment areas for a given pollutant.

Neither Shasta nor Tehama County has any specific significance thresholds for construction activities. Instead, discussions with the districts indicate that projects use BMPs and other management methods to try to reduce construction-related project emissions. Within Tehama County, if a complaint is received regarding a project, a fugitive dust permit may be required. In addition, roads within 1,000 feet of a sensitive receptor boundary should be watered or treated with a paliative dust agent.

Impact Assessment

As applicable, the general environmental protection measures listed in the introduction to this chapter shall be used for this resource. In addition, specific mitigation measures for this resource are identified below.

No Action Alternative

The No Action Alternative would not affect air quality. This alternative assumes that the projected future air quality would be the same as now exists. This assumption is predicated on existing air quality maintenance and improvement programs, as well as state and federal requirements that may require further reductions in emissions from stationary sources and will likely require further reductions in vehicular emissions.

Five Dam Removal Alternative (Proposed Action)

Impact 4.11-1 Significant—Construction-related emissions in excess of allowable thresholds.

Construction emission estimates have not been included in this report because SCAQMD and TCAPCD do not have specific significance thresholds for construction activities. Instead, these districts require the use of BMPs and other management methods to try to reduce construction-related project emissions. Implementation of the Five Dam Removal could result in a temporary increase in an undetermined amount of construction-related emissions. Because of the number of construction activities that may occur simultaneously and the large number of truck trips anticipated daily, this impact is considered significant. Implementing the following mitigation measure will reduce construction-related emissions to less-than-significant levels and minimize adverse air quality effects.

Mitigation Measures for Impact 4.11-1. Reclamation's contractor shall implement the following mitigation measures to minimize air quality impacts.

- To control the generation of construction-related PM10 emissions, Reclamation's contractor shall comply with BMPs summarized below in Table 4.11-4.

Table 4.11-4. Control Measures for Construction Emissions of PM10

Several PM10 dust controls are required to be implemented at all construction sites. The following controls are applicable to the Battle Creek project and should be implemented.
▪ All disturbed areas, including storage piles, that are not being actively used for construction purposes, shall be effectively stabilized of dust emissions using water, chemical stabilizer/suppressant, or tarp or other suitable cover or vegetative ground cover.
▪ All on-site unpaved roads and off-site unpaved access roads shall be effectively stabilized of dust emissions using water or chemical stabilizer/suppressant.
▪ All land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities shall be effectively controlled of fugitive dust emissions by applying water or by presoaking.
▪ When materials are transported off site, all material shall be covered or effectively wetted to limit visible dust emissions, and at least 6 inches of freeboard space from the top of the container shall be maintained.
▪ Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions using sufficient water or chemical stabilizer/suppressant.
▪ Within urban areas, trackout shall be immediately removed when it extends 50 or more feet from the site and at the end of each workday.

- The BMPs listed in Table 4.11-4 shall be made a component of the project description and incorporated into the working project.

- Reclamation's contractor shall obtain all applicable permits required by SCAQMD and TCAPCD. To ensure that the operation of all motors associated with construction of the proposed project does not result in significant air quality impacts, the project applicant shall obtain all applicable permits required by SCAQMD and TCAPCD.

Guidance from the EPA indicates that the conformity rule applies only to nonattainment and maintenance areas (EPA 1994). Because the proposed project area is in attainment for the criteria pollutants, the proposed project is not subject to a federal conformity analysis. Consequently, a federal conformity analysis was not completed.

Further, permits may require additional measures to further reduce emissions. The incorporation of the mitigation measures listed above would reduce construction-related air emissions to less-than-significant levels.

Impact 4.11-2 Less than Significant—Increased emissions from operational and maintenance activities would contribute to violation of air quality standards.

Emissions associated with operational activities (including maintenance and monitoring) would be limited to emissions from vehicles transporting necessary equipment and personnel. During normal operations and depending on the accessibility of the site, personnel vehicle trips would be limited to one trip daily for operations, maintenance, and periodic monitoring of environmental restoration measures.

Similarly, maintenance activities associated with the fish ladders and screens and other environmental restoration measures would require infrequent equipment operation and soil or dust disturbance. The limited number of vehicle trips used to transport personnel and to support maintenance activities would not contribute substantially to the violation of an existing air quality standard, expose sensitive receptors to substantial pollutant concentrations, or otherwise produce emissions of criteria pollutants to levels of significance. Therefore, the increased emissions from operational and maintenance activities are considered less-than-significant direct air quality impacts.

No Dam Removal Alternative

Air quality impacts would be the same as those described for the Five Dam Removal Alternative. With the implementation of the proposed mitigation measures, these potential impacts would be mitigated to a less-than-significant level.

Impact 4.11-3 Significant—Construction-related emissions in excess of allowable thresholds.

This impact is similar to Impact 4.11-1 described under the Five Dam Removal Alternative. Construction of the fish screens and fish ladders at the North Battle Creek Feeder Eagle Canyon Diversion Dam, Wildcat Diversion Dam, South

Diversion Dam, Inskip Diversion Dam, and Coleman Diversion Dam would result in air emissions in excess of allowable thresholds. Although SCAQMD and TCAPCD do not have specific significance thresholds for construction activities, these districts require the use of BMPs and other management methods to try to reduce construction-related project emissions. Implementation of the No Dam Removal Alternative could result in a temporary increase in an undetermined amount of construction-related emissions. This impact is considered significant. Implementing Mitigation Measures for Impact 4.11-1 would reduce this impact to a less-than-significant level.

Impact 4.11-4 Less than Significant—Increased emissions from operational and maintenance activities would contribute to violation of air quality standards.

This impact is similar to Impact 4.11-2 described under the Five Dam Removal Alternative. Emissions associated with operational activities (including maintenance and monitoring) would be limited to emissions from vehicles transporting necessary equipment and personnel to the project sites. During normal operations and depending on the accessibility of the site, personnel vehicle trips would be limited to one trip daily for operations, maintenance, and periodic monitoring of environmental restoration measures. Under the No Dam Removal Alternative, no action would occur at the Lower Ripley Creek Feeder and Soap Creek Feeder Diversion Dams compared to the Five Dam Removal Alternative. Therefore, operation and maintenance emissions produced under the No Dam Removal Alternative are expected to be somewhat lower than under the Five Dam Removal Alternative. This impact is considered less than significant.

Six Dam Removal Alternative

Air quality impacts would be the same as those described for the Five Dam Removal Alternative. With the implementation of the proposed mitigation measures, these potential impacts would be mitigated to a less-than-significant level.

Impact 4.11-5 Significant—Construction-related emissions in excess of allowable thresholds.

This impact is similar to Impact 4.11-1 described under the Five Dam Removal Alternative. Constructing fish screens and fish ladders at North Battle Creek Feeder and Inskip Diversion Dams and removing Eagle Canyon, Wildcat, South, Inskip, Coleman, Soap Creek Feeder, and Lower Ripley Creek Feeder Diversion Dams would result in air emissions in excess of allowable thresholds. Although one additional dam would be removed under the Six Dam Removal Alternative compared to the Five Dam Removal Alternative, construction would not occur all at the same time, and the daily emission rates during construction would not be substantially different from the Five Dam Removal Alternative. SCAQMD and TCAPCD do not have specific significance thresholds for construction activities; however, these districts require the use of BMPs and other management methods to try to reduce construction-related project emissions. Implementation of the Six Dam Removal Alternative could result in a temporary increase in an undetermined amount of construction-related emissions. This impact is considered significant. Implementing Mitigation Measures for Impact 4.11-1 would reduce this impact to a less-than-significant level.

Impact 4.11-6 Less than Significant—Increased emissions from operational and maintenance activities would contribute to violation of air quality standards.
This impact is similar to Impact 4.11-2 described under the Five Dam Removal Alternative. Emissions associated with operational activities (including maintenance and monitoring) associated with the Six Dam Removal Alternative would be limited to emissions from vehicles transporting necessary equipment and personnel to the project sites. During normal operations and depending on the accessibility of the site, personnel vehicle trips would be limited to one trip daily for operations, maintenance, and periodic monitoring of environmental restoration measures. Under the Six Dam Removal Alternative, one additional dam (Eagle Canyon Diversion Dam) would be removed rather than receive a new fish screen and fish ladder as proposed under the Five Dam Removal Alternative. Because the dam would be removed, the site would not require future operations and maintenance. Therefore, operation and maintenance emissions produced under the No Dam Removal Alternatives are expected to be less than under the Five Dam Removal Alternative. This impact is considered less than significant.

Three Dam Removal Alternative

Air quality impacts would be smiliar to those described for the Five Dam Removal Alternative. With the implementation of the proposed mitigation measures, these potential impacts would be mitigated to a less-than-significant level.

Impact 4.11-7 Significant—Construction-related emissions in excess of allowable thresholds.
This impact is similar to Impact 4.11-1 described under the Five Dam Removal Alternative. Constructing fish screens and fish ladders at North Battle Creek Feeder, South, and Inskip Diversion Dams and removing Eagle Canyon, Wildcat, and Coleman, Diversion Dams would result in air emissions in excess of allowable thresholds. Because fewer dams would be removed, cumulative emissions from the Three Dam Removal Alternative would be less than the emissions potentially resulting from either the Five or Six Dam Removal Alternative. SCAQMD and TCAPCD do not have specific significance thresholds for construction activities; however, these districts require the use of BMPs and other management methods to try to reduce construction-related project emissions. Implementation of the Three Dam Removal Alternative could result in a temporary increase in an undetermined amount of construction-related emissions. This impact is considered significant. Implementing Mitigation Measures for Impact 4.11-1 would reduce this impact to a less-than-significant level.

Impact 4.11-8 Less than Significant—Increased emissions from operational and maintenance activities would contribute to violation of air quality standards.

This impact is similar to Impact 4.11-2 described under the Five Dam Removal Alternative. Emissions associated with operational activities (including maintenance and monitoring) would be limited to emissions from vehicles transporting necessary equipment and personnel to the project sites. During normal operations and depending on the accessibility of the site, personnel vehicle trips would be limited to one trip daily for operations, maintenance, and periodic monitoring of environmental restoration measures. Under the Three Dam Removal Alternative, no action would occur at the Lower Ripley Creek Feeder and Soap Creek Feeder Diversion Dams, compared to the Five Dam Removal Alternative. Therefore, operation and maintenance emissions produced under the No Dam Removal Alternative are expected to be somewhat lower than the Five Dam Removal Alternative. This impact is considered less than significant.

Cumulative Impacts

Implementation of the Restoration Project, in combination with other past, present, and reasonably foreseeable projects (including those mentioned in Chapter 6), would not result in cumulative air quality impacts. The Restoration Project would divert water flow from existing PG&E hydroelectric power plants. This action would result in a reduction in the amount of energy produced by this powerplant. This reduction in generated power at the power plant would be made up by other existing power plants connected on the power grid. It is important to note that the diversion in power production would go to power plants that have gone through stringent air quality regulations and permitting processes pursuant to the Federal Clean Air Act (42 USC 7401-7661) and to California statutes and regulations. Any new power plants that would be constructed to make up for the loss in power supply resulting from the Proposed Action would be subject to a new source permitting process and would be cleaner than the existing power plant. In addition, there would be no *net increase* in power demand resulting from the Proposed Action; additional power would not need to be generated above current levels, only power to *maintain* current levels. Consequently, this project has no significant cumulative impacts. Chapter 6 contains a discussion of all related projects near the Restoration Project area.

Table 4.11-3. Ambient Air Quality Standards Applicable in California

			Standard (parts per million)		Standard (micrograms per cubic meter)		Violation Criteria	
Pollutant	Symbol	Average Time	California	National	California	National	California	National
Ozone	O3	1 hour	0.09	0.12	180	235	If exceeded	If exceeded on more than 3 days in 3 years
		8 hours	NA	0.08	NA	157	NA	If exceeded on more than 3 days in 3 years
Carbon monoxide	CO	8 hours	9.0	9	10,000	10,000	If exceeded	If exceeded on more than 1 day per year
		1 hour	20	35	23,000	40,000	If exceeded	If exceeded on more than 1 day per year
(Lake Tahoe only)		8 hours	6	NA	7,000	NA	If equaled or exceeded	NA
Nitrogen dioxide	NO2	Annual average	NA	0.053	NA	100	NA	If exceeded
		1 hour	0.25	NA	470	NA	If exceeded	
Sulfur dioxide	SO2	Annual average	NA	0.03	NA	80	NA	If exceeded
		24 hours	0.04	0.14	105	365	If exceeded	If exceeded on more than 1 day per year
		1 hour	0.25	NA	655	NA	NA	NA
Hydrogen sulfide	H2S	1 hour	0.03	NA	42	NA	If equaled or exceeded	NA
Vinyl chloride	C2H3Cl	24 hours	0.010	NA	26	NA	If equaled or exceeded	NA
Sulfate particles	SO4	24 hours	NA	NA	25	NA	If equaled or exceeded	NA
Inhalable particulate matter	PM10	Annual geometric mean	NA	NA	20	NA	If exceeded	NA
		Annual arithmetic mean	NA	NA	NA	50	NA	If exceeded
		24 hours	NA	NA	50	150	If exceeded	If average 1% over 3 years is exceeded

Pollutant	Symbol	Average Time	Standard (parts per million) California	Standard (parts per million) National	Standard (micrograms per cubic meter) California	Standard (micrograms per cubic meter) National	Violation Criteria California	Violation Criteria National
	PM2.5	Annual geometric mean	NA	NA	12	NA	If exceeded	NA
		Annual arithmetic mean	NA	NA	NA	15	NA	If exceeded
		24 hours	NA	NA	NA	65	NA	If average 2% over 3 years is exceeded
Lead particles	Pb	Calendar quarter	NA	NA	NA	1.5	NA	If exceeded no more than 1 day per year
		30 days	NA	NA	1.5	NA	If equaled or exceeded	NA

Notes:

All standards are based on measurements at 25ºC and 1 atmosphere pressure.

National standards shown are the primary (health effects) standards.

NA = not applicable.

4.12 Public Health and Safety

Affected Environment

Local Setting

The public health and safety environment typically is defined by first characterizing the area's human population and structures (i.e., sensitive receptors or residences). Then, the general health and safety typically are defined by identifying existing substances, activities, or circumstances that may dictate the likelihood of those people and structures being adversely exposed to such elements. Public health and safety issues relate to both short-term construction and long-term operations and maintenance.

Many issues discussed elsewhere in this document have the potential either directly or indirectly to affect public health and safety within the Restoration Project area. These include flood hazards, water quality, air quality, soil erosion, transportation, land uses, noise, and public services (including fire protection). The affected environment and potential effects that could lead to public health and safety impacts on these resources are discussed under the corresponding resource sections found elsewhere in this EIS/EIR (see Sections 4.3, "Hydrology"; 4.4, "Water Quality"; 4.6, "Land Use"; 4.7, "Geology and Soils"; 4.9, "Transportation"; 4.10, "Noise"; 4.11, "Air Quality"; and 4.13, "Public Services and Utilities").

This discussion will not include routine hazards associated with construction, such as incidental injury to construction workers. The analysis assumes that construction would occur in accordance with Occupational Safety and Health Administration (OSHA) workplace rules and Reclamation's own *Reclamation Safety and Health Standards* and that complying with these rules would avoid risks of incidental injuries. Where OSHA rules and Reclamation's *Standards* conflict, the most stringent requirements will apply.

The *Reclamation Safety and Health Standards* are made a part of all of Reclamation's construction contracts and are enforced comprehensively by Reclamation. The *Standards* address all aspects of construction work, including worker safety. This includes, but is not limited to:

- preparation and implementation of job hazard assessments;
- provision for medical services and first aid;
- preparation of emergency plans;
- occupational health;
- personal protective equipment;

- fire prevention and protection, including preparation and implementation of fire prevention plans for each job site;
- materials handling, storage, and disposal;
- electrical safety, including control of hazardous energy;
- walking and working surfaces;
- fall protection;
- operation of hand tools, power tools, and welding;
- hoisting equipment;
- helicopter operations;
- traffic safety;
- excavation operations;
- tunnel and shaft construction;
- blasting operations; and
- concrete, masonry, and steel construction.

Sensitive Receptors

The Restoration Project is located in the rural portions of Shasta and Tehama Counties. The area is very remote and not heavily populated with either residences or other sensitive receptors. In addition, many of the Restoration Project sites and access roads to these sites are either on property owned by PG&E or on other private property. Public access to the sites is further discouraged by the use of locking gates at access road entry points. Public access to many of the Restoration Project sites (specifically including Wildcat, Eagle Canyon, and South Diversion Dams) is limited by the remote nature of the area and the rough terrain of the roads used to access the sites.

Sensitive receptors include members of the general public and the project construction crews during the construction phase, and PG&E staff during operations and maintenance. There are few residences within 1–5 miles of the Restoration Project sites. The Oasis Springs Lodge, a 3,000-acre fly-fishing lodge along South Fork Battle Creek, is located just upstream of Inskip Diversion Dam. Also, access roads to Inskip Diversion Dam cross private property and pass through a residential area with a posted speed limit of 5 miles per hour and a logbook for signing in and out. The Oasis Springs Lodge and the residential area are the closest sensitive receptors to any of the Restoration Project sites or access routes. Other residences adjacent to access roads would also be sensitive receptors, particularly during construction when traffic levels are expected to increase. Information on construction and removal activities, including the duration of these activities and the number of construction workers, is discussed or referenced in Water Management Alternatives (see Chapter 2, “Purpose and Need, Project Background, and Project Description”).

Hazardous Materials

Public health aspects associated with construction, modification, or removal activities at the Restoration Project sites include the possibility of hazardous material releases from construction areas and the exposure of construction workers to these releases. Constructed in the early 1900s, the Hydroelectric Project has been owned and operated by PG&E since 1919 and was licensed by FERC in 1976. Because of the age of the facilities, hazardous materials including polychlorinated biphenyls (PCBs), lead-based paint, asbestos, and pentachlorophenol could be discovered during activities at the Restoration Project sites.

Trace amounts of PCBs may be found in chlorinated hydrocarbon fluids that were once used in electrical equipment (primarily transformers) because they are electrically nonconductive and stable at high temperatures. PCBs were widely used until the mid-1970s, when the production and application of the chemicals were restricted because the chemicals were found to be injurious to living organisms. PCBs could be found in the transformers and other electrical components and could be present at some Restoration Project sites because of the upstream power plants.

Materials containing asbestos may also be found in the buildings that house the electrical equipment at some of the dam sites. At some sites, asbestos sheet packing may need to be removed or remediated as part of the dam removal. Asbestos can consist of several different types of fibrous minerals that range from extremely hazardous to less hazardous. Extremely hazardous asbestos fibers include amphibole fibers that are used commercially and that, once inhaled, can remain indefinitely in lung tissue and may cause cancer. Less hazardous asbestos fibers include chrysotile, which is less likely to remain suspended in the air and be inhaled. Ninety-nine percent of current asbestos production is chrysotile, which poses no health threat when small quantities are inhaled. However, before the 1970s, products were made with asbestos fibers of all types.

Facilities at some of the Restoration Project sites could have been painted with lead-based paint. Until the late 1970s, lead was a major ingredient in paint.

Some of the timber supports used at some of the Restoration Project sites may have been treated with pentachlorophenol, a manufactured chemical that was used as a biocide and a wood preservative. Short-term exposure to large amounts of pentachlorophenol or long-term exposures to low levels can harm the liver, kidneys, blood, lungs, nervous system, and gastrointestinal tract. The chemical may also be a carcinogen.

Other hazardous materials that may be encountered during removal, modification, and construction activities include small amounts of oils and grease.

Traffic

Immediate vehicular access to the site is along paved county roads and unpaved, gravel or dirt private roads. These roads, particularly the private roads, typically carry very little traffic and practically no truck traffic at the present time. Residents, especially children and domestic pets, are not used to experiencing automobile and truck traffic along these roads.

Helicopter Operations

Portions of the site cannot be accessed by road, including the following facilities:

- North Battle Creek Feeder Diversion Dam,
- Eagle Canyon Diversion Dam,
- Wildcat Diversion Dam, and
- South Diversion Dam and South Canal.

Where this is the case, helicopters will be used to deliver machinery and materials to the work site. Helicopter use would be limited to the construction period.

Helicopter operations would be subject to compliance with Section 19.22 of Reclamation's *Reclamation Safety and Health Standards*. This includes requirements for daily pilot and ground crew briefings on the daily plan of operations; requirements for the securing of suspended loads; personal protective equipment; visibility; working in the vicinity of helicopters; radio communications during operations; and inspection and maintenance.

Environmental Safety/Mosquitoes

In addition to being persistent pests, mosquitoes can carry various strains of diseases known as arboviruses. Western equine encephalomyelitis and St. Louis encephalomyelitis (both commonly known as encephalitis) are of particular concern. Neither virus is usually reported unless patients develop acute symptoms; therefore, the prevalence of both viruses is considerably underreported. Mosquitoes are also known to transmit malaria (a parasitic blood disease) to humans and heartworms (a parasite) to dogs. Local mosquito control agencies have been developed to control mosquitoes and other vectors in an effort to control epidemics of human encephalitis, malaria, and West Nile virus. The mosquito abatement districts and control agencies adapt their practices in response to hydrologic conditions and the extent of areas that support appropriate breeding habitat.

Any environment in which water is allowed to stand in shallow areas can serve as breeding ground for mosquitoes. These environments include wetlands, wildlife refuges, pastures, drains, and slack water areas along streams, canals, reservoirs, and other areas where water is relatively still.

Regulatory Setting

Federal and state laws and regulations that establish standards relating to worker safety include those governed by:

- the *Reclamation Safety and Health Standards,*
- the Occupational Safety and Health Act of 1970 (29 USC 651 *et seq.*),
- OSHA, and
- the EPA.

Other industry standards, laws, and regulations that may be applicable to the Restoration Project include:

- Uniform Fire Code and Uniform Fire Code Standards. The Uniform Fire Code contains provisions necessary for fire prevention and information about fire safety, special processes, explosives, and flammable, combustible, and hazardous materials. The standards are a companion publication to the code.
- California Building Code. The California Building Code is designed to provide minimum standards to safeguard human life, health, property, and public welfare by regulating and controlling the design, construction, quality of materials, and use and occupancy of buildings and structures.
- Section 112 of the Clean Air Act (42 USC 7401-7661). This section of the Clean Air Act established national emission standards for hazardous air pollutants, which include the release of asbestos fiber emissions into the air.
- The Asbestos Hazard Emergency Response Act (15 USC 2641 *et seq*). This act contains regulations that cover protection for employees who work around asbestos-containing materials.
- The Toxic Substances Control Act (15 USC 2601 *et seq*). Under this act, the EPA regulates the removal and disposal of PCBs.
- California Code of Regulations Title 22. The state regulations for the removal and disposal of PCBs are more stringent than their federal equivalents.

Environmental Consequences

Summary

The No Action Alternative is expected to have no impacts on public health and safety in addition to those already anticipated as part of the current operations at the existing facilities. The Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal) discussed below would have health and safety impacts common to construction projects. However, they would be required to comply with standard safety procedures for the construction industry and the *Reclamation Safety and Health Standards* as part of their contracts for work on this project. Accordingly, the alternatives are not expected to create substantial risk of harm or injury to workers or the general public.

Impact Significance Criteria

Based upon Appendix G and section 15065 of the CEQA Guidelines, adverse impacts would be potentially significant if the Proposed Action or an action alternative could:

- create substantial risk of harm or injury to workers or the general public,
- increase public exposure to toxic or hazardous materials or significant levels of pollutants,
- increase the potential for human exposure to disease-bearing animals or insects, or
- expose workers or the general public to hazardous conditions.

Impacts were identified by comparing the proposed facility changes for the action alternatives to these impact criteria. The significance of the impact was then assessed using the above-described criteria. Individual facility changes that would not meet these significance criteria would be considered to have no impact. Activities that would decrease the likelihood for adverse impacts to occur would be considered beneficial impacts.

Impact Assessment

No Action Alternative

Under the No Action Alternative, it is assumed that there would be no construction, modification, or removal of facilities at any of the Restoration Project sites. The No Action Alternative is expected to have no impacts on public health and safety in addition to those already anticipated as part of the current operations at the existing facilities.

Five Dam Removal Alternative (Proposed Action)

Site operations and maintenance after completion of the Five Dam Removal Alternative are not expected to involve construction or generate substantial amounts of automobile and truck traffic. Operations and maintenance work would comply with all federal and state laws relating to safety and safe handling of any hazardous or toxic materials (hazardous and toxic materials are expected to be limited to fuel and lubricants). Improvements installed as part of the Five Dam Removal Alternative, including adequate power and communications at the sites, trail improvements, and new or improved access roads, would reduce risk to workers and the public. As a result, operations and maintenance activities would not have an effect on the environment.

Impact 4.12-1 Significant—Construction workers could be exposed to hazardous or toxic materials disturbed during construction, modification, or removal activities at the Restoration Project sites. Asbestos, PCBs, lead-based paint, pentachlorophenol, and other hazardous materials may be encountered during the activities proposed under the Five Dam Removal Alternative. Heavy metals have been found in tests of metal work paint at the Wildcat, Inskip, and Soap Creek Feeder Diversion Dams and may exist at other affected dam sites as well. While asbestos sheet packing is known to be present at Wildcat Diversion Dam, similar materials could be found at other diversion dam sites. Construction workers could come into contact with these hazardous materials. Workers could also be exposed to hazardous materials brought on site for use during the construction, modification, or removal of Restoration Project facilities. These materials could include petroleum-based materials, solvents, and lubricants. This impact is considered significant.

As a means to reduce the significance of exposure, Reclamation will require as a contract specification that contractors prepare a safety program for review and approval by Reclamation. The program will be required to cover all work phases. Part of the safety program will be specific operating procedures (SOP) and hazards analysis addressing hazardous operations and activities. The SOP will break down the operation into specific basic steps. The hazard analysis will define the hazards associated with each step and propose methods for eliminating or neutralizing the hazard. This will apply to all activities involving the use of hazardous and/or toxic materials.

In addition to the preceding contract requirements, implementing the following mitigation measures would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.12-1. Construction contractors will implement the following measures to reduce construction workers' exposure to hazardous or toxic materials.

- Comply with all applicable regulations, including the use of appropriate transportation, storage, use, and disposal procedures.
- Develop and implement a spill prevention, containment, and countermeasure plan. This plan will ensure that all personnel are aware of the proper handling techniques and appropriate responses and actions to be taken if hazardous materials are accidentally released. It will include specific handling techniques for those hazardous materials with the greatest potential to occur in the area (including PCBs, asbestos, lead-based paint, and pentachlorophenol).

- Implement measures to reduce the amounts of hazardous materials in use at the Restoration Project sites.
- Evaluate the potential hazards at each dam site as part of the preconstruction design work. This evaluation will be followed by a more detailed evaluation to confirm the presence and extent of any existing hazardous materials and to develop a plan that recommends appropriate procedures to remove the materials and thus minimize the risk to public health.

Impact 4.12-2 Significant—The public could be exposed to hazardous or toxic materials associated with or disturbed during construction, modification, or removal activities at the Restoration Project sites; public access to construction areas could also increase the potential for exposure to hazardous materials.

The implementation of the Five Dam Removal Alternative could result in an increased risk to the public associated with equipment use, exposure to potentially hazardous materials used during construction, and other hazards including open trenches and increased access to hydroelectric facilities. This risk is a possibility despite many of the diversion dam sites being located in remote areas away from public access areas. The site closest to a sensitive receptor is Inskip Diversion Dam, which is located downstream of the Oasis Springs Lodge. Because the lodge typically operates from May through mid-November, any construction activities at Inskip Diversion Dam during this period would potentially result in an increased public presence at and around the construction sites.

Although many of the proposed activities are located in remote locations away from populated areas, it is possible that the increased traffic and activity at the Restoration Project sites and along access roads could also increase public curiosity and draw them to construction sites. Because access to these sites would increase the potential threat to public health and safety, unrestricted public access would be considered a potentially significant health and safety impact.

Reclamation, as a contract specification, requires contractors to limit the use of hazardous materials during construction to those described in the List of Hazardous Materials and Material Safety Data Sheets submitted to Reclamation. Further, no hazardous materials that are not on either of these lists may be delivered to the job site. This contract provision restricts hazardous materials on the job to those that are known and for which safety information is readily available. Contract requirements for preparation of SOPs and hazard analysis as part of a contractor safety program will also reduce this impact. In addition, implementing the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.12-2. Reclamation will implement the following measures to reduce exposure of the public to hazardous or toxic materials.

- Clearly mark all construction areas around each dam site as hazardous and off-limits to the public.

- Backfill or cover any excavated areas and other particular areas of hazard at the end of each workday.
- Fence off areas around the Restoration Project sites and gate and lock all access roads to deter public access.
- Notify nearby sensitive receptors and residents (including the management of the Oasis Springs Lodge) of the schedule of activities expected to occur at the Restoration Project site.

Impact 4.12-3 Significant—Increased vehicle traffic along private access roads during construction activities could endanger residents and domestic animals.

Increased traffic associated with construction would increase hazards to people and domestic animals that live along Restoration Project access roads. Hazards to people and domestic animals would increase especially during peak morning and evening commuting hours when work crews typically arrive and leave from the project sites. Truck traffic, consisting of trucks delivering materials to the job sites and hauling away waste materials from the job sites, would greatly increase over current levels and contribute to public hazards. In addition, equipment such as road graders used to improve roads for construction access, as described in Chapter 3, would contribute to these hazards.

Traffic is expected to increase substantially over current levels during long-term operations and maintenance activities; therefore, the Five Dam Removal Alternative would have a significant impact on public health and safety. The contract specifications for work on this project include traffic control measures intended to reduce the impact of construction traffic. These specifications include:

- submitting a traffic control plan for Reclamation's approval;
- limiting speeds to a maximum of 15 miles per hour, except near residences where a lower speed may be required;
- informing affected residents along the routes about changes in traffic levels and providing reasonable accommodations to ensure traffic safety, such as fencing or lower speed limits;
- providing a hot line for public input regarding traffic concerns through the community of Manton;
- providing necessary traffic control devices and flag persons to prevent accidents and damage or injury;
- delaying work along public and private roads until proper traffic control devices are in place;
- providing unobstructed, smooth, and dustless passageway for one lane of traffic through construction operations; and
- maintaining traffic flow to minimize obstruction and inconvenience to public traffic.

In addition, implementing the following mitigation measures would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.12-3. Reclamation will implement the following measures to reduce traffic hazards to people and domestic animals that live along Restoration Project access roads.

- During construction, traffic on private roads within 500 feet of residences and near the Oasis Springs Lodge will be limited to a speed of 5 miles per hour. Notice of the upcoming speed zone will be visibly posted in advance of the zone. The speed limit will be posted visibly at the beginning of the restricted speed zone. Reclamation will specify this limit in contract specifications with construction contractors.
- During construction, truck traffic on private roads will be limited to daylight hours only. No trucks will operate on private roads within 1 hour of sunset. Reclamation will specify construction time constraints in contract specifications with construction contractors.
- Reclamation will establish a complaint line where residents may report allegations of excessive speed. When a complaint is made, Reclamation will inform the contractor and advise them of the contract provisions limiting speeds along private roads.

Impact 4.12-4 Significant—Dewatering activities at the Restoration Project sites could provide breeding grounds for mosquitoes.
Removal of surface water and/or groundwater is expected to be required at some Restoration Project sites. Whether these activities are accomplished by using temporary cofferdams to stop the water flow, diverting the flow, or pumping the water to a temporary detention pond, the activities could produce standing water in shallow areas that can serve as breeding ground for mosquitoes.

At many of the Restoration Project sites, rock, rubble, and cement materials would be broken up into small pieces and distributed downstream. Existing sediment behind some of the dams would also be left in place for larger flow events to distribute downstream. An excavator would be used to channel in some streambeds and facilitate the distribution of the sediments. It is expected that, until they are distributed downstream by natural flows, these materials could initially result in some ponded or standing water that could serve as breeding ground for mosquitoes. Proposed activities conducted during the winter, when mosquitoes are dormant, would not result in increased populations. However, activities conducted in the summer have the potential to result in increased quantities of breeding ground. This impact is considered significant. Implementing the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.12-4. Reclamation will implement the following measures to reduce mosquito breeding grounds during construction at the Restoration Project sites.

- Maximize the protection of public health in the area of the Restoration Project sites during the summer months with applicable mosquito abatement districts and control agencies.
- Inform workers during the worker education program of the potential for increases in mosquito breeding populations and of the appropriate precautions to take to protect their health.

Impact 4.12-5 Less than Significant—Helicopter operations at some of the Restoration Project sites could result in worker injury or fire. Helicopters will be used at the facilities listed above. Without proper operational safeguards, accidents or crashes could result in injuries to workers and wildfire. The helicopter operations requirements of Reclamation's *Standards* will be made a part of all construction contracts. In addition, the contract specifications imposed by Reclamation on its contractors will include the following measures to reduce the risk from injuries:

- provide the on-site services of an Emergency Medical Technician (EMT) during all construction activities,
- provide the EMT with a direct line of communication with local medical services, and
- provide dependable ambulance service.

These measures will reduce the risk of worker injury to a less-than-significant level.

Section 10 of Reclamation's *Standards* require the preparation and implementation of a fire prevention plan for each job site. In addition, the *Standards* require that each facility prepare a fire protection plan, including provisions for fire suppression equipment and, where community fire department services are not available, providing a trained fire fighting brigade. Fire fighting equipment must be in place at each facility as well. These project requirements will reduce the risk of fire to a less-than-significant level.

No Dam Removal Alternative

Although the specific activities at some of the Restoration Project sites may vary from those of the Five Dam Removal Alternative (e.g., no construction is proposed at the Soap Creek Feeder and Lower Ripley Creek Feeder), the No Dam Removal Alternative could create risk of harm or injury to workers or the general public similar to the Five Dam Removal Alternative.

Impact 4.12-6 Significant—Construction workers could be exposed to hazardous or toxic materials disturbed during construction, modification, or removal activities at the Restoration Project sites. This impact is similar to Impact 4.12-1 described under the Five Dam Removal Alternative. Construction activities under the No Dam Removal Alternative would include installing new fish screen and ladder facilities at the North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams. Construction workers may encounter hazardous materials during construction at these project sites. Because the No Dam Removal Alternative does not include the removal of dams, the likelihood of exposure to hazardous or toxic materials is less than for the Five Dam Removal Alternative; however, this impact is still considered significant. Reclamation's contract specifications and the Mitigation Measures for Impact 4.12-1 would reduce this impact to a less-than-significant level.

Impact 4.12-7 Significant—The public could be exposed to hazardous or toxic materials associated with or disturbed during construction, modification, or removal activities at the Restoration Project sites; public access to construction areas could also increase the potential for exposure to hazardous materials.
This impact is similar to Impact 4.12-2 described under the Five Dam Removal Alternative. Under the No Dam Removal Alternative, construction would occur at the North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams. Similar to the Five Dam Removal Alternative, the No Dam Removal Alternative could expose the public to hazardous or toxic materials, although exposure would be less because no construction would occur at the Soap Creek Feeder or the Lower Ripley Creek Feeder Diversion Dams. This impact is considered significant. Reclamation's contract specifications and the Mitigation Measures for Impact 4.12-2 would reduce this impact to a less-than-significant level.

Impact 4.12-8 Significant—Increased vehicle traffic along private access roads during construction activities could endanger residents and domestic animals.
Construction activities under the No Dam Removal Alternative would require access to six dam sites to remove and install fish screens and fish ladders (i.e., North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams). Increased traffic associated with construction activities would increase hazards to people and domestic animals that live along Restoration Project access roads. Hazards to people and domestic animals would increase especially during peak morning and evening commuting hours when work crews typically arrive and leave from the project sites. Truck traffic, consisting of trucks delivering materials to the job sites and hauling away waste materials from the job sites, would greatly increase over current levels and contribute to public hazards. These potential impacts are similar to Impact 4.12-3 described for the Five Dam Removal Alternative and considered significant. Implementing Mitigation Measures for Impact 4.12-3 and Reclamation's contract specifications would reduce this impact to a less than significant level.

Impact 4.12-9 Significant—Dewatering activities at the Restoration Project sites could provide breeding grounds for mosquitoes.
This impact is similar to Impact 4.12-4 described under the Five Dam Removal Alternative. Similar to the Five Dam Removal Alternative, the No Dam Removal Alternative would require dewatering activities, which could provide

breeding habitat for mosquitoes. This impact is considered significant. Implementing Mitigation Measures for Impact 4.12-4 would reduce this impact to a less-than-significant level.

Impact 4.12-10 Less than Significant—Helicopter operations at some of the Restoration Project sites could result in worker injury or fire.
This impact is similar to Impact 4.12-5 described under the Five Dam Removal Alternative. Similar to the Five Dam Removal Alternative, the No Dam Removal Alternative would require helicopter operations during construction to serve sites without vehicular access. This impact is considered less than significant, based on the requirements that will be imposed by Reclamation's *Reclamation Safety and Health Standards* and contract specifications.

Six Dam Removal Alternative

The Six Dam Removal Alternative would remove Eagle Canyon Diversion Dam in addition to those dams to be removed under the Five Dam Removal Alternative (i.e., Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams). Similar to the Five Dam Removal Alternative, the Six Dam Removal Alternative could create risk of harm or injury to workers or the general public.

Impact 4.12-11 Significant—Construction workers could be exposed to hazardous or toxic materials disturbed during construction, modification, or removal activities at the Restoration Project sites.
This impact is similar to Impact 4.12-1 described under the Five Dam Removal Alternative. Construction activities under the Six Dam Removal Alternative would include removing the Eagle Canyon, Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams, and installing fish screens and fish ladders at the North Battle Creek Feeder and Inskip Diversion Dam. Construction workers may encounter hazardous materials during construction at these project sites. This impact is similar to Impact 4.12-1 and is considered significant. Reclamation's contract specifications and the Mitigation Measures for Impact 4.12-1 would reduce this impact to a less-than-significant level.

Impact 4.12-12 Significant—The public could be exposed to hazardous or toxic materials associated with or disturbed during construction, modification, or removal activities at the Restoration Project sites; public access to construction areas could also increase the potential for exposure to hazardous materials.
This impact is similar to Impact 4.12-2 described under the Five Dam Removal Alternative. Under the Six Dam Removal Alternative, construction would occur at the North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Soap Creek Feeder, Inskip, Lower Ripley Creek Feeder, and Coleman Diversion Dams. Under the Six Dam Removal Alternative the public could be exposed to hazardous or toxic materials similar to exposure under the Five Dam Removal

Alternative. This impact is considered significant. Reclamation's contract specifications and the Mitigation Measures for Impact 4.12-2 would reduce this impact to a less-than-significant level.

Impact 4.12-13 Significant—Increased vehicle traffic along private access roads during construction activities could endanger residents and domestic animals.

Construction activities under the Six Dam Removal Alternative would require access to eight dam sites to remove diversion dams or install fish screens and fish ladders (i.e., North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams, as well as Soap Creek Feeder and Ripley Creek Feeder). Increased traffic associated with construction activities would increase hazards to people and domestic animals that live along Restoration Project access roads. Hazards to people and domestic animals would increase especially during peak morning and evening commuting hours when work crews typically arrive and leave from the project sites. Truck traffic, consisting of trucks delivering materials to the job sites and hauling away waste materials from the job sites, would greatly increase over current levels and contribute to public hazards. These potential impacts are similar to Impact 4.12-3 described for the Five Dam Removal Alternative and are considered significant. Implementing Mitigation Measures for Impact 4.12-3 and Reclamation's contract specifications would reduce this impact to a less-than-significant level.

Impact 4.12-14 Significant—Dewatering activities at the Restoration Project sites could provide breeding grounds for mosquitoes.

This impact is similar to Impact 4.12-4 described under the Five Dam Removal Alternative. Similar to the Five Dam Removal Alternative, the Six Dam Removal Alternative would require dewatering activities, which could provide breeding habitat for mosquitoes. This impact is considered significant. Implementing Mitigation Measures for Impact 4.12-4 would reduce this impact to a less-than-significant level.

Impact 4.12-15 Less than Significant—Helicopter operations at some of the Restoration Project sites could result in worker injury or fire.

This impact is similar to Impact 4.12-5 described under the Five Dam Removal Alternative. Similar to the Five Dam Removal Alternative, the Six Dam Removal Alternative would require helicopter operations during construction to serve sites without vehicle access. This impact is considered less than significant, based on the requirements that will be imposed by Reclamation's *Reclamation Safety and Health Standards* and contract specifications.

Three Dam Removal Alternative

Although the specific activities at some of the Restoration Project sites may vary from those of the Five Dam Removal Alternative (e.g., no construction is proposed at the Soap Creek Feeder and Lower Ripley Creek Feeder), the Three

Dam Removal Alternative could create risk of harm or injury to workers or the general public similar to the Five Dam Removal Alternative.

Impact 4.12-16 Significant—Construction workers could be exposed to hazardous or toxic materials disturbed during construction, modification, or removal activities at the Restoration Project sites. This impact is similar to Impact 4.12-1 described under the Five Dam Removal Alternative. Construction activities under the Three Dam Removal Alternative would include installing new fish screen and ladder facilities at the North Battle Creek Feeder, South, and Inskip Diversion Dams. Dam removal would occur at Eagle Canyon, Wildcat, and Coleman Diversion Dams. Construction workers may encounter hazardous materials during construction at these project sites. Because the Three Dam Removal Alternative does not include the removal of Soap Creek Feeder and Lower Ripley Creek Feeder, the likelihood of exposure to hazardous or toxic materials is less than for the Five Dam Removal Alternative; however, this impact is still considered significant. Reclamation's contract specifications and the Mitigation Measures for Impact 4.12-1 would reduce this impact to a less-than-significant level.

Impact 4.12-17 Significant—The public could be exposed to hazardous or toxic materials associated with or disturbed during construction, modification, or removal activities at the Restoration Project sites; public access to construction areas could also increase the potential for exposure to hazardous materials. This impact is similar to Impact 4.12-2 described under the Five Dam Removal Alternative. Under the Three Dam Removal Alternative, construction would occur at the North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams. Although construction activities under the No Dam Removal Alternative would be less than under the Five Dam Removal Alternative, because no construction would occur at the Soap Creek Feeder or the Lower Ripley Creek Feeder the public could still be exposed to hazardous or toxic materials similar to exposure under the Five Dam Removal Alternative. This impact is considered significant. Reclamation's contract specifications and the Mitigation Measures for Impact 4.12-2 would reduce this impact to a less-than significant level.

Impact 4.12-18 Significant—Increased vehicle traffic along private access roads during construction activities could endanger residents and domestic animals. Construction activities under the Three Dam Removal Alternative would require access to six dam sites to remove three diversion dams (Eagle Canyon, Wildcat, and Coleman Diversion Dams) and install fish screens and fish ladders at North Battle Creek Feeder, South, and Inskip Diversion Dams. Increased traffic associated with construction activities would increase hazards to people and domestic animals that live along Restoration Project access roads. Hazards to people and domestic animals would increase especially during peak morning and evening commuting hours when work crews typically arrive and leave from the project sites. Truck traffic, consisting of trucks delivering materials to the job sites and hauling away waste materials from the job sites, would greatly increase over current levels and contribute to public hazards. These potential impacts are similar to Impact 4.12-3 described for the Five Dam Removal Alternative and considered significant. Implementing the Mitigation Measures recommended for Impact 4.12-3 and Reclamation's contract specifications would reduce this impact to a less-than-significant level.

Impact 4.12-19 Significant—Dewatering activities at the Restoration Project sites could provide breeding grounds for mosquitoes.
This impact is similar to Impact 4.12-4 described under the Five Dam Removal Alternative. Similar to the Five Dam Removal Alternative, the Three Dam Removal Alternative would require dewatering activities, which could provide breeding habitat for mosquitoes. This impact is considered significant. Implementing Mitigation Measures for Impact 4.12-4 would reduce this impact to a less-than-significant level.

Impact 4.12-20 Less than Significant—Helicopter operations at some of the Restoration Project sites could result in worker injury or fire.
This impact is similar to Impact 4.12-5 described under the Five Dam Removal Alternative. Similar to the Five Dam Removal Alternative, the Three Dam Removal Alternative would require helicopter operations during construction to serve sites without vehicular access. This impact is considered less than significant; based on the requirements that will be imposed by Reclamation's *Reclamation Safety and Health Standards* and contract specifications.

Cumulative Impacts

Cumulative public health and safety impacts associated with the Proposed Action and past, present, or probable future projects (including those mentioned in Chapter 6) that would occur in the Battle Creek watershed could potentially be significant. However, implementing the proposed mitigation measures would minimize impacts associated with public health and safety. With the implementation of the proposed mitigation measures, the Restoration Project is not expected to result in or contribute to any cumulative impacts on public health and safety in the Battle Creek Watershed.

4.13 Public Services and Utilities

Affected Environment

The construction, modification, or removal of facilities at the various Restoration Project sites could affect the following public services and utilities:

- electric utility service and natural gas supply,
- domestic water service,
- solid waste disposal,
- hazardous waste disposal,
- fire protection,
- police protection,
- wastewater, and
- emergency medical services.

A description of the public services and utilities located in Shasta and Tehama Counties and in the Restoration Project is provided below.

Natural Gas Supply and Electric Utility Service

Natural gas service in the area is provided by PG&E, which owns and operates distribution systems and provides services to retail customers. PG&E operates several natural gas pipelines in Shasta and Tehama Counties. Two gas pipelines run in a north-south direction through Burney and Shingletown and pass through the Restoration Project.

PG&E also provides electric utility service in the Restoration Project area. PG&E owns, operates, and maintains distribution systems, provides service to retail customers, and maintains numerous electric transmission lines that service the Hydroelectric Project facilities. PG&E also maintains a field office in Manton, California.

Two 500-kilovolt (kV) electric transmission lines operated by PG&E run north to south through the Restoration Project. Three PG&E 230-kV electric transmission lines and one Western Area Power Administration 230-kV electric transmission line run to the southwest from the Round Mountain Substation in Round Mountain to the Cottonwood Substation in Cottonwood. These four lines are located to the west of the Restoration Project.

Domestic Water Supply

Two general methods are used to deliver domestic water in the Tehama and Shasta County areas: community distribution systems and individual or on-site systems. In Tehama County, water for domestic use is secured primarily from the Sacramento River groundwater basin and, to a lesser extent, surface water flows. Domestic use water in Tehama County is provided by 66 separate distribution systems to water users in the incorporated areas of the county. Both Red Bluff and Corning have municipal water systems that serve their respective communities. The Rio Alta Water District provides a water distribution system to the Lake California area. The remaining rural portions of the county, including the Restoration Project, are served by smaller shared water systems and by individual wells that serve single-family homes. Manton, the only community near the Restoration Project, is supplied primarily with surface water from Cross Country Canal and Digger Creek (Tehama County Community Development Group 1983).

In Shasta County, water supply is derived primarily from surface flows. Surface water flows are allocated to supply primarily the south central region of Shasta County. This region covers the populated areas of the county that acquire their domestic water supply from water-controlling entities that include several large water purveyors (e.g., the Anderson-Cottonwood Irrigation District and the Bella Vista Water District). The Restoration Project is located outside the south central region. The remaining unincorporated and rural portions of the county, including the Restoration Project, are served primarily by groundwater supplied through individual wells.

Solid Waste Disposal

Two landfills operate in Shasta County. Located in the city of Anderson, the Anderson Solid Waste facility is operated as a Class III (nonhazardous) facility[1] and receives about 200 tons of solid waste from residential, commercial, industrial, and agricultural sources each day. Its maximum intake allowed by permit is 1,018 tons per day (tpd); it has a remaining capacity of 7,997,000 cubic yards, and its projected closure date is 2020 (CIWMB 2002). The facility is permitted to receive asbestos waste, shredder wastes, and special wastes. The West Central Landfill, located to the east of Redding, operates as a Class III (nonhazardous) facility. It receives about 400 tons of nonhazardous waste from residential, commercial, industrial, and agricultural sources each day. Its maximum allowed intake is 700 tpd; at last update it had a remaining capacity of more than 5,790,000 cubic yards, and its projected closure date is also 2020 (CIWMB 2002). A third landfill, the Simpson (Twin Brides) Landfill, is located near Igo and Ono, southwest of Redding and until recently operated as a Class II (nonhazardous) facility. The owners of this facility have filed for bankruptcy and

[1]Class I landfills are zoned for hazardous waste, Class II landfills are zoned to handle sewage and wastewater, and Class III landfills are zoned to handle municipal solid waste.

the landfill is currently listed as "inactive" by the California Integrated Waste Management Board (CIWMB) (Graber pers. comm.), but if the site reopened it would be the closest landfill to the restoration project.

In addition to the three landfills, 12 transfer stations are located in Shasta County. The Shingletown Transfer Station is the closest to the Restoration Project.

One solid waste disposal site is in Tehama County. The Red Bluff Sanitary Landfill is a Class III (nonhazardous) facility and is located 2 miles northwest of Red Bluff. It receives tires and about 130 tons of solid waste from agricultural, construction/demolition, green materials, industrial, and mixed municipal sources each day. All solid wastes generated in Tehama County are dumped at the county-owned and privately operated Red Bluff site (Tehama County Community Development Group 1983). The landfill is expected to have sufficient capacity to operate until at least 2019 (Kohn pers. comm.).

Four limited-volume transfer stations are located in Tehama County. The Manton Transfer Station and the Paynes Creek Transfer Station are the closest to the Restoration Project.

Hazardous Waste Disposal

There are no hazardous waste treatment, storage, or disposal sites in the Restoration Project area and no hazardous waste disposal facilities in Tehama County (Kohn pers. comm.). According to the Department of Toxic Substance Control, two facilities in Shasta County (one in the City of Shasta Lake and the second near Redding Medical Center) accept hazardous waste (Shasta County 1998).

Fire Protection

The California Department of Forestry and Protection (CDF) has developed hazard severity zones based on such factors as fuel load (i.e., the amounts of grass, shrubs, or heavy woods located in an area), climate, and topography (i.e., the steeper the slope, the faster a fire will burn). The northern portion of the Restoration Project located in Shasta County is in a fire hazard severity zone rated "very high" (Shasta County 1998). In Shasta County, CDF is responsible for wildland fire[2] control outside U.S. Forest Service land or city boundaries. The CDF is responsible for fire control on approximately 1.1 million acres of private wildland and an additional 250,000 acres of U.S. Forest Service and BLM lands. As discussed in Section 4.6, "Land Use," land ownership in the Restoration Project is predominantly private, with a smaller portion of BLM

[2]Wildland fires burn natural or wild vegetation located on undeveloped land. Non-wildland fires include structural, chemical, petroleum, electrical, vehicle, and other human-made material fires.

land. The U.S. Forest Service is responsible for wildland fire control on its lands. However, the Restoration Project contains no U.S. Forest Service land.

The CDF serves Shasta County with five battalions and 10 seasonal fire stations in the county and one battalion with three stations outside the county boundaries. In addition, there are 12 community fire districts, 19 volunteer fire companies, and, in Redding, the Shasta County Fire Station. The 19 volunteer fire companies and the Shasta County Fire Station are operated under the jurisdiction of the Shasta County Fire Department. The volunteer fire department in Shingletown is the closest to the Restoration Project. The Cottonwood Fire District has jurisdiction over the Restoration Project from the westernmost project area boundary east to the Coleman Powerhouse. The Cottonwood Fire District would be responsible for combating non-wildland fires in the area during the non-fire season (November through April). It would work with the CDF during the fire season (May through October) to contain all fires within their jurisdiction. The eastern portion of the Restoration Project located in Shasta County would be served by the CDF.

Tehama County is also divided into fire hazard severity zones, and the portion of the Restoration Project that is located in Tehama County is again entirely within a zone rated “very high” (Sherman pers. comm.; CDF 2001). Fire protection in the rural areas of Tehama County is provided by the Tehama County Fire Department. City governments provide fire protection in urban areas (Tehama County Community Development Group 1983). Fire protection is also provided by Schedule C stations staffed by volunteer fire companies. Fire protection in those portions of the Restoration Project located in Tehama County is provided by the Tehama County Fire Department, whose primary responsibility is non-wildland fires, and the CDF, whose year-round responsibility is wildland fires (Stelle pers. comm.).

Many of the local fire agencies overlap with CDF jurisdictions. Generally, local agencies are responsible primarily for non-wildland fires, while CDF responds primarily to wildland fires. However, in practice, all agencies overlap duties and work together when the need is present (Shasta County 1998).

Police Protection

Law enforcement needs for the Restoration Project will be served by Shasta and Tehama County. The portion of the Restoration Project within Shasta County is in the unincorporated, rural area of the county. This area receives general public safety, police protection, and law enforcement services from the Shasta County Sheriff’s Office in Redding, California. Three geographic patrol areas cover the county with stations in the Cities of Shasta Lake, Anderson, and Burney (Shasta County 1998). The Sheriff’s Office has 153 sworn deputy positions and 88 non-sworn positions. In addition, the Shingletown area, which is the community in Shasta County closest to the Restoration Project, also has resident deputies.

Law enforcement in the rural areas of Tehama County is provided by the Tehama County Sheriff's Department in Red Bluff. The portion of the Restoration Project in Tehama County is primarily in the unincorporated area of the county. Unincorporated areas of Tehama County receive general public safety, police protection, and law enforcement services from this office. In addition, the police departments in both Red Bluff and Corning patrol three geographic patrol areas (CopQuest.org 2001).

Wastewater Services

Wastewater in Shasta and Tehama Counties is treated in one of two ways: (1) community collection and treatment with discharge or (2) individual treatment at the site with return to the ground.

Several community wastewater collection and treatment systems serve the incorporated areas of Shasta and Tehama Counties. In Shasta County, the seven community wastewater collection and treatment systems are:

- three major community wastewater treatment systems in Anderson, Redding, and Shasta Lake;
- community wastewater systems in Cottonwood and Palo Cedro operated by county service areas; and
- systems in the communities of Burney and Fall River Mills that are served by centralized wastewater treatment facilities.

In Tehama County, the five community collection wastewater treatment systems are:

- the City of Red Bluff wastewater treatment system,
- the City of Corning wastewater treatment system,
- the Rio Alta Water District (serving the Lake California area),
- Tehama County Sanitation District No. 1 (serving the immediate Mineral area), and
- the Gerber sanitary sewer system.

In areas not served by these systems, all wastewater is treated by individual systems that use either septic/leachfield systems or seepage pits. Similar to other unincorporated areas in Tehama County, Manton, the only community near the Restoration Project, is served with wastewater treatment by individual septic tanks. The Restoration Project is located in the rural areas in the county; therefore, residents in the area would likely be served by individual systems.

Emergency Medical Services

Numerous hospitals provide emergency medical services in Shasta and Tehama Counties. The hospitals that are the closest to the Restoration Project include the Redding Medical Center and Mercy Medical Center, both located in Redding, and St. Elizabeth Community Hospital, located in Red Bluff.

Regulatory Setting

There are no regulations applicable to the project in the area of public services and utilities. The project does not consume services and utilities.

Environmental Consequences

Summary

No significant public services and utilities impacts are associated with the No Action Alternative or the Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal) when mitigation measures are applied. Proposed activities at the Restoration Project sites may increase demands on fire, police, and emergency medical services because the project area is in a very high fire hazard severity zone, which means that the chance of a fire igniting and spreading is relatively high. Although the Restoration Project could potentially increase the demand on fire, police, and emergency medicial services, other public services and utilities in the Restoration Project and surrounding area would not be affected by the implementation of the Restoration Project.

Impact Significance Criteria

Based on specific project concerns, impacts would be considered significant for this analysis if implementation of the Restoration Project would:

- reduce the ability of utility providers (electric, natural gas, water, and wastewater) to maintain the current level of service to their customers in the area;
- reduce the ability of solid waste disposal facilities to absorb an additional waste stream without substantially altering their ability to meet current life expectancy projections;
- reduce the ability of fire and police departments to maintain current levels of service to area residents; or
- increase the potential release or disturbance of hazardous materials or waste.

Impact Assessment

As applicable, the General Environmental Protection Measures listed in the introduction to this chapter shall be used for this resource.

No Action Alternative

The No Action Alternative would not affect public services and utilities. The No Action Alternative is not expected to contribute to the increased usage of those public services and utilities identified above.

Five Dam Removal Alternative (Proposed Action)

Impact 4.13-1 Significant—Proposed activities at the Restoration Project sites may increase demands on fire, police, and emergency medical services.

Activities proposed under the Five Dam Removal Alternative have the potential to result in temporary increased demands on fire protection, police protection, and emergency medical services that may be needed in the area. The proposed activities would result in additional temporary traffic and workers in the general area of the Restoration Project. The maximum number of construction workers required to implement this alternative is 360. It is assumed that a maximum of 360 workers distributed over several Battle Creek sites could be engaged in construction activities at any given time. While activity, traffic, and personnel in the area of the Restoration Project would temporarily increase, this increase is not expected to exceed, under normal circumstances, the capacity of existing protective and emergency response demands in the area. However, because the proposed project is in a "very high" fire hazard severity zone, which means that the chance of a fire igniting and spreading is relatively high in this area, the Restoration Project could potentially increase the demand on fire services. This impact is considered significant. Implementing the following mitigation measures would reduce this impact to a less-than-significant level.

Mitigation Measures for Impact 4.13-1. The construction contractor will follow these measures to minimize the need for protective and emergency response services:

- Practicable and conventional precautions will be taken by the contractor to ensure the safety of workers and the general public by adequately securing work sites and fencing hazardous areas and trenches during construction activities. This will be the responsibility of the contractor and will be made a part of the standards and specifications included in their contract.
- Physical barriers and sign postings (including "No Trespassing") consistent with standard construction safety management practices will be used by the contractor to discourage and limit access to construction areas. This will be

the responsibility of the contractor and will be made a part of the standards and specifications included in their contract.

- The contractor will provide notice to county law enforcement and fire protection agencies during proposed activities. This requirement will be included in the standards and specifications made a part of the contract.
- Standard precautions and approaches required by the CDF, and Shasta and Tehama County Fire Departments when dealing with very high fire hazard severity zones will be adhered to during construction activities by the contractor. The lead agencies will prepare a fire plan in consultation with the CDF and Shasta and Tehama County Fire Departments, as outlined in the *Industrial Operations Fire Prevention Field Guide* published by the CDF and State Fire Marshal, and filing of the plan with the appropriate fire protection agency prior to beginning construction. Precautions will include, but are not limited to, the use of Forest Service–approved spark arresters on all internal combustion engines, preplacement of fire suppression equipment, restricting smoking and equipment refueling to cleared areas, and restricting activities during "Red Flag" conditions. The fire plan will be included in the standards and specifications made a part of the contract for construction work.

Impact 4.13-2 Less than Significant—Proposed activities at the Restoration Project sites may increase demand on solid waste and hazardous waste disposal facilities.

Construction activities at the dam sites associated with the Five Dam Removal Alternative would generate small volumes of solid waste and potentially small volumes of hazardous waste. The solid waste would include standard construction waste, concrete, litter, and miscellaneous reinforcing steel and metal. The hazardous waste could include materials exposed during construction activities such as PCBs, lead-based paint, asbestos, and pentachlorophenol. These hazardous materials are discussed in detail in Section 4.12, "Public Health and Safety." In many cases, the concrete and rubble materials would be used on site or broken down into small pieces and distributed downstream, thereby avoiding the need for their disposal in a landfill. As much as 3,000 cubic yards of construction waste would need to be trucked to an appropriate landfill.

In addition, because many of the Restoration Project sites would be in remote locations, it is assumed that contractors would provide self-contained collection facilities and transport the minimal quantities of worker-generated solid waste to appropriate disposal facilities.

Three solid waste disposal facilities and a number of transfer stations are located in Shasta and Tehama Counties, and two hazardous waste disposal facilities are located in Shasta County. These disposal facilities would absorb disposal materials generated at the Restoration Project sites without significantly affecting existing landfill capacity. At last count by the CIWMB, there was more than 12,000,000 cubic yards of capacity remaining among the three solid waste disposal facilities (CIWMB 2002). An adequate number of trash bins, dumpsters, and other appropriate containers will be kept on site to minimize the potential for adverse impacts associated with litter in the Restoration Project.

Because local disposal facilities have the capacity to absorb disposal materials generated at the Restoration Project sites without significantly affecting existing landfill capacity, this impact is considered less than significant.

Impact 4.13-3 Less than Significant—Relocation or removal of electric transmission facilities could temporarily affect services provided by utilities.

Electricity is provided directly by power lines and transmission poles that both extend and provide power to some of the individual Restoration Project sites. As some of the activities proposed under the Five Dam Removal Alternative would be implemented, some of those lines and poles may need to be relocated or temporarily removed. For example, it is estimated that power line relocation would be required at several sites and that power conduits would be reconfigured to fit the new facilities at some sites after construction has been completed. The power lines and poles that would be subject to disruption serve only the facilities at the specific sites, and no widespread impacts on power supply are anticipated. Power line relocation or removal, therefore, would not result in a significant impact. During necessary power disruptions, portable generators would provide power at the site. Because none of existing natural gas supply facilities would need to be relocated, there would be no impacts on them. This impact is less than significant.

No Dam Removal Alternative

Impact 4.13-4 Significant—Proposed activities at the Restoration Project sites may increase demands on fire, police, and emergency medical services.

This impact is similar to Impact 4.13-1 described above under the Five Dam Removal Alternative. It is estimated that 240 construction workers would be needed, resulting in potentially slightly smaller impacts on fire, police, and emergency medical services than under the Five Dam Removal Alternative. However, because the proposed project is in a very high fire hazard severity zone, which means that the chance of a fire igniting and spreading is relatively high in this area, the Restoration Project could potentially increase the demand on fire services. This impact is considered significant. Implementing the Mitigation Measure for Impact 4.13-1 would reduce this impact to a less-than-significant level.

Impact 4.13-5 Less than Significant—Proposed activities at the Restoration Project sites may increase demand on solid waste and hazardous waste disposal facilities.

This impact is similar to Impact 4.13-2 described above under the Five Dam Removal Alternative. It is estimated that 2,700 cubic yards of solid or hazardous waste materials would be generated as a result of the implementation of the No Dam Removal Alternative, which is less than the 3,000 cubic yards that would be generated by the Five Dam Removal Alternative. Therefore, the No Dam Removal Alternative would also have a less-than-significant impact on waste disposal facilities.

Impact 4.13-6 Less than Significant—Relocation or removal of electric transmission facilities could temporarily affect services provided by utilities.
This impact is similar to Impact 4.13-3 described above under the Five Dam Removal Alternative. The impact on utility services would remain less than significant as well under the No Dam Removal Alternative because this alternative would affect electrical and gas infrastructure in the same ways as described under the Five Dam Removal Alternative.

Six Dam Removal Alternative

Impact 4.13-7 Significant—Proposed activities at the Restoration Project sites may increase demands on fire, police, and emergency medical services.
This impact is similar to Impact 4.13-1 described above under the Five Dam Removal Alternative. It is estimated that 360 construction workers would be needed for the Six Dam Removal Alternative, similar to the number of workers required for the Five Dam Removal Alternative and resulting in similar impacts on fire, police, and emergency medical services. However, because the proposed project is in a very high fire hazard severity zone, which means that the chance of a fire igniting and spreading is relatively high in this area, the Restoration Project could potentially increase the demand on fire services. This impact is considered significant. Implementing the mitigation measure for Impact 4.13-1 would reduce this impact to a less-than-significant level.

Impact 4.13-8 Less than Significant—Proposed activities at the Restoration Project sites may increase demand on solid waste and hazardous waste disposal facilities.
This impact is similar to Impact 4.13-2 described above under the Five Dam Removal Alternative. It is estimated that that approximately 3,000 cubic yards of solid or hazardous waste materials would be generated during the implementation of the Six Dam Removal Alternative, similar to the amount of solid or hazardous waste materials generated by the Five Dam Removal Alternative. Therefore, the Six Dam Removal Alternative would also have a less-than-significant impact on waste disposal facilities.

Impact 4.13-9 Less than Significant—Relocation or removal of electric transmission facilities could temporarily affect services provided by utilities.
This impact is similar to Impact 4.13-3 described above under the Five Dam Removal Alternative. The impact on utilities services would remain less than significant as well under the Six Dam Removal Alternative because this alternative would affect electrical and gas infrastructure in the same ways as described under the Five Dam Removal Alternative.

Three Dam Removal Alternative

Impact 4.13-10 Significant—Proposed activities at the Restoration Project sites may increase demands on fire, police, and emergency medical services.

This impact is similar to Impact 4.13-1 described above under the Five Dam Removal Alternative. It is estimated that 290 construction workers would be needed for the Three Dam Removal Alternative, resulting in slightly fewer impacts on fire, police, and emergency medical services than under the Five Dam Removal Alternative. However, because the proposed project is in a very high fire hazard severity zone, which means that the chance of a fire igniting and spreading is relatively high in this area, the Restoration Project could potentially increase the demand on fire services. This impact is considered significant. Implementing the mitigation measure for Impact 4.13-1 would reduce this impact to a less-than-significant level.

Impact 4.13-11 Less than Significant—Proposed activities at the Restoration Project sites may increase demand on solid waste and hazardous waste disposal facilities.

This impact is similar to Impact 4.13-2 described above under the Five Dam Removal Alternative. It is estimated that only 2,900 cubic yards of solid or hazardous waste materials would be generated during the implementation of the Three Dam Removal Alternative, which is slightly less than the amount of solid or hazardous waste materials generated by the Five Dam Removal Alternative. Therefore, the Three Dam Removal Alternative would also have a less-than-significant impact on waste disposal facilities.

Impact 4.13-12 Less than Significant—Relocation or removal of electric transmission facilities could temporarily affect services provided by utilities.

This impact is similar to Impact 4.13-3 described above under the Five Dam Removal Alternative. The impact on utilities services would remain less than significant as well under the Three Dam Removal Alternative because this alternative would affect electrical and gas infrastructure in the same ways as described under the Five Dam Removal Alternative.

Cumulative Impacts

This section addresses cumulative public services and utilities impacts associated with the Proposed Action and past, present, or probable future projects that would occur in the Battle Creek Watershed. Chapter 6 discusses projects that are planned for the same region of Shasta and Tehama Counties and examines their relationships to the Proposed Action. Some of the planned projects, such as improvements to the Coleman National Fish Hatchery, the Lassen Lodge hydropower project, gravel removal agreements, the U.S. Forest Service sediment reduction programs, and the Battle Creek spawning gravel study and restoration, would make demands on local public services and utilities that are similar to the impacts of the Proposed Action. The timelines for these related projects are not currently known, but if the construction phases for these projects occur concurrently with the Proposed Action, the cumulative impacts could be significant.

4.14 Recreation

Affected Environment

Regional Setting

The Restoration Project is located in northern Tehama and southern Shasta Counties east of the Sacramento River and west of Lassen Volcanic National Park and Lassen National Forest.

Land ownership in the Restoration Project is primarily private with a smaller portion of public land administered by the BLM. The area of potential effect for recreational resources includes private and public lands, waterways, and other areas within the Restoration Project area that provide recreational opportunities. Recreational activities that occur in and around the Restoration Project area include hunting, fishing, boating, wildlife viewing, kayaking, hiking, and family recreation (i.e., river access). Recreational activities are discussed in more detail below under "Recreation Activities."

Wildlife Refuges and Parks

Wildlife Refuges

No state or national wildlife refuges are located within the Restoration Project. The DFG manages the Battle Creek Wildlife Area and the Tehama Wildlife Area in the vicinity of the Restoration Project area. The 418-acre Battle Creek Wildlife Area is located west of the Restoration Project area and is adjacent to the Coleman National Fish Hatchery. The wildlife area includes 320 acres of riparian forests, marshes, and oak woodland, and is available for bird watching and fishing activities. The section of Battle Creek running through the Battle Creek Wildlife Area can be accessed for fishing and provides excellent spawning grounds for chinook salmon. The Tehama Wildlife Area is located about 3 miles south of the town of Paynes Creek and of the Restoration Project area. The Tehama Wildlife Area includes 46,900 acres of oak woodland, grasslands, and chaparral in which camping, hunting, and fishing are available activities. These two wildlife areas would not be directly affected by activities at the Restoration Project sites so are not discussed further in this section.

The national wildlife refuge closest to the Restoration Project area is the Red Bluff Diversion Dam Salmon Viewing Plaza (GORP 2001), located in Red Bluff, west of the Restoration Project area. The Red Bluff site would not be directly affected by activities at the Restoration Project sites; therefore, it is not discussed further in this document.

Parks

There are no national or state parks, reserves, historic parks, or recreation areas within the Restoration Project area (California Department of Finance 2000a). The closest national park is the Lassen Volcanic National Park, which lies east of the Restoration Project area. Lassen Volcanic National Park, located just north of the Sierra Nevada, contains 106,000 acres of forested foothills and volcanic relics. Popular recreational activities in the park include hiking, sledding, snowshoeing, and birdwatching. The state park closest to the Restoration Project area is the William B. Ide Adobe State Historic Park, located along the Sacramento River south of Redding.

Because these parks would not be directly affected by activities at the Restoration Project sites, they will not be discussed further in this document.

Water Bodies

Battle Creek

During the dry season, spring-fed Battle Creek has exceptionally high flows, making it important habitat for anadromous fish. Battle Creek is composed of two main branches, North Fork Battle Creek (about 29.5 miles in length from its headwaters to its confluence with the Sacramento River) and South Fork Battle Creek (about 28 miles in length from its headwaters to the same confluence). Both forks are made up of steady-flowing cold water, flow through deep gorges, and have relatively high flows even during dry seasons. Battle Creek also has a number of tributaries, including Soap, Ripley, and Baldwin Creeks.

Forebays

Three forebays are associated with the Hydroelectric Project.

Coleman Forebay. Coleman Forebay is the only forebay associated with the Hydroelectric Project located in the Restoration Project area. The 10.6-acre forebay is located to the north of the Coleman Powerhouse and Battle Creek. Picnicking, fishing, and berry picking are popular recreational activities for visitors. There are at least three points for public access for fishing and two areas designated for waterfowl hunting (PG&E 1969).

Lake Grace. Lake Grace is north of North Fork Battle Creek and is not within the Restoration Project area. Because its surface area is only 8.5 acres, Lake Grace has had limited recreational development. To maintain a sport fishery throughout the recreation season, the DFG typically plants sport-sized trout in Lake Grace several times per month, starting in April. In addition, there are day-use picnic facilities and sanitary facilities at the lake. Berry picking is another recreational activity at the lake. Because Lake Grace would not be affected by activities at the Restoration Project sites, it is not discussed further in this document.

Lake Nora. Lake Nora is north of North Fork Battle Creek and south of Lake Grace; it is not within the Restoration Project. Because its surface area is only 3.5 acres, it has had limited recreational development. To maintain a sport fishery throughout the recreation season, the DFG typically plants sport-sized trout in Lake Nora several time per month, starting in April. In addition, there are day-use picnic facilities and sanitary facilities at the lake. Berry picking is another recreational activity at the lake. Lake Nora would not be affected by activities at the Restoration Project sites and, therefore, is not discussed further in this document.

Reservoirs

The two storage reservoirs associated with the Hydroelectric Project are described below. Neither reservoir is within the Restoration Project area.

Macumber Reservoir. Macumber Reservoir is located on North Fork Battle Creek to the west of North Battle Creek Reservoir. It has a surface area of 127 acres and a storage capacity of 860 acre-feet. Macumber Reservoir has 12 camping units, including five that were upgraded from picnic units in the 1970s (PG&E 2003). A separate boat-launching facility is also located on the west shore of the reservoir. Macumber Reservoir would not be affected by activities at the Restoration Project sites and, therefore, is not discussed further in this document.

North Battle Creek Reservoir. North Battle Creek Reservoir has a surface area of 76 acres and a storage capacity of 1,012 acre-feet. The reservoir supports a cold-water trout fishery, which attracts a considerable number of anglers during the summer. Recreational facilities at the reservoir consist of 10 campsites with hookups for trailers and recreational vehicles, and five walk-in campgrounds (PG&E 2003). Services include access for car-top boats. Because access roads are often impassable during the winter and spring, recreational use of the reservoir is limited to the warmer months. Because North Battle Creek Reservoir would not be affected by activities at the Restoration Project sites, it is not discussed further in this document.

Wildlife Viewing Areas/Hatcheries

The Coleman National Fish Hatchery is located on Battle Creek just west of the Restoration Project and includes viewing of the chinook salmon and steelhead migrating up the Sacramento River from the Pacific Ocean. In addition to the hatchery, nine private trout-rearing facilities and one state-run facility are located within the Battle Creek watershed. The private hatcheries, which are operated by Mt. Lassen Trout Farms, Inc., raise rainbow and brown trout for stocking private ponds and lakes throughout California (Paquin-Gilmore 1999). These facilities do not directly interact with fish populations in Battle Creek, although the accidental downstream releases of fish may occur. The Darrah Springs Hatchery is a state-run facility located at Darrah Springs on Baldwin Creek. It raises catchable trout for sport fisheries and is a key hatchery in the DFG's inland fisheries program. Baldwin Creek connects the hatchery to Battle Creek.

Recreational Activities

The following section highlights some of the more popular recreational activities available in the Restoration Project area.

Fishing

Public Access. PG&E reservoirs, lakes, and streams are typically open to the public, except where operational, safety, and other requirements preclude recreational use. Correspondingly, there are numerous public access points for fishing in the vicinity of the Restoration Project area and at the Hydroelectric Project facilities. There is public access at Coleman Forebay, on Baldwin Creek near Ashbury Diversion Dam, on South Fork Battle Creek near Inskip Powerhouse, on the Cross Country Canal south of Volta Powerhouse 2, and along other canals in the Restoration Project area (PG&E 1969, 1978). In addition, there are other public access points for fishing within the Battle Creek watershed.

Fishing is also permitted on private land. Historically, some landowners have protected these upland areas from human disturbance by limiting access and by focusing land management on areas away from the water (Kier Associates 1999a). In 1997, fishing access on South Fork Battle Creek near the Inskip Powerhouse was eliminated when the private property owner closed the road to the public. However, more landowners have recently supplemented their incomes from agriculture and cattle ranching with the sale of trespass rights for fishing that allow public access for this activity (McCampbell pers. comm.).

Fishing in Canals. The extensive canal system for the hydropower facilities, including Cross Country Canal, South Canal, Union Canal, Inskip Canal, Eagle Canyon Canal, and Coleman Canal, supports juvenile and adult rainbow trout and other species (DFG 1966). Spawning habitat for rainbow trout within the canals is limited. The abundance of rainbow trout in the canals is dependent on entrainment of juvenile and adult rainbow trout from Battle Creek.

Regulations. The DFG regulates freshwater sport-fishing in California waters. The most current regulations, for the year 2003, will be effective from March 1, 2003, through February 28, 2004 (DFG 2003). Both Shasta and Tehama Counties, excluding Black Butte Lake, are considered for the regulations to be part of the Sierra District. Battle Creek is the only water body in the Restoration Project area with special fishing regulations. The Sierra District's general regulations apply to all other water in the area of the Restoration Project.

By special regulations, fishing in Battle Creek from its confluence with the Sacramento River to the Coleman National Fish Hatchery is prohibited all year. Fishing from 250 feet upstream from the hatchery to the Coleman Powerhouse is permitted from the last Saturday in April through September 30. Fishing is limited to one hatchery trout or one hatchery steelhead, taken only with artificial lures and barbless hooks (DFG 2003).

Regulations prohibit the take of salmon in all tributaries to the upper Sacramento River, including Battle Creek and its tributaries (DFG 2003). The special regulations also state that in the Sierra District, up to 10 brook trout that are less than eight inches in total length may be taken and possessed per day in addition to the other daily bag and possession limits. In Shasta and Tehama Counties, daytime and nighttime[1] fishing are permitted. However, no trout or salmon may be taken during nighttime hours.

Fish Stocking. To maintain sport fishing throughout the recreation season, fish are stocked in some of the water bodies in the Restoration Project area. The DFG typically plants sport-sized trout in South Fork Battle Creek. Rainbow trout have been stocked annually at various locations in North Fork Battle Creek since 1940, with the exception of 1947 and 1975, and at various locations in South Fork Battle Creek since 1946. Rainbow trout generally come from the Darrah Springs Fish Hatchery, although other hatcheries are occasionally used. Brook trout were stocked in North Fork Battle Creek on at least five separate occasions and in South Fork Battle Creek annually since 1990 and on two earlier occasions. In 1995, the DFG stopped stocking the anadromous waters of Battle Creek with hatchery trout. Coleman National Fish Hatchery also releases chinook salmon juveniles into Battle Creek. These fish, however, do not support sport fishing in Battle Creek; rather these fish support the larger ocean sport and commercial fishery and also a large recreational fishery in the mainstem of the Sacramento River.

Private parties also currently stock small quantities of fish in the Battle Creek watershed with the approval of the DFG. The Oasis Springs Lodge annually stocks 400 sterile rainbow trout into South Fork Battle Creek. Another resort owner stocks rainbow trout into the Hydroelectric Project's canals within the watershed. Stocking of Hydroelectric Project waterways, wherever it may occur, is not done with PG&E's knowledge, approval, or concurrence.

Fishing Guide Services. In addition to the public access areas discussed above, other privately owned areas are accessed for fishing on a limited basis. The Fly Shop, located in Redding, provides fishing and guide service to the Restoration Project Area through leases and exclusive rights from property owners (The Fly Shop 2001). This service includes fishing rights to an 8- to 9-mile stretch of Battle Creek, known as Battle Creek Ranch, extending from the confluence of North Fork and South Fork Battle Creek to just downstream of the Coleman National Fish Hatchery. Private-property owners have also provided The Fly Shop with fishing access to over a mile of spring-fed stream on Baldwin Creek and along Coleman Ditch, which has all of the characteristics of a spring creek and averages 15 feet across and 4 to 6 feet in depth.

Through The Fly Shop, anglers pay for trespass rights and for an optional guide service. Occupancy is limited to eight anglers per day. The fishing season on this privately owned portion of Battle Creek extends from May 15 to

[1]Daytime hours are defined as one hour before sunrise to one hour after sunset. Remaining hours are considered nighttime hours.

November 15 and the species fished is rainbow trout. Fishing is restricted to catch-and-release, barbless hooks, and fly-fishing.

Kayaking/Rafting

Kayaking is known to occur along some sections of Battle Creek. Rafting season typically runs from March (after snowmelt) through May or June.

Two sections of Battle Creek in the Restoration Project have been used for kayaking. The first is a 13-mile stretch from Manton Road to the Coleman National Fish Hatchery. The run begins at a public right-of-way at the Manton Bridge and ends at the hatchery. This section is considered primarily a Class III, or intermediate, run with one stretch that is considered a Class IV, or advanced, run (California Creekin' 2000). The second section is an 11.5-mile stretch along South Fork Battle Creek beginning east of South Diversion Dam near Ponderosa Way and passing Inskip Diversion Dam, Inskip Powerhouse, and Coleman Diversion Dam to Manton Road. This section is a Class V, or expert, run with a few areas that are considered unrunnable, including the areas near Inskip and Coleman Diversion Dams. At these points, kayakers leave the water and portage around the facility. Since the area is not listed in any official river rafting guidebooks, kayaking and rafting use in the area could not be quantified.

Hunting

California's range of game animals include deer, wild pig, bear, wild turkey, pheasant, grouse, quail, dove, duck, and goose. Hunting is permitted on BLM lands in accordance with state hunting regulations administered by DFG (DFG 2000b). These regulations also apply to hunting on private property.

Hunting occurs in the Restoration Project area. Because of the remote, rural nature of the area, hunting by landowners is assumed to be prevalent on private lands. Landowners have supplemented their incomes from agriculture and cattle ranching with the sale of access rights to hunters (McCampbell pers. comm.).

DFG allows hunting for deer, wild pig, and wild turkey at its Tehama Wildlife Area. As discussed above, the wildlife area is located near but not within the Restoration Project area. No wildlife areas or state-operated shooting areas are located within the Restoration Project. Target shooting is permitted on BLM lands and, therefore, may also occur in the Restoration Project (BLM 2001).

Lodging/Campgrounds

Only one lodging facility is located within the Restoration Project area. Oasis Springs Lodge is a 3,000-acre fly-fishing lodge and dude ranch located along South Fork Battle Creek just upstream of Inskip Diversion Dam. The lodge offers catch-and-release fly-fishing for rainbow trout. Other facilities include a spa, a pool, tennis courts, and nature trails. The lodge is typically open from May through mid-November.

The campground closest to the Restoration Project area is Camp Latieze, located in Manton. Owned by the Shasta County Department of Education, the camp is open year-round and can house up to 80 people in 10 rustic cabins. Activities in the camp include swimming, hiking, and wilderness studies. The camp would not be affected by activities at the Restoration Project sites.

Regulatory Setting

There are few regulations that apply to recreational activities. As described above, freshwater sport fishing along Battle Creek is subject to restrictions imposed by DFG. DFG also regulates hunting activity.

Environmental Consequences

Summary

No significant recreation impacts are associated with the No Action Alternative. Significant impacts are associated with all of the Action Alternatives (Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal). Disturbance would be limited to those areas associated with construction, modification, or removal activities, such as streambeds, stream banks, short-term and long-term access roads, staging areas, and Hydroelectric Project dam site facilities, conveyances, and appurtenant facilities. All of the Action Alternatives would result in a significant unavoidable construction impact on recreational opportunities at Oasis Springs Lodge. Otherwise, Reclamation will implement mitigation measures to reduce significant impacts to a less-than-significant level.

Impact Significance Criteria

For this analysis, based on the criteria contained in Appendix G of the State CEQA Guidelines, impacts would be considered significant if implementation of the Restoration Project would:

- Substantially reduce recreational opportunities in Shasta or Tehama County.
- Increase the use of existing recreational facilities such that substantial physical deterioration of a facility would occur or be accelerated.
- Include recreational facilities or require the construction or expansion of recreational facilities that may have an adverse physical effect on the environment.

Impact Assessment

As applicable, the General Environmental Commitments listed in the introduction to this chapter shall be utilized to reduce impacts on recreation. Specifically, commitments to postconstruction restoration will maintain the resources on which fishing is based. In addition, specific mitigation measures for this resource are identified below.

The Restoration Project does not propose any new recreational opportunities or facilities (nor expand any recreational opportunities or facilities) that would have an adverse physical effect on the environment. There would be no measurable increase in the use of wildlife refuges, parks, or other water bodies outside the Restoration Project area. The additional work force required to complete construction activities is not expected to exceed the normal variability in users of these recreational facilities. Because the majority of this work force would reside near the Restoration Project or in nearby cities and towns, no substantial, permanent increase in population would result from the project. As discussed previously, recreational activities and public access to Battle Creek are expected to experience a minimal increase. However, this increase cannot be quantified. Implementation of the Alternatives would not result in a significant increase in use of nearby recreational resources.

The impact assessment, therefore, will focus on the reductions to recreational opportunities that may result from the Restoration Project.

No Action Alternative

The No Action Alternative would not affect recreation. The No Action Alternative is not expected to result in any changes to the existing recreational resources in and around the Restoration Project area. Recreational activities such as hunting, fishing, boating, wildlife viewing, kayaking, hiking, and family recreation would continue as they are currently. Entrainment in the Cross Country, South, Union, Inskip, Eagle Canyon, and Coleman Canals would also continue to maintain rainbow trout abundance for local fishing.

Five Dam Removal Alternative (Proposed Action)

Impact 4.14-1 Significant and Unavoidable—Construction activities at Inskip Diversion Dam could reduce recreational opportunities at the Oasis Springs Lodge.

The Oasis Springs Lodge is a fly-fishing lodge and dude ranch located along South Fork Battle Creek near Inskip Diversion Dam. The lodge, which typically operates from May through mid-November, is noted for its remote location, quiet surroundings, unspoiled landscapes, and retreat-like atmosphere. Because construction activities at Inskip Diversion Dam could potentially extend from spring 2004 through fall 2006, the lodge could be affected during three operating seasons. Recreational activities at the lodge could be disturbed or disrupted by the neighboring construction-related activities. Temporarily increased vehicular traffic and increased noise levels could directly affect recreational use of the lodge (see Sections 4.9, "Transportation," and Section 4.10, "Noise"). Fishing would be disturbed if water flow is stopped by using temporary cofferdams or if flow is diverted or pumped to temporary holding ponds. Construction activities could result in reduced recreational opportunities offered by the Oasis Springs Lodge. This impact is considered significant. Implementing the following mitigation measure would reduce this significant impact, but not to a less-than-significant level.

Mitigation Measures for Impact 4.14-1. To reduce construction-related impacts on recreational activities offered by the Oasis Springs Lodge, Reclamation will notify the Oasis Springs Lodge as soon as possible and prior to construction activities of the anticipated start date, duration, and type of construction activities. Measures developed in consultation with the lodge operators will be implemented to further reduce direct impacts on recreational opportunities.

Impact 4.14-2 Significant—Construction activities could temporarily reduce recreational resources and activities.

The precise timing of proposed activities at the Battle Creek sites could potentially determine whether recreational activities are temporarily affected. Preliminary information on the proposed construction sequence shows a range of months in which particular activities could occur at a certain site. The construction sequence and schedule would be refined during final design. To the extent construction activities occur when participation in recreation is highest (i.e., during open fishing season), the proposed activities could temporarily reduce recreational opportunities. For example, if construction activities at a specific site occur during open fishing season, public access to some areas could be limited and the recreational activities could be adversely affected. Correspondingly, during construction at some Battle Creek sites, either water flow would be stopped using temporary cofferdams or flow would be diverted or pumped to temporary holding ponds. As a result, downstream flows could be reduced and temporarily affect downstream fishing. A reduction in recreational resources and activities as a result of proposed construction at the Battle Creek project sites is considered significant. Implementing the following mitigation measure would reduce this significant impact to a less-than-significant level.

Mitigation Measures for Impact 4.14-2. To reduce construction-related impacts on recreational activities near the Restoration Project area, Reclamation will implement the following measures:

- Nearby land and property owners will be notified prior to the onset of construction activities of the anticipated start date and duration of these activities.
- To the extent feasible, the duration of construction activities will be minimized during those periods when recreational activities would be affected.

Adequate notification of and collaboration with landowners and recreational interests would reduce impacts that the Five Dam Removal Alternative may have on recreational opportunities in Shasta or Tehama County.

Impact 4.14-3 Significant—Construction activities, including the use of equipment and storage areas, may temporarily impede public access to Battle Creek for kayaking and to private property where landowners may grant public access by selling hunting and fishing rights.

Construction activities at many of the Restoration Project sites would involve the use of heavy equipment to remove existing facilities and to construct new facilities. Equipment use could temporarily disrupt or obstruct access in some locations, temporarily limiting the public's ability to fully participate in and enjoy recreational activities or resulting in the need to find alternative routes to recreational resources along Battle Creek.

Some temporary obstructions would not result in significant impacts because the use of equipment would be localized to the immediate areas disturbed by construction, many of which are in remote areas, often on private land accessed by gated roads and away from public access areas. Impacts would potentially be greater at some sites like Inskip Diversion Dam, which is adjacent to Oasis Springs Lodge, where equipment use would be closer to recreational activities, public access, or other sensitive receptors. This impact is considered to be significant. Implementing the following mitigation measure would reduce this significant impact to a less-than-significant level.

Mitigation Measures for Impact 4.14-3. To reduce construction-related impacts on access to public and private recreational areas, Reclamation will implement the following measures:

- Nearby land and property owners will be notified prior to construction activities of the anticipated start date and duration of these activities.
- During construction periods, access roads will be posted with signs alerting recreationalists to the presence of construction machinery and activities and advising them of the anticipated start date and duration of these activities.
- Where practicable, heavy equipment will be stored alongside access roads and roadways to allow public passage.
- To the extent feasible, the duration of construction activities will be minimized when recreational activities would be most affected.

Impact 4.14-4 Less than Significant—Removing canals and installing fish screens to stop movement of fish into the remaining canals would virtually eliminate the resident trout populations and recreational trout fishing in the canals.

The Hydroelectric Project's extensive canal system is a recognized recreational trout fishery (DFG 1966). Although private land ownership limits public access, the fishery is used by landowners and fishing clubs. The canals have limited spawning habitat and are subject to annual dewatering for maintenance, which eliminates most of the fish population. During maintenance, most of the stranded fish are rescued and returned to the creek. Presently, the recruitment of new fish into the canal fishery is from Battle Creek via the unscreened diversions.

Under the Five Dam Removal Alternative, diversions at Wildcat, South, Soap Creek Feeder, Ripley Creek Feeder, and Coleman Diversion Dams would cease, and the construction of effective fish screens at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams (Table 4.1-4) would stop entrainment of rainbow trout in the canals. Rainbow trout abundance would likely be substantially less under the Five Dam Removal Alternative than under the No Action Alternative.

The reduction of rainbow trout abundance in the canals is considered less than significant because the canals do not constitute a stable ecosystem capable of producing a dependable fishery without recruitment from outside sources, such as entrainment of stream fish or stocking hatchery fish. In addition to entraining in the canals' populations of trout that are not self-sustaining, draining the canals for periodic maintenance also eliminates most of their rainbow trout populations. Most fish stranded in drained canals are rescued and released to Battle Creek. In addition, public access to the canals is not available in the Restoration Project area; therefore, the loss of this recreational opportunity would not result in a substantial reduction in recreation available in Shasta and Tehama Counties.

Under the Five Dam Removal Alternative, anadromous fish habitat in North Fork and South Fork Battle Creek would be restored, which would increase the abundance of trout in the nearby stream reaches and thus provide greater fishing opportunities. The substantial benefit of dam removal and fish screens to production of juvenile chinook salmon and steelhead (the anadromous form of rainbow trout) in Battle Creek is discussed in detail in Section 4.1, "Fish" (Entrainment section). In addition, the Five Dam Removal Alternative would maintain full flow of water in Coleman Canal, which has a limited amount of public access; therefore, recreational opportunities would not be eliminated at this location. As a result, the Five Dam Removal Alternative would have a less-than-significant impact on recreational trout fishing in the canals.

Impact 4.14-5 Beneficial—Increased flows in North Fork and South Fork Battle Creek could increase the opportunities for kayaking, rafting, and/or fishing activities.

Implementing the Five Dam Removal Alternative would result in increased flows in portions of both North Fork and South Fork Battle Creek. These increased flows could also result in beneficial impacts on recreational activities associated with using the creek for kayaking and rafting. Battle Creek is not listed in any official rafting guidebooks; therefore, the current usage for rafting and kayaking activities cannot be quantified. Increased recreational use of Battle Creek associated with increased flows is expected to be minimal because current use is relatively low and implementing this alternative would not directly result in Battle Creek being listed in any official rafting guidebooks.

After flows increase and new fish ladders and screens are constructed, populations of some fish species are expected to increase. This increased fish population could benefit recreational industries by providing more fish to catch and resulting in the creation of more fishing clubs, guide services, and commercial fisheries. As a result, increased fish populations could attribute to an increase in the number of people fishing in the area. Similar to kayaking and rafting discussed above, information on the current number of people fishing in the Battle Creek area is not available; therefore, the increased use of Battle Creek could not be quantified. While the number of people fishing in the area may increase, all commercial and sport fishing would continue to operate under strict fishing regulations until species listed under federal and state endangered species statutes have fully recovered and applicable fishing regulations have been modified. Fishing would also continue to be in compliance with the applicable DFG fishing regulations. While no change in fishing regulations would result directly from the implementation of the Five Dam Removal Alternative, increased sport fishing opportunities are consistent with the goals of the California Fish and Game Commission.

No Dam Removal Alternative

The No Dam Removal Alternative would leave the diversion dams in place and would involve the construction of new fish screens and ladders at six diversion dams (North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman). Although construction activities proposed for the No Dam Removal Alternative differ from the Five Dam Removal Alternative, construction-related impacts on recreational activities such as hunting, fishing, boating, wildlife viewing, kayaking, hiking, and family recreation would be similar.

Impact 4.14-6 Significant and Unavoidable—Construction activities at Inskip Diversion Dam could reduce recreational opportunities at the Oasis Springs Lodge.

This impact is similar to Impact 4.14-1 described under the Five Dam Removal Alternative. Under the No Dam Removal Alternative, a fish screen and ladder would be constructed at the Inskip Diversion Dam site. Because proposed construction activities could potentially extend from spring 2004 through fall 2006, the lodge could be affected during three operating seasons. This impact is considered significant. Implementing the mitigation measure recommended for Impact 4.14-1 would reduce this impact, but not to a less-than-significant level.

Impact 4.14-7 Significant—Construction activities could temporarily reduce recreational resources and activities.

This impact is similar to Impact 4.14-2 as described under the Five Dam Removal Alternative. As with the Five Dam Removal Alternative, the precise timing of construction activities proposed for the No Dam Removal Alternative could potentially determine whether recreational activities are temporarily affected. For example, if construction activities at a specific site occur during open fishing season, public access to some areas could be limited and the recreational activities could be adversely affected. Correspondingly, during construction at some Battle Creek sites, either water flow would be stopped using temporary cofferdams or flow would be diverted or pumped to temporary holding ponds. As a result, downstream flows could be reduced and temporarily affect downstream fishing. A reduction in recreational resources and activities as a result of proposed construction at the Battle Creek project sites is considered significant. Implementing the mitigation measure recommended for Impact 4.14-2 would reduce this significant impact to a less-than-significant level.

Impact 4.14-8 Significant—Construction activities, including the use of equipment and storage areas, may temporarily impede public access to Battle Creek for kayaking and to private property where landowners may grant public access by selling hunting and fishing rights.

This impact is similar to Impact 4.14-3 described under the Five Dam Removal Alternative. Construction activities proposed for the No Dam Removal Alternative would involve the use of heavy equipment to construct new fish screens and ladders. Equipment use could temporarily disrupt or obstruct access in some locations, temporarily limiting the public's ability to fully participate in and enjoy recreational activities or resulting in the need to find alternative routes to recreational resources along Battle Creek. This impact is considered significant. Implementing the mitigation measure recommended for Impact 4.14-3 would reduce this impact to a less-than-significant level.

Impact 4.14-9 Less than Significant—Installing fish screens to stop movement of fish into the canals would virtually eliminate the resident trout populations and recreational trout fishing in the canals.

The Hydroelectric Project's extensive canal system is a recognized recreational trout fishery as a result of trout becoming entrained in these canals. Although private land ownership limits public access to the canals, the fishery is used by landowners and fishing clubs. Under the No Dam Removal Alternative, fish screens would be installed at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman diversions, which would stop entrainment of rainbow trout in the canals. However, under the No Dam Removal Alternative, anadromous fish habitat in North Fork and South Fork Battle Creek would be restored by increasing instream flows, which would in turn increase the abundance of trout in the nearby stream reaches and thus provide greater fishing opportunities to the public. As a result, the No Dam Removal Alternative would have a less-than-significant impact on recreational trout fishing in the canals.

Impact 4.14-10 Beneficial—Increased flows in North Fork and South Fork Battle Creek could increase the opportunities for kayaking, rafting, and/or fishing activities.

Implementing the No Dam Removal Alternative would result in increased flows in portions of both North Fork and South Fork Battle Creek. These increased flows could also result in beneficial impacts on recreational activities associated with use of the creek for kayaking and rafting. Increased flows in Battle Creek, as well as the installation of new fish screens and ladders at the diversion dams, would contribute to the increase in some fish populations and therefore benefit recreational fishing. This beneficial impact is similar to Impact 4.14-5 described above under the Five Dam Removal Alternative.

Six Dam Removal Alternative

The Six Dam Removal Alternative would remove Eagle Canyon, Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams. Fish screens and ladders would also be installed at North Battle Creek Feeder and Inskip Diversion Dams under this alternative. Although construction activities proposed for the Six Dam Removal Alternative differ from the Five Dam Removal Alternative, construction-related impacts on recreational activities such as hunting, fishing, boating, wildlife viewing, kayaking, hiking, and family recreation would be similar.

Impact 4.14-11 Significant and Unavoidable—Construction activities at Inskip Diversion Dam could reduce recreational opportunities at the Oasis Springs Lodge.
This impact is similar to Impact 4.14-1 described under the Five Dam Removal Alternative. Under the Six Dam Removal Alternative, a fish screen and ladder would be constructed at the Inskip Diversion Dam site. Because proposed construction activities could potentially extend from spring 2004 through fall 2006, the lodge could be affected during three operating seasons. This impact is considered significant. Implementing the mitigation measure recommended for Impact 4.14-1 would reduce this impact, but not to a less-than-significant level.

Impact 4.14-12 Significant—Construction activities could temporarily reduce recreational resources and activities.
This impact is similar to Impact 4.14-2 as described under the Five Dam Removal Alternative. As with the Five Dam Removal Alternative, the precise timing of construction activities proposed for the Six Dam Removal Alternative could potentially determine whether recreational activities are temporarily affected. For example, if construction activities at a specific site occur during open fishing season, public access to some areas could be limited and the recreational activities could be adversely affected. Correspondingly, during construction at some Battle Creek sites, either water flow would be stopped using temporary cofferdams or flow would be diverted or pumped to temporary holding ponds. As a result, downstream flows could be reduced and temporarily affect downstream fishing. A reduction in recreational resources and activities as a result of proposed construction at the Battle Creek project sites is considered significant. Implementing the mitigation measure recommended for Impact 4.14-2 would reduce this significant impact to a less-than-significant level.

Impact 4.14-13 Significant—Construction activities, including the use of equipment and storage areas, may temporarily impede public access to Battle Creek for kayaking and to private property where landowners may grant public access by selling hunting and fishing rights.
This impact is similar to Impact 4.14-3 described under the Five Dam Removal Alternative. Construction activities proposed for the Six Dam Removal Alternative would involve the use of heavy equipment to remove existing facilities and to construct new fish screens and ladders. Equipment use could temporarily disrupt or obstruct access in some locations, temporarily limiting the

public's ability to fully participate in and enjoy recreational activities or resulting in the need to find alternative routes to recreational resources along Battle Creek. This impact is considered significant. Implementing the mitigation measure recommended for Impact 4.14-3 would reduce this impact to a less-than-significant level.

Impact 4.14-14 Less than Significant—Removing canals and installing fish screens to stop movement of fish into the remaining canals would virtually eliminate the resident trout populations and recreational trout fishing in the canals.
The Hydroelectric Project's extensive canal system is a recognized recreational trout fishery as a result of trout becoming entrained in these canals. Although private land ownership limits public access to the canals, the fishery is used by landowners and fishing clubs. Under the Six Dam Removal Alternative, fish screens would be installed at North Battle Creek Feeder and Inskip diversions, which would stop entrainment of rainbow trout in the canals. In addition, Eagle Canyon, Wildcat, and South Canals would be removed. However, under the Six Dam Removal Alternative, anadromous fish habitat in North Fork and South Fork Battle Creek would be restored by increasing instream flows, which would in turn increase the abundance of trout in the nearby stream reaches and thus provide greater fishing opportunities to the public. As a result, the Six Dam Removal Alternative would have a less-than-significant impact on recreational trout fishing in the canals.

Impact 4.14-15 Beneficial—Increased flows in North Fork and South Fork Battle Creek could increase the opportunities for kayaking, rafting, and/or fishing activities.
Implementing the Six Dam Removal Alternative would result in increased flows in portions of both North Fork and South Fork Battle Creek. These increased flows could also result in beneficial impacts on recreational activities associated with the increased use of the creek for kayaking and rafting. Increased flows in Battle Creek, as well as the installation of new fish screens and ladders at the diversion dams, would contribute to the increase in some fish populations and therefore benefit recreational fishing. This beneficial impact is similar to Impact 4.14-5 described above under the Five Dam Removal Alternative.

Three Dam Removal Alternative

The Three Dam Removal Alternative would remove Eagle Canyon, Wildcat, and Coleman Diversion Dams and retain Soap Creek Feeder and Lower Ripley Creek Feeder. Fish screens and ladders would also be installed at North Battle Creek Feeder, South, and Inskip Diversion Dams under this alternative. Although construction activities proposed for the Three Dam Removal Alternative differ from the Five Dam Removal Alternative, construction-related impacts on recreational activities, such as hunting, fishing, boating, wildlife viewing, kayaking, hiking, and family recreation, would be similar.

Impact 4.14-16 Significant and Unavoidable—Construction activities at Inskip Diversion Dam could reduce recreational opportunities at the Oasis Springs Lodge.

This impact is similar to Impact 4.14-1 described under the Five Dam Removal Alternative. Under the Three Dam Removal Alternative, a fish screen and ladder would be constructed at the Inskip Diversion Dam site. In addition, the tailrace connection between the South Powerhouse and the Inskip Canal would be an open channel, rather than the full-flow tunnel proposed under the Five Dam Removal Alternative. Because proposed construction activities could potentially extend from spring 2004 through fall 2006, the lodge could be affected during three operating seasons. This impact is considered significant. Implementing the mitigation measure recommended for Impact 4.14-1 would reduce this impact, but not to a less-than-significant level.

Impact 4.14-17 Significant—Construction activities could temporarily reduce recreational resources and activities.

This impact is similar to Impact 4.14-2 as described under the Five Dam Removal Alternative. As with the Five Dam Removal Alternative, the precise timing of construction activities proposed for the Three Dam Removal Alternative could potentially determine whether recreational activities are temporarily affected. For example, if construction activities at a specific site occur during open fishing season, public access to some areas could be limited and the recreational activities could be adversely affected. Correspondingly, during construction at some Battle Creek sites, either water flow would be stopped using temporary cofferdams or flow would be diverted or pumped to temporary holding ponds. As a result, downstream flows could be reduced and temporarily affect downstream fishing. A reduction in recreational resources and activities as a result of proposed construction at the Battle Creek project sites is considered significant. Implementing the mitigation measure recommended for Impact 4.14-2 would reduce this significant impact to a less-than-significant level.

Impact 4.14-18 Significant—Construction activities, including the use of equipment and storage areas, may temporarily impede public access to Battle Creek for kayaking and to private property where landowners may grant public access by selling hunting and fishing rights.

This impact is similar to Impact 4.14-3 described under the Five Dam Removal Alternative. Construction activities proposed for the Three Dam Removal Alternative would involve the use of heavy equipment to remove existing facilities and to construct new fish screens and ladders. Equipment use could temporarily disrupt or obstruct access in some locations, temporarily limiting the public's ability to fully participate in and enjoy recreational activities or resulting in the need to find alternative routes to recreational resources along Battle Creek. This impact is considered significant. Implementing the mitigation measure recommended for Impact 4.14-3 would reduce this impact to a less-than-significant level.

Impact 4.14-19 Less than Significant—Installing fish screens to stop movement of fish into the canals would virtually eliminate the resident trout populations and recreational trout fishing in the canals.
The Hydroelectric Project's extensive canal system is a recognized recreational trout fishery as a result of trout becoming entrained in these canals. Although private land ownership limits public access to the canals, the fishery is used by landowners and fishing clubs. Under the Three Dam Removal Alternative, fish screens would be installed at North Battle Creek Feeder, South, and Inskip diversions, which would stop entrainment of rainbow trout in the canals. However, under the Three Dam Removal Alternative, anadromous fish habitat in North Fork and South Fork Battle Creek would be restored by increasing instream flows, which in turn would increase the abundance of trout in the nearby stream reaches and thus provide greater fishing opportunities to the public. As a result, the Three Dam Removal Alternative would have a less-than-significant impact on recreational trout fishing in the canals.

Impact 4.14-20 Beneficial—Increased flows in North Fork and South Fork Battle Creek could increase the opportunities for kayaking, rafting, and/or fishing activities.
Implementing the Three Dam Removal Alternative would result in increased flows in portions of both North Fork and South Fork Battle Creek. These increased flows could also result in beneficial impacts on recreational activities associated with the use of the creek for kayaking and rafting. Increased flows in Battle Creek, as well as the installation of new fish screens and ladders at the diversion dams, would contribute to the increase in some fish populations and therefore benefit recreational fishing. This beneficial impact is similar to Impact 4.14-5 described above under the Five Dam Removal Alternative.

Cumulative Impacts

Cumulative recreational impacts associated with the Proposed Action and past, present, or probable future projects would likely benefit recreational opportunities in the Battle Creek watershed because other projects (including related projects described in Chapter 6) would contribute to restoring the conditions in Battle Creek. Long-term benefits would include increased opportunities for rafting, kayaking, and fishing.

The removal of dams and appurtenant facilities would remove the impediments restricting rafting and kayaking in certain areas along Battle Creek. In addition, implementing the Proposed Action would result in increased instream flows that could contribute to more people fishing in Battle Creek. The increased number of people participating in these recreational activities would likely result in increased requests for public access to the Battle Creek; however, access to Battle Creek must be obtained through other means and is not part of the Restoration Project. The related projects identified and discussed in Chapter 6, "Related Projects," do not appear to negatively affect recreational resources and activities and therefore do not contribute to a cumulative impact on recreation.

4.15 Cultural Resources

This section discusses the potential for the Restoration Project to affect cultural resources. The section describes the prehistory, ethnography, and history of the project region; study methods and results; the findings and conclusions of previous studies relevant to the Restoration Project; the effects of the Restoration Project on cultural resources; and available mitigation measures for effects to significant cultural resources.

This analysis is based on a cultural resources inventory, evaluation, determination of effect, and a Memorandum of Agreement (MOA) prepared by Reclamation pursuant to Section 106 of the National Historic Preservation Act (Section 106) and NEPA (West 2001; West and Welch 2000). The MOA is attached to this EIS/EIR in Appendix P.

Affected Environment

Prehistoric Context

The region's prehistory probably extends back more than 8,000 years although no direct evidence has been noted for the Battle Creek area. Other than a few minor archeological surveys, very little archeological work has taken place in the Battle Creek drainage. The prehistory of Battle Creek is probably very similar to nearby areas as they share similar environments and were most likely occupied by related populations.

Baumhoff (1957) provided one of the first temporal-cultural reconstructions for the Southern Cascade Mountain foothill region based on data recovered from Kingsley Cave and Payne Cave. He postulated a two-phase chronology, with the earlier prehistoric phase termed the Kingsley Complex and the following phrase termed the Mill Creek Complex. The major distinction between these two complexes was the difference in projectile point styles.

Since the late 1960s, investigations in the Southern Cascade region have resulted in the expansion and refinement of Baumhoff's interpretations. Based on the analysis of materials recovered from eight Southern Cascade sites, researchers from California State University, Sacramento, have postulated a five-phase chronological sequence that spans the last 4,000 years (Johnson n.d.). Johnson's (n.d.) phases, which incorporated Baumhoff's, are, from earliest to latest: Deadman, Kingsley, Dye Creek, Mill Creek, and Ethnographic Yana.

Ethnographic Context

At the time of contact, the Yana, a Hokan-speaking group, occupied the Battle Creek study area. The Yana inhabited the upper Sacramento River valley, and the foothills east of the Sacramento River and south of the Pit River and north of Pine and Rock Creeks (primarily along the Deer Creek drainage). The crest of the southern Cascades passing through Lassen Peak formed the eastern boundary. The Yanas' numbers probably never exceeded 2,000 individuals. Much of what is known about Yana culture was provided by Ishi, a Yahi Yana, who was brought to the University of California in 1911 after his family group died and he was left alone to survive.

The Yana lived in small bands that seasonally occupied villages and campsites along the perennial streams of the region. Gathering, fishing, and hunting provided subsistence and material resources. Manufacturing was restricted to stone, bone, and wood tools, and the weaving of baskets, nets, and bags.

The Yana suffered severely from Anglo-American contact. In 1844, Mexican land grants to Peter Lassen and Job F. Dye were established along the east side of the valley and extended into the foothills occupied by the Southern and Yahi Yana. Daniel Sill settled on part of the Lassen grant in 1846 (Johnson 1978:362). The first major hostility took place when Captain John Fremont attacked a peaceful gathering of Indians at a village on Bloody Island (at the mouth of Battle Creek) in the Sacramento River. Researchers attribute the village to the Yana (Johnson 1978.). This initial conflict marked the beginning of the end for the Yana. Johnson (1978) estimates that in approximately 20 years, their numbers were reduced from 1,900 individuals to fewer than 100. Today, while a few individuals claim Yana ancestry, there are no federally recognized Yana Indian tribes.

Historic Context

Although there were some early settlers, primarily sheep and cattle ranchers, in the area, they had little effect on the Battle Creek watershed. The area had no gold deposits and, therefore, was passed by the prospectors racing to the gold discoveries northwest of Battle Creek. The history of the area is related primarily to the history of hydropower in the region.

Hay (1991) provides a general historic context of hydroelectric power. Specific historical documentation of the Battle Creek hydropower system is provided in a number of documents. The Historic American Engineering Record (HAER) document contains a detailed account of hydroelectric development on the Battle Creek watershed (Reynolds and Scott 1980). Reynolds (1995) provides the most complete summary and analysis of the system and its management from 1900 to 1919. Reynolds and Scott (1980) provide a summary of PG&E operation of the system. Finally, several articles found in industry journals deal with components of the hydropower system (Van Norden 1910, 1911, 1912).

Development of hydropower on Battle Creek is the story of a small electric company that was eventually incorporated into a large utility company. The hydropower system was constructed originally to provide power to mines and smelters in the Keswick area.

In 1900, the property, water rights, and franchises to erect poles and transmit electricity were transferred from Shasta County to the Keswick Electric Power Company, the corporate predecessor of the Northern California Power Company (NCPC). In the fall of 1900, Keswick Electric Power Company began construction of a hydroelectric plant on North Fork Battle Creek. By 1901, the new plant, named Volta, began delivering power to Mountain Copper Company's smelters at Keswick. Over the next decade, the NCPC increased its Battle Creek generating capacity, expanding its first plant at Volta, and building three more plants, the South, Inskip, and Coleman Powerhouses, to become one of the largest electric utilities in northern California. In 1911, NCPC's complete system consisted of four hydroelectric plants, 15 storage and diversion dams, seven reservoirs, and more than 60 miles of artificial watercourses. Water collected from the Battle Creek watershed above Volta was passed successively through the Volta (1 & 2), South, Inskip, and Coleman Powerhouses, being used four different times (Reynolds 1995:16). The NCPC also expanded its customer base by providing power to cities, towns, and farms.

The second decade of the twentieth century was disastrous for the NCPC. Profits dropped, dividends were suspended, and interest debt increased on bonds used to finance construction and purchase Sacramento Valley Power. PG&E offered to purchase the system and NCPC stockholders approved the offer by a large majority in 1919. Thus, "...on April 1, 1919, Northern California Power Company, consolidated, joined a long list of electric utilities that vanished in the early 20th century due to either poor technological judgment or, as in NCPC's case, poor managerial judgment" (Reynolds 1995:21).

Between 1919 and 1979, PG&E made only a small number of major improvements to NCPC's Battle Creek hydroelectric system. The relative lack of change supports Reynolds' argument that it was poor management that led to NCPC's demise. Ultimately, the NCPC would have been absorbed into a larger system, possibly in the 1930s or 1940s (Reynolds 1995). Unattended, float-controlled, semiautomatic-automatic plants replaced the original powerhouses in 1980 and all old powerhouses and ancillary support structures were removed.

Nine diversion dams associated with the Battle Creek hydroelectric system are included as part of the Restoration Project. These diversion dams include North Battle Creek Feeder, Eagle Canyon, and Wildcat Diversion Dams on North Fork Battle Creek; South, Inskip, and Coleman Diversion Dams on South Fork Battle Creek; Asbury on the mainstem of Battle Creek; Lower Ripley Creek Feeder on Ripley Creek (a tributary to South Fork Battle Creek); and Soap Creek Feeder on Soap Creek (a tributary to South Fork Battle Creek). Each diversion dam is described in Chapter 3 of this report.

Regulatory Setting

Section 106 of the National Historic Preservation Act

Section 106 of the NHPA requires that, before beginning any undertaking, a federal agency must take into account the effects of the undertaking on historic properties and afford the Advisory Council on Historic Preservation an opportunity to comment on these actions. Specific regulations (36 Code of Federal Regulation [CFR] 800) regarding compliance with Section 106 state that, although the tasks necessary to comply with Section 106 may be delegated to others, the federal agency is ultimately responsible for ensuring that the Section 106 process is completed according to the provisions of 36 CFR 800. The Section 106 process has four basic steps:

1. initiation of the Section 106 process (define area of potential effects [APE] and scope of identification efforts),
2. identification of historic properties,
3. assessment of adverse effects to historic properties, and
4. resolution of adverse effects to historic properties.

California Environmental Quality Act

CEQA requires that public or private projects financed or approved by public agencies assess the effects of the project on historic resources. Historic resources are defined in the CEQA Guidelines as buildings, sites, structures, objects, or districts, each of which may have historical, architectural, archaeological, cultural, or scientific significance. CEQA states that if a proposed project would result in an effect that may cause a substantial adverse change in the significance of a historic resource, alternative plans or mitigation measures must be considered; however, only significant historical resources need to be addressed. Therefore, before mitigation measures are developed, the significance of cultural resources must be determined.

The steps normally taken in a cultural resources investigation for CEQA compliance are as follows:

1. identify cultural resources,
2. evaluate the significance of the resources,
3. evaluate the effects of a project on *all* cultural resources, and
4. develop and implement measures to mitigate the effects of the project on *significant* resources.

Methods

The methods employed in the cultural resources inventory consisted of a record search at the Northeast Center of the California Historical Resources Information System, implementation of an oral history program, examination of PG&E maintenance and building records, archival research at various repositories, consultation with Native Americans, and an intensive cultural resources inventory of the Restoration Project's APE (West and Welch 2000). Information gathered from prefield research was used to establish the cultural setting of the Restoration Project and to evaluate identified cultural resources.

Results and Identified Cultural Resources

The records search revealed that 54 prehistoric and historic sites had been previously recorded and only one large survey had been completed (Atwell and Bowyer 1992) in the vicinity of the Restoration Project. None of the surveys or sites occurred in the APE. Reclamation initiated consultation via notification letters with the Redding Rancheria, Berry Creek Rancheria, Enterprise Rancheria, and Mooretown Rancheria. Reclamation received no response from the rancherias (West and Welch 2000Reclamation subsequently contacted the Chico Band of Mechoopda Indians regarding the Restoration Project. Reclamation has received no response from the Chico Band of Mechoopda Indians to date (Welch pers. comm.).

Reclamation's inventory of the APE recorded two prehistoric sites (one campsite and one flake scatter and rock shelter); three historic sites and eight diversion dams were newly recorded. The prehistoric campsite also has an overlay of historic debris, primarily the old type of soldered tin cans (West and Welch 2000).

Prehistoric Sites

Flake Scatter and Rock Shelter

A flake scatter is present on the 20-degree slope extending from a small rock overhang near the Inskip Powerhouse. This site consists of an observed scatter of 60 basalt flakes, six basalt cores, an elliptical core, one unifacial retouched basalt flake, one corner-notched basalt projectile point, and two tertiary obsidian flakes. No cultural remains were found within the rock overhang.

Downslope of the main flake scatter are large flaking debris indicating primary and secondary reduction of fine-grained basalt. Surface scrapes revealed additional flakes were confined within the top ¾ inch (2 centimeters) of the surface.

Campsite

The campsite consists of a midden deposit on a terrace/fan of South Fork Battle Creek. Basalt flakes and fire-cracked rocks are present. The primary occupation is likely prehistoric, but other than the degree of midden development, direct evidence is lacking. An access road to South Diversion Dam and Canal bisects the site.

A number of soldered tin cans of a type dating to the early twentieth century are scattered over the southeastern quarter of the site. These cans probably are from the work camp for the construction of South Diversion Dam and Canal as the area is one of the few level surfaces nearby.

Historic Sites

South Battle Creek Diversion Dams and Canals

The South Battle Creek diversion dams and canals (South Diversion Dam and South Canal, Inskip Diversion Dam and Inskip Canal, Coleman Diversion Dam and Coleman Canal, and Asbury Diversion Dam) are described and photographed in Chapter 3 of this document. Discussion of modifications to these historic features is provided below under "Evaluation of Identified Cultural Resources."

North Battle Creek Diversion Dams and Canals

The North Battle Creek diversion dams and canals (North Battle Creek Feeder Diversion Dam and Cross Country Canal, Eagle Canyon Diversion Dam and Eagle Canyon Canal, Wildcat Diversion Dam and Wildcat Canal, Soap Creek Feeder, Lower Ripley Creek Feeder, and Penstock from Inskip Head Box to Inskip Powerhouse) are described and photographed in Chapter 3 of this report. Discussion of modifications to these historic features is provided below under "Evaluation of Identified Cultural Resources."

Other Historic Sites

Three additional historic-age sites (a rock wall, a rock pile, and a foundation) were recorded during fieldwork. These resources are not directly related to the diversion dams. Although the origin of the rock pile is unknown, it could represent the remains of quarry trimmings. The foundation, which is near the Inskip Powerhouse, must have served as some kind of support to the original facility or the community that once existed there.

Crescent-Shaped Rock Wall

This low rock wall is located on volcanic uplands approximately 550 feet north of the Inskip penstock and 2,400 feet north of the Inskip collector box. The site consists of a curved low rock wall that appears to have been partly filled, possibly to create a relatively flat platform. The wall, approximately 46 feet (14 meters) long and 2.5 to 3 feet (0.75 to 0.9 meters) high, is made of multiple courses of large country rock (basalt boulders and cobbles) three courses high.

Rock Pile/Quarry

The rock pile is an elliptical- to crescent-shaped pile of medium- to small-sized angular cobbles. The south side has been disturbed, possibly more recently by heavy equipment.

Immediately to the north of the rock pile about 30 feet is a bedrock outcrop composed of the same type of stone found in the rock pile. The face of the outcrop shows evidence of having been quarried. It can be reasonably assumed that the rock pile is the result of trimming quarried blocks that were being prepared for construction purposes, possibly in the manufacture of the rectangular blocks used to build structures at Inskip Powerhouse and Coleman Diversion Dam. A small, poorly preserved trail or road extends from the rock pile to the Inskip Powerhouse area.

Foundation

A structure foundation is located on South Fork Battle Creek upstream near the proposed alignment of the Inskip Powerhouse Tailrace. It consists of two adjacent parts, a partly dilapidated brick and mortar structure and a patio-like feature. The second part consists of a concrete-bordered, brick patio-like structure. The structure is adjacent to the brick remains and measures approximately 15 feet (4.6 meters) long by 21 feet (6.5 meters) deep.

Environmental Consequences

Summary

Significant impacts on cultural resources are associated with all alternatives except the No Action Alternative. The Five Dam Removal, Six Dam Removal, and Three Dam Removal Alternatives would result in significant and unavoidable impacts on cultural resources. Significant and unavoidable impacts would result from removal of Coleman, Eagle Canyon, Wildcat, and Inskip Diversion Dams. Significant and unavoidable impacts cannot be reduced to a less-than-significant level. Significant impacts would result from the installation of fish screens and fish ladders on significant cultural resources, as well as potential damage to a significant archaeological site. Reclamation will implement mitigation measures to reduce significant impacts resulting from project activities to a less-than-significant level.

Impact Significance Criteria

Section 106 of the National Historic Preservation Act and the National Environmental Policy Act

Because the NEPA and Section 106 processes were completed in parallel and because Section 106 provides clear guidance regarding effects (impacts) to historic properties, the criteria of resource significance and adverse effect (stipulated in 36 CFR 60 and 36 CFR. 800.5, respectively) were applied to the Restoration Project.

For federal undertakings, cultural resource significance is evaluated in terms of eligibility for listing in the NRHP. Specific NRHP significance criteria are applied to evaluate cultural resources and are defined in 36 CFR 60.4 as follows:

- The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and
- that are associated with events that have made a significant contribution to the broad patterns of our history; or
- that are associated with the lives of persons significant in our past; or
- that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- that have yielded, or may be likely to yield, information important in prehistory or history.

An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association (36 CFR 800.5[a][1]).

In order to retain its eligibility, a resource must retain its overall integrity, which is the ability of the property to convey its historic significance. The importance and applicability of the qualities of integrity listed above depend on the significance of the property and the nature of the character defining features that convey the significance.

The regulations further provide examples of adverse effects on historic properties:

- physical destruction of or damage to all or part of the property;

- alteration of a property that is not consistent with the Secretary of the Interior's standards for the treatment of historic properties (36 CFR 68) and applicable guidelines;
- removal of the property from its historic location;
- change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance;
- introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features;
- neglect of a property that causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; and
- transfer, lease, or sale of property out of federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance (36 CFR 800.5[a][2]).

California Environmental Quality Act

The CEQA statutes define a historical resource as "a resource listed or eligible for listing on the California Register of Historical Resources" (Public Resources Code [PRC] 5024.1; 14 California Code of Regulations [CCR] 15064.5). A historical resource may be eligible for inclusion in the California Register of Historical Resources (CRHR) if it:

- is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
- is associated with the lives of persons important to our past;
- embodies the distinctive characteristics of a type, period, region, or method of construction;
- represents the work of an important, creative individual; or possesses high artistic values; or
- has yielded, or may be likely to yield, information important to prehistory or history.

In addition, CEQA also distinguishes between two classes of significant archaeological resources: archaeological sites that meet the definition of a historical resource as above, and "unique archaeological resources." An archaeological resource is considered unique if it:

- is associated with an event or person of recognized significance in California or American history or of recognized scientific importance in prehistory;
- can provide information that is of demonstrable public interest and is useful in addressing scientifically consequential and reasonable research questions;

- has a special or particular quality such as oldest, best example, largest, or last surviving example of its kind;
- is at least 100 years old and possesses substantial stratigraphic integrity; or
- involves important research questions that historical research has shown can be answered only with archaeological methods (PRC 21083.2).

The CEQA Guidelines (14 CCR 15064.5[c]) state that the lead agency must treat an archaeological resource that meets the definition of a historical resource according to the provisions of PRC 21084.1, 14 CCR 15064.5, and 14 CCR 15126.4. If an archaeological resource does not meet the definition of a historical resource, but does meet the definition of a unique archaeological resource, the lead agency is obligated to treat the resource according to the provisions of PRC 21083.2 (14 CCR 15064.5[c][3]).

According to the CEQA Guidelines (14 CCR 15064.5), a project with an effect that may cause a substantial adverse change in the significance of a historical resource or a unique archaeological resource is a project that may have a significant effect on the environment (14 CCR 15064.5[b]). CEQA further states that a substantial adverse change in the significance of a resource means the physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of a historical resource would be materially impaired. Actions that would materially impair the significance of a historical resource are any actions that would demolish or adversely alter those physical characteristics of a historical resource that convey its significance and qualify it for inclusion in the CRHR or in a local register or survey that meets the requirements of PRC 5020.1(k) and 5024.1(g).

Evaluation of Identified Cultural Resources

Background

The hydraulic system that provides water to the Battle Creek powerhouses consists of diversion dams, canals, flumes, junction boxes, and penstocks. The canal system is composed of lined and unlined earthen canals, flumes, tunnels, and siphons. The following evaluation of the Battle Creek hydraulic system is considered within the larger contexts outlined in *Hydraulic Systems* (Hay 1991) and *Dams and Hydroelectric Technology in the American West: A Different Model* (Reynolds 1996). The eligibility status of each cultural resource identified by Reclamation is summarized in Table 4.15-1.

Table 4.15-1. Eligibility Status of Identified Cultural Resources

Cultural Resource	Eligible for Listing in the NRHP and CRHR?
South Diversion Dam and South Canal	No
Inskip Diversion Dam and Canal	Yes
Coleman Diversion Dam and Canal	Yes
Asbury Diversion Dam	No
North Battle Creek Feeder Diversion Dam and Cross Country Canal	No
Eagle Canyon Diversion Dam and Canal	Yes
Wildcat Diversion Dam and Canal	Yes
Soap Creek Feeder Dam	No
Lower Ripley Creek Feeder Canal	No
Penstock from Inskip Head Box to Inskip Powerhouse	No
Flake Scatter and Rock Shelter	No
Prehistoric/Historic Campsite	Yes

The utilitarian nature of the Battle Creek hydraulic system, with little exception, placed minimizing costs above other considerations. Large storage reservoirs were not required because of the relatively even flows in Battle Creek throughout the year. The dams were used to shunt water rather than to store it for later use. The Battle Creek hydraulic system used existing technology; no design elements were unique or innovative. Use of native rock and wood for construction economized on steel and concrete. Flumes were chosen over tunnels because of costs. However, in some instances, tunnels were selected over flumes despite costs because the tunnels would be more reliable and require less maintenance (Van Norden 1910). Despite emphasizing the cost-effective approach, the basic diversion and conveyance system design has survived because the original engineering was sound (Reynolds 1995).

Van Norden (1912:237), a consulting engineer for the NCPC, stated in a review of the hydraulic system that it “is a typical old-style California construction, dependable and simple.” The NCPC was “typical of many of the small power companies that emerged in the decades immediately following the development of electric power distribution (Reynolds and Scott 1980:6).” As Reynolds and Scott (1980:6) further point out, the Battle Creek hydroelectric system is important because it is “typical of the California electric power industry and representative of California hydroelectric practice at the turn-of-the-century.” Williams (1998:4–5) argues that “California’s electric power history involves internationally significant developments in fields such as high-head hydropower, long-distance power transmission, rural electrification, marketing, and resource conservation and regulation.”

Evaluation of Historical Significance

The historical significance of the Battle Creek hydraulic system cannot be evaluated in isolation from the entire hydropower system. As with any hydropower system, the hydroelectric generators are the key element of the Battle Creek system. The Battle Creek hydraulic system only offers support to the powerhouses, and no element or subsystem of the Battle Creek hydroelectric system exists in isolation. It is difficult to consider the diversion dams as a district in the absence of the original hydroelectric plants for which they were built.

By 1900, about 10 hydroelectric power systems were operating in California. Thus, while early, the Battle Creek hydroelectric system was not the first as it was not initiated until October 18, 1900, and the bulk of the system was not placed on line until 1910. The Battle Creek hydroelectric system also did not involve innovations, but instead relied upon proven, existing technologies.

The replacement concrete slab, bunker-like powerhouses, and the removal of all powerhouse-related structures have eliminated any feelings or association with the project's history. While there is "continuity of use" from the NCPC system to the modern-day system, there is no historic landscape and consequently no district here.

Initially, Battle Creek power was supplied directly to the Mountain Copper Company's smelters at Keswick. However, by 1911, with the addition of the South, Inskip, and Coleman Powerhouses, the NCPC had become one of the larger electric utilities in northern California. When the NCPC faltered in 1919, PG&E purchased the company. With relatively little change, PG&E continued to operate NCPC's hydroelectric generation system as part of its grid through the 1970s (Reynolds 1995).

In the late 1970s, PG&E replaced the four original power plants with new semiautomated plants. The original basalt masonry hydroelectric plants and their associated support facilities (e.g., housing, shops, storage, and garages) were demolished by 1980. Nothing of the original hydroelectric plants remains. The Battle Creek hydroelectric system has also been altered over time. Individual dams have been replaced, altered, rehabilitated, repaired, or raised. Table 4.15-2 depicts the modifications that each diversion dam has experienced.

Table 4.15-2. Summary of Major Repairs and Actions Substantially Altering the Integrity of Diversion Dams on North Fork and South Fork Battle Creek

Dam	Date	Description of Modification
Coleman	1923	Raise dam and install log boom.
	1932	Install radial spill gate and construct spillway.
	1936	Install radial gate in diversion dam.
	1938	Replace fish ladder.
	1978	Replace operating deck and walkway.
	not known	Cover downstream face with wire mesh and shotcrete.
	not known	Left abutment concrete block installed.
Eagle Canyon	1938	Install log boom at diversion dam; repair damage at canal head.
	1979	Repairs.
	1985	Modify fish ladder intake and replace fish ladder.
Inskip	1928	Fish ladder repaired and modified.
	1945	Replace headgate platform.
	1961	Replace headgate at dam.
	1984	Install cap on dam and install Alaskan fish ladder.
North Fork Feeder	1929	Raise dam.
	1939	Install hydraulic sluice gate control.
	1987	Install prefabricated steel fish ladder.
Lower Ripley	1929	Replace wooden diversion with concrete diversion.
	1944	Replace diversion on Ripley Creek.
Soap Creek	1933	Repair dam and flume.
	1936	Install concrete dam and sand trap at head of flume.
	1963	Replace sluice gate at dam.
	not known	Cover dam with gunite or shotcrete.
South	1927	Replace dam.
	1938	Replace timber crib dam and repair damage to dam.
	1941	Replace wood facing on radial gate with steel.
	1952	Repair diversion dam.
	1981	Replace diversion dam.
	1987	Repair right abutment.
Wildcat	1925	Construct permanent fish ladder around diversion.

Other alterations to the system have occurred. All of the original wooden flumes have been replaced with standard gage steel flumes. Scaffolding, walkways, and fish ladders have been added or replaced on most dams. Power lines have been replaced with modern structures and wire. Portions of the original unlined canals have been lined with gunite or similar concrete coatings. Major segments of the penstocks have been replaced. Thus, the Battle Creek hydroelectric system does not retain integrity of design, materials, or workmanship.

The modifications to the entire hydroelectric system of North Fork and South Fork Battle Creek preclude the possibility of considering the diversion dams and interlinking canals systems in a district format. Nothing exceptional or innovative in the design and construction of the dams, canals, tunnels, flumes, and penstocks indicates that the system as a whole is eligible. Thus, individual dams and other sites documented during fieldwork will be evaluated for possible inclusion in the NRHP and the CRHR under an individual site format.

South Diversion Dam

In past years, three previous diversion dams were at the current South Diversion Dam site. The first diversion dam was a masonry structure that was replaced with a timber crib structure in 1926–1927. The 1927 dam was replaced by a second diversion dam in 1938.

The South Canal flumes originally were constructed of wood carried on wooden trestles. Beginning about 1941, but mainly in the 1980s, the wooden flumes were replaced by steel ones with new concrete and foundations for the steel flume supports. A number of the canals have been lined with hand plaster and gunite within the last 50 years.

South Diversion Dam was replaced again in 1981 by a steel bin structure that has no historical significance; “continuity of use” is too much of a rationalization to consider it eligible for listing in the NRHP or the CRHR. Because the South Diversion Dam does not meet the eligibility criteria of the NRHP or the CRHR, the South Diversion Dam is neither a historical resource nor a historic property.

Lower Ripley Creek Diversion Dam

Lower Ripley Creek Diversion Dam (Ripley Creek Feeder) was constructed by PG&E in 1929 to replace a wooden dam and was replaced again in 1944. A weir was installed in 1952. A small piece of plywood serves as the gate. This very small concrete structure does not resemble the dam from the NCPC period other than that it is in the same location. It does not exhibit any important design or construction techniques. It is not associated with any historically significant person or event, nor does it qualify under any of the remaining NRHP or CRHR criteria. This resource therefore does not meet the definition of a historical resource nor is it a historic property.

Soap Creek Feeder Diversion Dam

Soap Creek Feeder Diversion Dam, as well as the associated pipeline and flume, have received five major changes and repairs since 1933, the most significant being the replacement of the sluice gate in 1963 and encasing the dam in gunite, which has affected the dam’s historical integrity. Like the Lower Ripley Creek Feeder Diversion Dam, Soap Creek Feeder Diversion Dam does not exhibit any important design or construction techniques and is not associated with any historically significant individuals or historical events. Other than their minor role as ancillary structures in the hydroelectric system, the recordation of these two very small feeder dams has yielded all the information they contain that is important to the history of the system. Therefore, the Soap Creek Diversion Dam is not eligible for listing in the NRHP or the CRHR and does not qualify as a historical resource or historic property.

Inskip Diversion Dam

Rising to a height of about 28 feet, Inskip Diversion Dam is the tallest of the dams in the Battle Creek APE. Constructed prior to 1910, Inskip Diversion Dam and Inskip Canal have retained their basic forms. In 1929, the fish ladder's pools were repaired and new pools were added. The dam's headgate was replaced in 1961. In 1984, an Alaska Steeppass fish ladder and a steel cap on the crest of the dam were installed. Other changes have included the automation of the intake gate for the Inskip Canal. The dam retains its rock rubble face and, with the exception of the fish ladders and motorized head gates, looks much as it did when constructed early in the twentieth century. However, the dam's historic setting or landscape has been severely compromised by a fishing resort on the south bank of the reservoir. Portions of the canal prism have been coated with gunite.

Because it is a simple rock-filled masonry structure, Inskip Dam has no outstanding engineering features that would make it eligible under criterion C of the NRHP or the third criterion of the CRHR. It has been modified and repaired and its fish ladders have been modified, so there is some question as to its historic integrity. The dam was an important part of the NCPC Battle Creek hydroelectric system and still functions as part of that same system today, yet the rest of the hydroelectric system has been so altered as to negate the dam's historical value as an element within a historic district.

J.A. Strutt and H.A. Tedford were the design engineers, and Hamden Holmes Noble was the president and prime mover behind the NCPC. Both Strutt and Tedford had important roles as engineers in northern California. Strutt had been the chief engineer for Pacific Power Company, and Tedford was the head of the NCPC engineering corps and apparently played an important role in the design and construction of the first three NCPC hydroelectric plants (Reynolds 1995). Noble, the largest stockholder in the NCPC, was involved in mining, smelting, promoting hydropower, and other business ventures, and had a significant role in the development of California's hydroelectric system. Thus, it appears that Inskip Diversion Dam is eligible under criteria A and B of the NRHP and the second and third criteria of the CRHR. Other than its specifications and recordation, the dam has yielded all the information important to history and is not eligible under criterion D of the NRHP and the fourth criterion of the CRHR. The Inskip Diversion Dam meets the definition of a historical resource for the purposes of CEQA and a historic property.

Coleman Diversion Dam and Canal

Coleman Diversion Dam and Coleman Canal are similar in construction to the other NCPC rubble masonry gravity dams. It has no outstanding engineering features that would make it eligible under criterion C. The dam has been altered from its original configuration (a concrete panel on the left abutment blocks the original fish ladder, its elevation has been raised, and crest and downstream surfaces have been covered with wire-reinforced shotcrete or gunite). The associated diversion structure is relatively unaltered masonry.

Coleman Diversion Dam, Canal, and Powerhouse were designed by Rudolph Van Norden (1866–1954). Van Norden had a long and impressive career. After graduating from Stanford in 1896, he became the chief engineer of the Central California Electric Company. When PG&E acquired that company, Van Norden became the division superintendent. In 1906, Van Norden set up a private practice as a consulting engineer. In the 1930s, he served as technical adviser to the U.S. Secretary of the Interior on the construction of Boulder (Hoover) Dam. During his lifetime, Van Norden designed 30 hydroelectric plants and 50 high dams and was successor to John S. Eastwood's business for the design and construction of multiple arch dams (Reynolds and Scott 1980). While the Coleman unit was a minor benchmark in his distinguished career, because of Van Norden's involvement, the Coleman unit would appear to be eligible under criterion B. The dam is also eligible under criterion A of the NRHP and the first criterion of the CRHR because of its importance in the NCPC hydroelectric system. Therefore, Coleman Diversion Dam meets the definition of a historical resource and a historic property.

Asbury Diversion Dam

Asbury Diversion Dam, which feeds the Coleman Canal, is a small auxiliary feature that has no outstanding or unique elements that would make it significant. It is a minor part of the hydroelectric system and is not associated with any important individual or persons. Because the Asbury Diversion Dam does not meet any of the eligibility criteria of the NRHP and the CRHR, it does not qualify as a historical resource or a historic property.

North Battle Creek Feeder Diversion Dam

The diversion dam, fish ladder, and flume have been repaired, replaced, or modified from their original condition. The dam was raised in 1929, a hydraulic sluice gate control was installed in 1939, a breast wall was added in 1985, and an Alaska Steeppass fish ladder was installed in 1987. The original wooden flume was replaced by the standard No. 96 steel flume. Old concrete foundations associated with the flume are visible in places.

North Battle Creek Feeder Diversion Dam has been altered significantly from its original design and does not retain sufficient integrity of the NCPC system to be historically significant. Because the North Battle Creek Feeder Diversion Dam does not meet the eligibility criteria of the NRHP and the CRHR, it does not qualify as a historical resource or a historic property.

Eagle Canyon Diversion Dam and Canal

PG&E made several repairs and replacements to Eagle Canyon Diversion Dam and Eagle Canyon Canal. These repairs included twice rebuilding and later replacing the access stairway in 1934, 1941, and 1980, respectively; repairing flood damage to the headwork structure of the canal in 1938; replacing the sluice gate and improving the sand trap in 1963; modifying the fish ladder intake in 1979; and repairing the radial gate at the diversion and replacing the fish ladder in 1985. Throughout this period, PG&E built and repaired the numerous pickup flumes that collected water from the many Eagle Canyon springs along North Fork Battle Creek and diverted the spring flow into the Eagle Canyon Canal.

Eagle Canyon Diversion Dam retains its basic form; however, the fish ladders, headworks, and access elements have all been modified or replaced. The dam has no exceptional engineering features but is associated with the original NCPC project proponents. Thus, it is concluded that Eagle Canyon Diversion Dam is eligible under criteria A and B of the NRHP and the first and second criteria of the CRHR. Eagle Canyon Diversion Dam therefore meets the definition for both a historic property and a historical resource.

Eagle Canyon Canal, however, retains no historical integrity because the flumes have been replaced by standardized steel flumes. Therefore the Eagle Canyon Canal does not meet the definition of a historical resource or a historic property.

Wildcat Diversion Dam and Canal

With an overall length of 55 feet and a crest height of about 8 feet, Wildcat Diversion Dam is one of the smallest diversion dams. It was constructed in 1923 to divert additional water to the Coleman Powerhouse, which was completed in 1911. A permanent fishway was constructed in 1925. The steel conduit apparently replaced a wooden flume in 1937.

The Wildcat Canal was constructed by PG&E in 1923 to provide additional flows to the Coleman Powerhouse. Before 1995, water was diverted through a 30-inch-diameter pipe in the right abutment section. From the pipe, a canal extends nearly 2 miles to its confluence with the Coleman Canal. In 1996, a rockfall damaged a section of the pipe about 1,000 feet downstream of the dam.

Although these features no longer function for their original purpose, their association with the Coleman Powerhouse and Van Norden would make the dam eligible under criteria A and B of the NRHP and the first and second criteria of the CRHR. It has no outstanding or distinctive characteristics that would make it eligible under criterion C of the NRHP or the third criterion of the CRHR. Wildcat Diversion Dam does not have any additional information, other than its recordation and location, which would make it eligible under criterion D of the NRHP or the fourth criterion of the CRHR. Because of its association with important historical figures and events, the Wildcat Diversion Dam qualifies as a historical resource and a historic property.

Wildcat Canal has been altered significantly from its original design and does not retain sufficient integrity of the NCPC system to be historically significant. The canal does not meet the eligibility criteria of the NRHP or the CRHR and, therefore, does not meet the definition of a historical resource or a historic property.

Inskip Powerhouse Headbox and Penstock

The Inskip Penstock is a 72-inch-diameter steel tube supported by concrete saddles on the flat upland and partially buried in rock masonry supports on the hill slope. The welded steel-tube penstock on the upland replaced an earlier wooden stave pipe and lap-riveted steel-pipe penstock. The hill slope penstock segment is the original riveted curved-plate pipe, which was formed and riveted together on site from prefabricated steel plates.

While the headbox has had some modifications, the entire original wooden stave section of the penstock that had been supported by rock rubble has been replaced with a steel tube supported by concrete foundations. The Inskip Powerhouse headbox and penstock do not retain the integrity to be considered a historic property or a historical resource.

Archeological Sites

Flake Scatter/Rock Shelter

The flake scatter extending from a small rock overhang near the Inskip Powerhouse contains a very limited expression of lithic technology, represented mainly by the reduction of local basalt cobbles. At least one elliptical biface/core was apparently manufactured on site. The activities conducted at this site were very limited, and little can be gained from additional study of this site. The absence of subsurface deposits, the apparent late prehistoric period of use indicated by the single projectile point, and the general lack of obsidian indicate that this site is not eligible under criterion D for inclusion in the NRHP, nor is it a historical resource for the purposes of CEQA, as the flake scatter/rock shelter does not meet the significance criteria of the CRHR. In addition, the flake scatter/rock shelter does not exhibit the outstanding qualities required by CEQA to be considered a unique archaeological resource.

Campsite

The prehistoric midden on a terrace/fan of South Fork Battle Creek is eligible under criterion D of the NRHP and appears to meet the fifth criterion of the CRHR, because the deposits undoubtedly contain scientifically consequential information on Battle Creek's prehistory. About 10% of the site's integrity has been compromised by a graded access road to South Diversion Dam that crosses through the site. The historic component of the site may provide additional information on the life in construction camps during the early twentieth century.

Other Historic Sites

The curved rock wall on the volcanic uplands near the Inskip penstock and collector box has no association that would make it historically significant and is such an insignificant feature that it is not eligible for inclusion in the NRHP or the CRHR.

The rock pile/quarry does not have sufficient association to qualify as a historic property or a historical resource.

The foundation near the proposed alignment of the Inskip Powerhouse tailrace connector is not eligible for listing in the NRHP or the CRHR because it retains no integrity, other than *in situ* fragments of a former structure, and the remains are not important for understanding NCPC history. That is, other than by their location, the concrete and brick remains add nothing to the history of the NCPC.

Impact Assessment

All alternatives except the No Action Alternative will have adverse effects on historic properties eligible for listing on the NRHP and significant impacts on historical resources under CEQA (Table 4.15-3). With the exception of the No Action Alternative, the alternatives share one or more adverse effect.

Table 4.15-3. Summary of Effects to Historic Properties by Alternative

	Alternative			
Action	No Dam Removal	Five Dam Removal	Six Dam Removal	Three Dam Removal
Construct Wildcat Diversion Dam fish screen and ladder.	Adverse	NA	NA	NA
Remove Wildcat Diversion Dam and appurtenant facilities.	NA	Adverse	Adverse	Adverse
Construct Eagle Canyon Diversion Dam fish screen and ladder.	Adverse	Adverse	NA	NA
Remove Eagle Canyon Diversion Dam and appurtenant facilities.	NA	NA	Adverse	Adverse
Construct North Battle Creek Feeder Diversion Dam fish screen and ladder.	No Effect	No Effect	No Effect	No Effect
Construct Coleman Diversion Dam fish screen and ladder.	Adverse	NA	NA	NA
Remove Coleman Diversion Dam and appurtenant facilities.	NA	Adverse	Adverse	Adverse
Construct Inskip Powerhouse bypass facility.	NA	No Effect	No Effect	NA
Construct Inskip Diversion Dam fish screen and ladder.	Adverse	Adverse	Adverse	Adverse
Construct Inskip Powerhouse tailrace connector.	NA	No Effect	No Effect	No Effect
Construct South Powerhouse tailrace connector tunnel.	NA	No Effect	No Effect	NA
Reoperate and gage Asbury Dam.	NA	No Effect	No Effect	No Effect
Construct South Diversion Dam fish screen and ladder.	No Effect	NA	NA	No Effect
Remove South Diversion Dam and appurtenant facilities.	NA	No Effect	No Effect	NA

Note: NA = not applicable

No Action Alternative

No changes would occur as the result of this alternative. The dams, canals, and fishways would continue to be affected by existing use and upgrades.

Five Dam Removal Alternative (Proposed Action)

Impact 4.15-1 Significant and Unavoidable—Removal of historic properties

The Five Dam Removal Alternative would adversely affect Coleman Diversion Dam and Wildcat Diversion Dam, which are considered to be historic properties under Section 106 and historical resources for the purposes of CEQA. Under the Five Dam Removal Alternative, Coleman Diversion Dam and Wildcat Diversion Dam would be removed. These impacts are considered significant and unavoidable because the dam removals would be irrevocable and would permanently alter the characteristics of the dams that convey their significance. Although this impact is considered significant and unavoidable under CEQA, implementing the following mitigation measure would meet Reclamation's Section 106 responsibilities.

Mitigation Measure for Impact 4.15-1. To comply with Section 106 of the NHPA, Reclamation has consulted with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation regarding the potential effects of the Restoration Project on significant cultural resources. An MOA between Reclamation and SHPO was prepared that outlines measures to mitigate the adverse effects to historic properties (see Appendix P).

Mitigation measures identified in the MOA include preparing HAER documentation for all eligible properties and seeking out and reproducing historic photographs and current and historic drawings for each property. A CD-ROM containing the interviews and summary report of the Battle Creek Watershed Conservancy's study (Paquin-Gilmore 2001) will be prepared and distributed to historical societies and other interested parties.

Impact 4.15-2 Significant—Historic properties would be adversely affected

The Five Dam Removal Alternative would adversely affect Eagle Canyon and Inskip Diversion Dams, which are considered to be historic properties under Section 106 and historical resources for the purposes of CEQA. A fish screen and ladder would be constructed at Eagle Canyon and Inskip Diversion Dams. These additions are considered significant impacts because adding new features to Eagle Canyon and Inskip Diversion Dams would alter the original configuration of the dams. Implementing the following mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measure for Impact 4.15-2. To comply with Section 106 of the NHPA, Reclamation has consulted with the SHPO and the Advisory Council on Historic Preservation regarding the potential effects of the Restoration Project on significant cultural resources. An MOA between Reclamation and the SHPO was prepared that outlines measures to mitigate the adverse effects to historic properties (see Appendix P).

Mitigation measures identified in the MOA include preparing HAER documentation for all eligible properties and seeking and reproducing historic photographs and current and historic drawings for each property. A CD-ROM containing the interviews and summary report of the Battle Creek Watershed Conservancy's study (Paquin-Gilmore 2001) will be prepared and distributed to historical societies and other interested parties. This mitigation measure reduces the impact to a less-than-significant level under CEQA.

Impact 4.15-3 Significant—Potential damage to archaeological deposits as a result of vehicular traffic

The Five Dam Removal Alternative has the potential to affect the prehistoric/historic campsite, which is a historic property under Section 106 and a historical resource under CEQA. Vehicular traffic along the South Diversion Dam access road would affect archaeological deposits associated with the prehistoric/historic campsite if vehicular traffic strayed from the road. Disturbance to archaeological deposits threatens the stratigraphic integrity of the site, which in turn degrades the information potential of the site. Such an effect would be considered a significant impact. Damage to the prehistoric/historic campsite would be reduced to a less-than-significant impact by implementing the following mitigation measure.

Mitigation Measure for Impact 4.15-3. Impacts on the prehistoric/historic campsite would be reduced by avoiding the site, as specified in Reclamation's determination of effect (West 2001). The access road will be flagged during construction and the contractor and construction crew will be instructed to prevent any traffic or activities beyond the flagging.

No Dam Removal Alternative

Impact 4.15-4 Significant—Historic properties would be adversely affected

This impact is similar to Impact 4.15-2. Under the No Dam Removal Alternative, fish screens and ladders would be constructed on Wildcat, Eagle Canyon, Coleman, and Inskip Diversion Dams, which are considered to be historic properties under Section 106 and historical resources for the purposes of CEQA. Similar to Impact 4.15-2 described above, this alternative would have a significant impact on historic properties because the new features would alter the original configuration of the dams. This impact would be reduced to a less-than-significant level by implementing the Mitigation Measure for Impact 4.15-2.

Impact 4.15-5 Significant—Potential damage to archaeological deposits as a result of vehicular traffic

This impact is similar to Impact 4.15-3. The No Dam Removal Alternative has the potential to affect the prehistoric/historic campsite located along the access road to South Diversion Dam as described under Impact 4.15-3. This campsite is a historic property under Section 106 and a historical resource under CEQA. This impact would be reduced to a less-than-significant level by implementing the Mitigation Measure for Impact 4.15-3.

Six Dam Removal Alternative

Impact 4.15-6 Significant and Unavoidable—Removal of historic properties

This impact is similar to Impact 4.15-1. The Six Dam Removal Alternative would adversely affect Coleman Diversion Dam, Eagle Canyon Diversion Dam, and Wildcat Diversion Dam, which are considered to be historic properties under Section 106 and historical resources for the purposes of CEQA. Under the Six Dam Removal Alternative, Coleman Diversion Dam, Eagle Canyon Diversion Dam, and Wildcat Diversion Dam would be removed. These removals are considered significant and unavoidable impacts because they would be irrevocable and would permanently alter the characteristics of the dams that convey their significance. Although this impact is considered significant and unavoidable under CEQA, implementing the Mitigation Measure for Impact 4.15-1 would meet Reclamation's Section 106 responsibilities.

Impact 4.15-7 Significant—Historic properties would be adversely affected

This impact is similar to Impact 4.15-2. The Six Dam Removal Alternative would adversely affect Inskip Diversion Dam, which is considered to be a historic property under Section 106 and a historical resource for the purposes of CEQA. A fish screen and ladder would be added to Inskip Diversion Dam. Similar to Impact 4.15-2 described above, this alternative would have a significant impact on a historic property because adding new features to Inskip Diversion Dam would alter the original configuration of the dam. Implementing the Mitigation Measure for Impact 4.15-2 would reduce this impact to a less than significant level.

Impact 4.15-8 Significant—Potential damage to archaeological deposits as a result of vehicular traffic

This impact is similar to Impact 4.15-3. The Six Dam Removal Alternative has the potential to affect the prehistoric/historic campsite located along the access road to South Diversion Dam as described under Impact 4.15-3. This campsite is a historic property under Section 106 and a historical resource under CEQA. This impact would be reduced to a less-than-significant level by implementing the Mitigation Measure for Impact 4.15-3.

Three Dam Removal Alternative

Impact 4.15-9 Significant and Unavoidable—Removal of historic properties

This impact is similar to Impact 4.15-1. The Three Dam Removal Alternative would adversely affect Coleman Diversion Dam, Eagle Canyon Diversion Dam, and Wildcat Diversion Dam, which are considered to be historic properties under Section 106 and historical resources for the purposes of CEQA. Under the Three Dam Removal Alternative, Coleman Diversion Dam, Eagle Canyon Diversion Dam, and Wildcat Diversion Dam would be removed. These removals are considered significant and unavoidable impacts because they would be irrevocable and would permanently alter the characteristics of the dams that convey their significance. Although this impact is considered significant and unavoidable under CEQA, implementing the Mitigation Measure for Impact 4.15-1 would meet Reclamation's Section 106 responsibilities.

Impact 4.15-10 Significant—Historic property would be adversely affected

This impact is similar to Impact 4.15-2. The Three Dam Removal Alternative would adversely affect Inskip Diversion Dam, which is considered to be a historic property under Section 106 and a historical resource for the purposes of CEQA. A fish screen and ladder would be added to Inskip Diversion Dam. Similar to Impact 4.15-2 described above, this alternative would have a significant impact on a historic property because adding new features to Inskip Diversion Dam would alter the original configuration of the dam. Implementing the Mitigation Measure for Impact 4.15-2 would reduce this impact to a less-than-significant level.

Impact 4.15-11 Significant—Potential damage to archaeological deposits as a result of vehicular traffic

This impact is similar to Impact 4.15-3. The Three Dam Removal Alternative has the potential to affect the prehistoric/historic campsite located along the access road to South Diversion Dam, as described under Impact 4.15-3. This campsite is a historic property under Section 106 and a historical resource under CEQA. This impact would be reduced to a less-than-significant level by implementing the Mitigation Measure for Impact 4.15-3.

Cumulative Impacts

The cumulative projects, programs, and studies that are related to the Proposed Action and that could potentially contribute to cumulative impacts in the project area are identified in Chapter 6, "Related Projects." The Proposed Action would significantly impact Wildcat, Eagle Canyon, Coleman, and Inskip Diversion Dams, all of which are considered historic properties and historical resources. The Proposed Action would also significantly affect one prehistoric/historic campsite. Therefore, the incremental effect of the Proposed Action on these cultural resources is considerable and the potential for cumulative impacts associated with these resources must be discussed.

The related projects presented in Chapter 6 would not result in significant cumulative impacts on historic properties or historical resources affected by the Proposed Action because none of these related projects would involve direct or indirect modification of the Proposed Action diversion dams. None of the cumulative projects or activities that could occur in the vicinity of the project area would involve direct or indirect impacts on cultural resources identified and evaluated for significance in the project area.

The evaluation of significance also indicates that the modifications to the entire Battle Creek hydroelectric system preclude the possibility of considering this hydroelectric system a historic district. Therefore, the cumulative impacts of past, present, and reasonably foreseeable projects on cultural resources within the project area are restricted to those historic or archaeological resources that would be affected by the Proposed Action, namely the diversion dams and the campsite. As stated above, no cumulative impacts on the diversion dams or the prehistoric/historic campsite would result from implementing related projects in the Battle Creek Watershed because none of these actions would involve direct or indirect impacts to cultural resources identified in the project area.

4.16 Other NEPA Analyses

This chapter includes a discussion of several topics that are required for NEPA analysis, but that are not required for CEQA analysis. These topics include Power Generation and Economics, Socioeconomics, Environmental Justice, and Indian Trust Assets. Under NEPA, an EIS must address economic and social effects.

Power Generation and Economics

Affected Environment

Facility Descriptions

PG&E operates hydroelectric facilities in the Battle Creek watershed. This set of facilities is operated under FERC license 1121 and is referred to as the Battle Creek Hydroelectric Project. PG&E has owned and operated the Hydroelectric Project since 1919. Between 1900 and 1912, Battle Creek was developed into one of the earliest hydroelectric systems in the western United States. The facilities consist of a series of small diversions, several long canals, and low-volume/high-head power generators. The system includes five hydroelectric powerhouses (Volta 1, Volta 2, South, Inskip, and Coleman Powerhouses) with a combined nameplate capacity of 36.3 megawatts (MW). The area served by the Hydroelectric Project has a summer peak load of approximately 157 MW and is growing at approximately 0.77 MW per year (0.5%) (California ISO 1998). Table 4.16-1 shows the normal operating capacity and historical average annual energy production from the Hydroelectric Project. Figure 4.16-1 shows the historical monthly power generation for Battle Creek facilities.

Table 4.16-1. Historical Generation Production 1975 through 1999

Powerhouse	Normal Operating Capacity (MW)	Average Annual Energy, Gigawatt hours (GWh)
Volta 1	9.0	53.3
Volta 2	0.9	6.7
South	7.0	50.1
Inskip	8.0	52.7
Coleman	13.0	82.5
Total	37.9	245.3

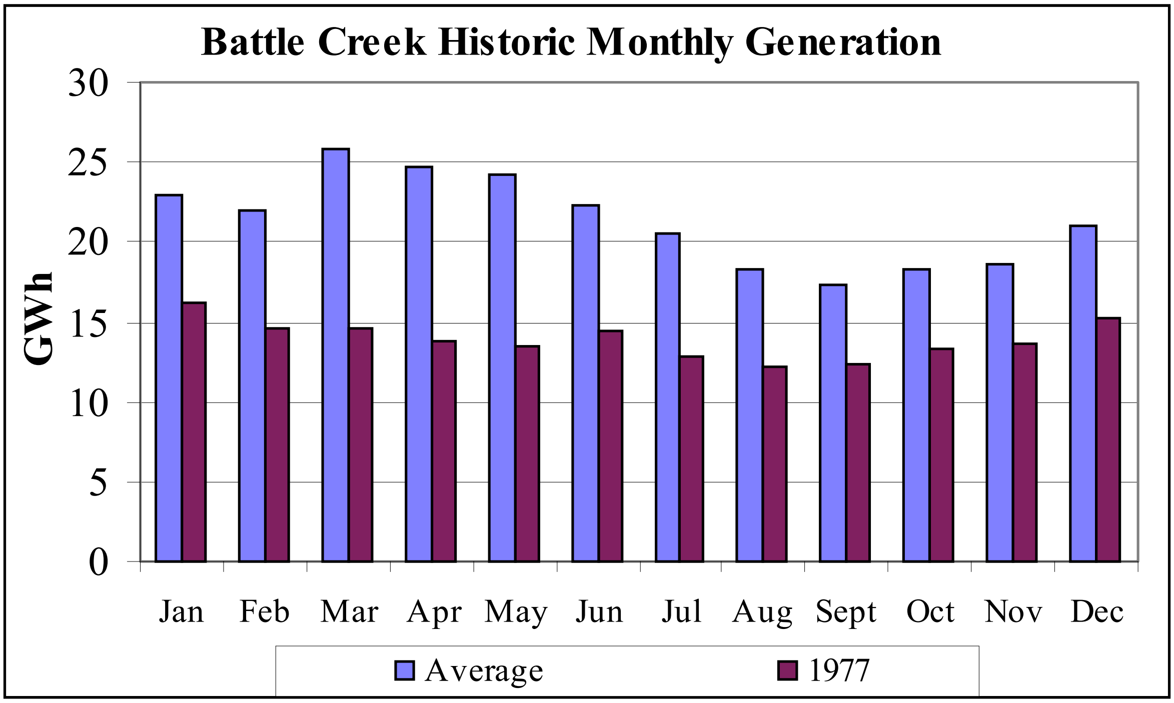


Figure 4.16-1. Historical Monthly Generation Production[1]

Flows from the upper reaches of North Fork Battle Creek are diverted via the Al Smith and Keswick diversions to Lake Grace and Lake Nora, where water is fed into the Volta 1 and Volta 2 Powerhouses for generation. The tailrace of Volta 2 connects directly to the Cross Country Canal, which transports water to South Fork Battle Creek for use in the South, Inskip, and Coleman Powerhouses. Water is also diverted from North Fork Battle Creek to powerhouses situated on South Fork Battle Creek via the North Battle Creek Feeder diversion, which diverts additional water into the Cross Country Canal, and via the Eagle Canyon diversion and canal, which transport water for use in the Inskip and Coleman Powerhouses. The Wildcat diversion and canal also divert water from North Fork Battle Creek to the Coleman Canal, where water is transported to the Coleman Powerhouse near the base of the watershed.

In upper South Fork Battle Creek, water is diverted at the South diversion for use in the South Powerhouse (along with diversions from the Cross Country Canal). The Inskip diversion diverts the outflow of the South Powerhouse and additional South Fork Battle Creek water to the Inskip Powerhouse. As noted above, the Inskip Powerhouse also receives North Fork Battle Creek water via the Eagle Canyon Canal. The Coleman diversion diverts the outflow of the Inskip Powerhouse and additional South Fork Battle Creek water to the Coleman Powerhouse from the Coleman Canal. The Coleman Canal also receives additional North Fork Battle Creek water directly from the Wildcat Canal. Several additional small diversions are scattered throughout the watershed,

[1] Critical dry year, 1977; historical production is prior to the construction of Volta 2 Powerhouse.

including diversions on Digger, Ripley, Soap, and Baldwin Creeks (see Chapter 3 descriptions). The flows of numerous springs are captured by a variety of measures for hydroelectric production.

No Action Alternative instream flow requirements for the watershed are described under Article 33 of the FERC license as maintaining a 3-cfs instream flow below all North Fork Battle Creek diversions and a 5-cfs instream flow below all South Fork Battle Creek diversions.

Volta 2 Powerhouse—Hydroelectric Turbine

Current instream flows, however, differ from the FERC license flows as a result of the 1998 Interim Flow Agreement, which provided for partial compensation to be paid to PG&E for power revenue forgone because of increased instream flows released at specific Hydroelectric Project diversion points. Under the terms of the Interim Agreement, which expired at the end of February 2001, PG&E provided the first 12.5 cfs released at Eagle Canyon and Coleman Diversion Dams. Releases at these sites in excess of 12.5 cfs, but not to exceed 35 cfs, were considered to be flows for which Reclamation would compensate PG&E. This Interim Flow Agreement reduces the average annual energy from the Hydroelectric Project by 18.45 GWh.

In addition to the augmented flows at the Eagle Canyon and Coleman diversions, PG&E suspended diversion of water from the Wildcat Diversion Dam. Reclamation compensated PG&E for 50% of the historical diversions at Wildcat Diversion Dam.

PG&E, Reclamation, and others are currently (April 2003) pursuing the development of a new interim agreement for augmented flows, similar to the previous agreements, that will bridge the time period until the Restoration Project measures have been implemented. In that new agreement, more focus is anticipated on North Fork Battle Creek, where the increased flows are more beneficial in terms of providing habitat for target species.

Regional Power Supplies

PG&E historically has had responsibility for generating, purchasing, transmitting and distributing electricity to its customers. However, with the start of the California competitive generation market in 1998, the California Power Exchange (CalPX) and Independent System Operator (ISO) were responsible for conducting a competitive bidding process for procuring electricity resources and for operating the transmission system throughout California to provide reliable electricity service at minimum cost. Soon after, the CalPX ceased to function in 2001, and DWR began purchasing power for the state's electricity consumers. PG&E resumed purchasing power for its customers in 2003. The Hydroelectric Project is operated in conjunction with PG&E's other generating resources to help meet the electricity demands of its customers.

Power Value Forecasts and Replacement Energy Cost

The alternative source of power currently available to PG&E is increased purchases. The latest California Energy Commission (CEC) Electricity Outlook report, published in February 2002, is a source of power value forecasts (California Energy Commission 2002). The CEC 2002–2012 Electricity Outlook report assesses California's electricity system over the next 10 years, focusing on supply and demand forecasts, reliability, wholesale spot market and retail prices, demand responsiveness, renewable generation initiatives, and environmental issues. The CEC conducted a simulated average annual wholesale spot prices for the years 2002, 2005, 2008, and 2012. Six scenarios were simulated and the average, on-peak, and off-peak prices for each year were generated.

The simulation yields an average wholesale price in 2002 in California of $34 to $37 [nominal $/MWh], depending on the extent to which demand returns to trend levels (levels before the summer of 2001). As large amounts of capacity are added during 2003–2005, prices fall. New, efficient combined cycles replace higher-cost steam turbines; expensive peaking units are needed in fewer hours of the year. As an adequate amount of transmission capacity is available to deliver energy from the Southwest into southern California, and from the Northwest into northern California, capacity additions in neighboring regions serve to lower prices in the state. Prices reach their low point in 2004–2005 as reserve margins in both the California ISO control area and the WSCC reach their peaks. As demand growth outpaces capacity addition after 2005, spot prices rise through 2012, their level depending on the extent to which reserve margins decline. (California Energy Commission 2002).

From an examination of daily and seasonal variations in prices, "the simulation yields monthly average wholesale prices that are lowest during May–June and higher during November–December than during the summer months" (California Energy Commission 2002).

The wholesale market price for electricity in any hour is set by the operating cost of the most expensive generation unit dispatched to meet demand (the "marginal unit") during that hour (Table 4.16-2). As new, efficient gas-fired capacity comes on line, reserve margins increase, reducing the need for older expensive units. This has the effect of reducing prices most in those periods in which the older expensive units were needed the most: peak hours during the summer. At the same time, maintenance rates for existing facilities have increased substantially during the past 2 years. As much of this maintenance is performed after prolonged operation during the summer, less-efficient plants are needed more often in November–December than would otherwise be the case. (California Energy Commission 2002).

Table 4.16-2. Average Annual Wholesale Spot Prices (Nominal $/MWh)

Average Price				
Scenario	2002	2005	2008	2012
High	$34	$27	$32	$37
Baseline	$35	$28	$32	$38
Low	$36	$29	$34	$40
Lower	$36	$30	$35	$41
Lowest	$36	$30	$36	$44
On Peak[2] Price				
Scenario	2002	2005	2008	2012
High	$42	$30	$35	$41
Baseline	$43	$31	$36	$42
Low	$45	$33	$38	$45
Lower	$45	$35	$40	$47
Lowest	$45	$35	$42	$51
Off Peak Price				
Scenario	2002	2005	2008	2012
High	$27	$24	$28	$34
Baseline	$27	$25	$29	$34
Low	$28	$25	$29	$35
Lower	$28	$26	$30	$36
Lowest	$28	$26	$31	$37

[2] Peak hours are Monday–Friday, 6 AM–10 PM

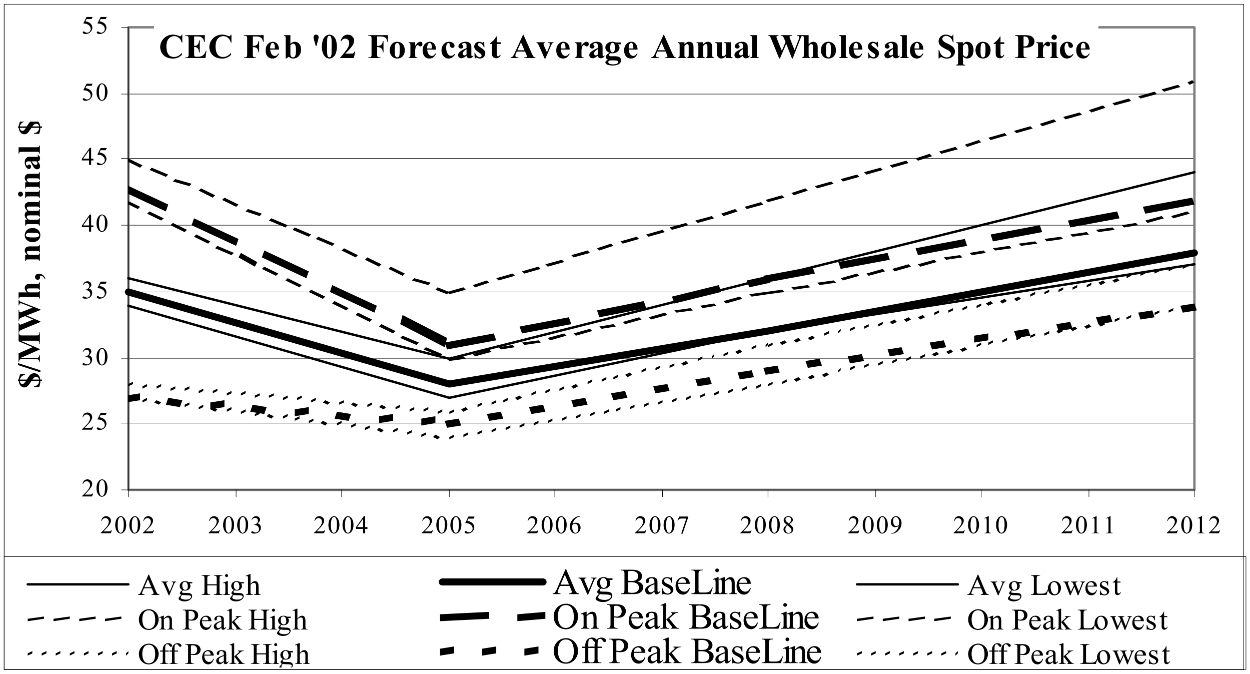


Figure 4.16-2
February 2002 Average Annual Wholesale Spot Price Forecast

From the above chart (Figure 4.16-2), the 2003 average annual wholesale spot price (average price for the baseline scenario) of about 3.4 cents will be deemed the current replacement energy cost. This forecast does not include capacity or ancillary services value. Because the Hydroelectric Project does not provide any significant ancillary services, no value for ancillary services will be included in the value of replacement power. However, a capacity value of about $75 per kilowatt (kW) per year at a 50% capacity factor (equivalent to about 1.71 cents per kilowatt-hour [kWh]) has been added to the energy values to develop a total replacement power cost of 5.11 cents per kWh. This replacement power cost of 5.11 cents per kWh will be used in the economic analyses in this EIS/EIR.

System Reliability

The Hydroelectric Project has been identified by California ISO as being needed for local system reliability. In 1998, a reliability must run (RMR) study was conducted by California ISO for the Hydroelectric Project.[3] The California ISO identified the Battle Creek area as covering the north central portion of Tehama County and the south central portion of Shasta County. The Battle Creek area is located east and south of Redding and includes the cities of Red Bluff, Los

[3] 1998 Five-Year RMR Study – Final Report and Study Data, Appendix 2 by Peter Mackin/Grid Planning, California ISO, September 1998

Molinos, and Whitmore. For both 1999 and 2003 modeling, the current transmission system configuration was used.

Internal generation in the Battle Creek Area consists of nine hydro generators (total maximum generation = 42.9 MW) and 12.6 MW of Qualifying Facility (QF) generation. Tables 4.16-3 and 4.16-4 show the internal generation facilities for the Battle Creek Area. (California ISO 1998).

Table 4.16-3. Battle Creek Area Load and Resources Modeled for 1999–2003 RMR Analysis

Year	1999	2003
Load		
Customer Load (MW)	157	163
Transmission Losses (MW)	7	9
Total Load + Losses (MW)	164	172
Generation—Dependable Operating Capacity		
Steam Turbines (MW)	0.0	0.0
Combustion Turbines (MW)	0.0	0.0
Hydro (MW)	42.9	42.9
QFs (historical levels) (MW)	7.0	7.0
Total Generation (MW)	49.9	49.9

Table 4.16-4. Battle Creek Area Generator Capacities

Name	Owner	River System	Nameplate Capacity (MW)
Inskip	PG&E	Battle Creek	8.0
South	PG&E	Battle Creek	7.0
Volta 1	PG&E	Battle Creek	9.0
Volta 2	PG&E	Battle Creek	0.9
Coleman	PG&E	Battle Creek	13.0
Kilarc Unit 1	PG&E	Cow Creek	1.6
Kilarc Unit 2	PG&E	Cow Creek	1.6
Cow Creek Unit 1	PG&E	Cow Creek	0.9
Cow Creek Unit 2	PG&E	Cow Creek	0.9
Total			42.9

Determination of Must Run Unit Requirements

An analysis of the Battle Creek RMR area was performed consistent with the Must Run Study Plan. The Battle Creek RMR area was analyzed using the 1999 and 2003 power flow and stability models. Loads in PG&E's Humboldt, North Valley, Sierra, and Sacramento Divisions were scaled to their area non-simultaneous levels to maximize the stress on the system. These load levels were selected to simulate the 1-in-5 heat-wave load levels that were called for in the RMR Study Criteria. The load levels used for each area are shown in Table 4.16-5.

Table 4.16-5. Load Scaling Factors Used for the Battle Creek Area

Division	1999 Base Case Load (MW)	1999 Non-Simultaneous Load (MW)	Increase	2003 Base Case Load (MW)	2003 Non-Simultaneous Load (MW)	Increase
Humboldt	91	123	35%	93	131	41%
North Valley	628	782	24%	672	815	21%
Sierra	879	990	13%	936	1091	17%
Sacramento	824	990	20%	881	1069	21%

Critical Contingency Analysis

The amount of required [RMR] generation for the Battle Creek area under conditions modeled in the 1999 and 2003 base cases is determined by a single transformer outage. For the Battle Creek Area this contingency was loss of the Cottonwood 230/60 kilovolt (kV) transformer (loss of the Cascade 115/60 kV transformer is also a very severe contingency). For this particular outage, the system limitation that determines the amount of required RMR generation is the loading on the remaining Cascade 115/60 kV transformer.

Contingency Analysis Summary

Table 4.16-6 lists branch loading and bus voltage for major contingencies in the Battle Creek Area that are affected by RMR units. There are a number of contingencies in PG&E's Sacramento, Sierra, and North Valley Divisions that result in violations of the RMR reliability criteria as well as PG&E's own internal Planning Criteria. As system performance during these outages is not affected by either the presence or absence of RMR generation, these particular outages are not listed in Table 4.16-6. In addition, for each scenario, Table 4.16-6 includes only the outages that caused the lowest bus voltage or highest branch loading.

As shown in Table 4.16-6, the minimum number of RMR units needed to meet the study criteria for the Battle Creek Area is nine. The contingency that determines this requirement is loss of the Cottonwood 230/60 kV transformer. (Table 4.16-6 also shows that loss of the Cascade 115/60 kV transformer is a very severe outage.)

Table 4.16-6. Battle Creek Area Must Run Study Contingency Analysis Results Summary

			Battle Creek Generation		Min. Voltage		Voltage Deviation (%)	Max. Line Loading		
Previous Contingency	Contingency	Year	QF (MW/# Units)	Hydro (MW/# Units)	p. u.	Bus		% Normal	% Emergency	Line
None	Open Cottonwood 230/ 60 kV Transformer [4]	1999	7.0/9	42.9/9	-	-	-	-	-	-
None	Open Cascade 115/ 60 Transformer	1999	7.0/9	42.9/9	0.96	Antler 60.0	-3.9	90.5	90.5	Cottonwood 230/ 60 kV Transformer
Coleman Unit Out (7 MW)	Open Cottonwood 230/ 60 kV Transformer 2	1999	7.0/9	42.9/9	-	-	-	-	-	-
Coleman Unit Out (7 MW)	Open Cascade 115/ 60 Transformer	1999	7.0/9	42.9/9	0.97	Antler 60.0	-3.6	99.8	99.8	Cottonwood 230/ 60 kV Transformer

Analysis of Off-Peak Load Case

The Battle Creek Area was analyzed using the 1999 Light Winter Must-Run base case. After shutting down all 10 Battle Creek Area units, the voltage at Kilarc 60 kV dropped to 1.104 power units (p.u.) from its pre-outage level of 1.116 p.u. All other buses in the Battle Creek Area exhibited similar performance. These results demonstrate that the Battle Creek area units are not needed during the off-peak for voltage control.

Load Management Alternatives

Table 4.16-7 shows the amount of load that would need to be dropped following a contingency in order to maintain reliability with a minimum of RMR contracts, for the Battle Creek Area. Because the transmission ties into the Battle Creek Area are weak, it is not possible to support all of the peak load in the area with no

[4] This contingency could not be solved with the power flow program. This situation indicates potential voltage collapse or dynamic instability for this contingency.

RMR generation. The amount of load management described below is based on the assumption of having no Cow Creek or Battle Creek units under RMR contracts.

The limiting contingency for this analysis was loss of the Cottonwood 230/60 kV transformer bank (because the other generation in the area is fairly minimal, no additional units were removed (i.e., this analysis did not look at overlapping outages). If this contingency were to occur, approximately 89 MW of load would need to be dropped in the Battle Creek Area to maintain branch loadings within ratings on the system.

The above analysis was performed by scaling all load in the area until the reliability criteria violations no longer occurred. Selective load tripping may reduce the amount of load tripping that is required, but such an analysis is beyond the scope of this study.

Table 4.16-7. Battle Creek Area Load Shedding Requirements

Scenario	Previous Outage	Load Shedding Required in 1999 (MW)	Load Shedding Required in 2003 (MW)
Loss of the Cottonwood 230/60 kV Transformer Bank[5]	None	89	97

Estimated Hours of Exposure

An analysis was performed to determine the approximate level of exposure to RMR reliability criteria violations if not all RMR units were not available. For this analysis, the load in PG&E's North Valley Division was reduced until all RMR reliability criteria violations no longer occurred. For the Battle Creek area, the worst contingency is an outage of the Cottonwood 230/60 kV transformer. For this outage the load level in the Battle Creek Area would need to be reduced to 42% of the area peak for all RMR criteria to be satisfied[6]. Using the 1997 load duration curve for the PG&E area, the percentage of time that the North Bay Area is at risk of RMR reliability criteria violations is 90%."

[5] The load shedding requirement was calculated by subtracting the Cascade 115/60 kV transformer rating and the remaining internal Battle Creek Area generation from the Battle Creek Area load for each year.

[6] For this analysis, the acceptable load level was calculated by dividing the rating of the Cascade 115/60 kV transformer bank by the peak load in the Battle Creek Area. In addition, voltage and dynamic stability were not checked for this analysis

Environmental Consequences

This section discusses power generation resource effects. Battle Creek hydroelectric power is a low-cost power-generating complex compared to other fossil-fueled generation facilities that might substitute for it, avoids some power plant air emissions, and contributes to a diversified generation resource mix. In addition, the Hydroelectric Project helps support the reliability of the local transmission system. If the electricity generating capacity of the Hydroelectric Project were replaced with fossil-fueled resources, greenhouse gas emissions could potentially increase by almost 35,000 metric tons of carbon per year.[7] Section 4.11 discusses the air quality consequences associated with the Restoration Project alternatives.

Assessment of Effects

This section assesses the effects of the action alternatives. For purposes of this analysis, the No Action Alternative is used as the environmental baseline. The No Action Alternative represents power production in the absence of the Interim Agreement. Effects are identified by comparing the components of each alternative to the No Action Alternative conditions. The significance of an effect is then assessed using the significance criteria. The Restoration Project alternatives are described more fully in Chapter 3, "Project Alternatives."

Hydroelectric Project capacity represents about 20% of the local electricity demand,[8] and about 0.1% of the California ISO market for the entire state of California. The load level in the Battle Creek area would need to be reduced to 42% of the area peak for all RMR criteria to be satisfied. This decrease in load is equivalent to about 91 MW. A reduction in generation capacity in excess of about 91 MW would be considered substantial. As the entire Hydroelectric Project output is only 42.9 MW, no Restoration Project alternative would result in a substantial effect on local or regional power supplies.

The ability to maintain low-cost, renewable, indigenous, and air emission–free hydroelectric power in the Battle Creek watershed is determined by maintaining the annual cost of Hydroelectric Project power at less than the annual replacement power costs. The annual Hydroelectric Project power costs and replacement power costs have been estimated using FERC's current cost method to derive the annual costs and benefits in 2003 dollars. This method uses current California electricity market conditions and current costs of owning and operating the Hydroelectric Project, plus the costs of implementing the Restoration Project alternatives. Future inflation and escalation of prices and costs are not considered.[9]

[7] Source of greenhouse gas emission from FERC's March 2003 Draft Environmental Impact Statement for Pit 3, 4, 5 Hydroelectric Project in Northern California
[8] 1998 Five-Year RMR Study – Final Report and Study Data, by Peter Mackin/Grid Planning, California ISO, September 1998
[9] See *Mead Corporation, Publishing Paper Division*, 72 FERC 61,027 (July 13, 1995).

The annual cost of project power includes all the costs of owning and operating a project. The Hydroelectric Project cost components include unrecovered past capital additions (e.g., the depreciated plant-in-service costs, or net book value), license amendment costs, future capital replacements, routine operations and maintenance costs, FERC fees, taxes, insurance, and the cost of implementing the Restoration Project alternatives. A fixed charge rate of 14% is used to annualize the costs of capital improvements (capital improvements have a service life in excess of 1 year and are repaid over time) and includes capital recovery (with a cost of capital of about 9%), taxes, and insurance costs. Expenses, such as payroll costs, are paid in the year the expenditure is made and do not include any tax or insurance component.

The net book value represents the cost of owning the facilities and reflects unrecovered past capital expenditures. The net book value of the Hydroelectric Project is currently $34.6 million. All of the other costs listed above represent future costs. An average of $300,000 per year is spent on capital additions for the Hydroelectric Project. Construction and decommissioning costs of the various Restoration Project alternatives are additional. The current annual operation and maintenance costs for the Hydroelectric Project total about $1.7 million per year. These costs would change under the various Restoration Project alternatives. In general, operation and maintenance costs increase with added facilities (i.e., fish screens, ladders) and decrease with removed facilities (i.e., decommissioned diversion dams). Cost allowances are also included for periodic storm damage repairs, one-time screen and ladder repairs, replacement power during construction, and PG&E's license amendment costs. Also shown are reimbursed forgone power costs and annual power benefits. The total cost of Hydroelectric Project power, net benefits, and cost of production are shown with and without the cost-sharing agreement of the MOU under the Five Dam Removal Alternative. Table 4.16-8 summarizes the annual cost of Hydroelectric Project power in 2003 dollars.

The annual cost of project power, on a cent–per-kWh basis, depends on the energy production from the project. The Hydroelectric Project's average annual energy production and dependable capacity are affected by the available stream flow (which varies with changing hydrologic conditions), minimum instream flow requirements, the scope of decommissioned facilities, and other environmental constraints such as ramping rates. The Hydroelectric Project historically has produced 245,300 MWh per year.[10] Table 4.16-9 summarizes the Hydroelectric Project's simulated average annual energy production and dependable capacity for the alternatives analyzed in this EIS/EIR.

Dependable capacity is the load-carrying ability of a hydroelectric plant under adverse hydrologic conditions for a specified time interval and period of a particular electric system load. Dependable capacity is based on a project's load-carrying ability during a dry hydrologic year coincident with the peak electric system load. Currently, the peak system load occurs during summer heat storms

[10] Actual average over the 25-year period of 1975–1999.

when the use of air-conditioning is high. Simply stated, if a powerhouse with flow-regulating capability has enough water to operate at its installed capacity for an average of 4–6 hours per day during July and August under dry hydrologic conditions, its dependable capacity is equal to its installed capacity. If sufficient water is unavailable and if a powerhouse cannot re-regulate the flow of water to match the system peak, its dependable capacity is less than its installed capacity. Because the Hydroelectric Project powerhouses are base-loaded facilities without significant water storage capabilities, dependable capacity declines with energy production. Table 4.16-9 summarizes the dependable capacity for the various alternatives.

Table 4.16-8. Detailed Cost of Project Power for the Hydroelectric Project

	No Action Alternative	Five Dam Removal Alternative	No Dam Removal Alternative	Six Dam Removal Alternative	Three Dam Removal Alternative
Average Annual Energy (GWh)	230.89	162.17	190.56	137.05	159.57
One-Time and Annually Recurring Cost Descriptions ($1,000s)					
Unrecovered Sunk Costs, or Net Book Value	$34,600	$34,600	$34,600	$34,600	$34,600
Future Capital Additions (per year)	$300	$300	$300	$300	$300
Operation and Maintenance (per year)	$1,700	$1,783	$1,880	$1,750	$1,947
Storm Repairs (every 10 years)	$500	$500	$500	$500	$500
Construct Screens and Ladders[11]	$0	$38,230	$45,560	$26,380	$32,850
One-Time Screen and Ladder Repairs	$0	$600	$1,200	$400	$600
Decommissioning Costs[12]	$0	$12,062	$0	$20,752	$17,590
Environ Compliance, Monitoring and Mitigation[12]	$0	$7,255	$7,255	$7,255	$7,255
MLTF Pathogen Problem Resolution[12]	$0	$2,329	$2,329	$2,329	$2,329
Future Water Acquisition	$0	$3,000	$3,000	$3,000	$3,000
Construction Outage Costs	$0	$1,259	$955	$841	$790
FERC License Amendment/EIS/EIR[12]	$0	$4,750	$4,750	$4,750	$4,750
Reimbursed Forgone Power (net present value)	$0	$2,080	$0	$0	$0
2003 Power Benefits (per year)	$11,798	$8,287	$9,738	$7,003	$8,154
FERC Current Cost Method (Annual cost in 2003 dollars; $1,000s/year)					
Unrecovered Sunk Costs, or Net Book Value	$4,844	$4,844	$4,844	$4,844	$4,844
Future Capital Additions	$427	$427	$427	$427	$427
Operation and Maintenance	$1,700	$1,783	$1,880	$1,750	$1,947
Storm Repairs	$140	$140	$140	$140	$140
Construct Screens and Ladders	$0	$5,352[1]	$6,819	$3,693	$4,599
One-Time Screen and Ladder Repairs	$0	$84	$168	$56	$84

[11] Reclamation updated construction cost estimated dated June 2003.

	No Action Alternative	Five Dam Removal Alternative	No Dam Removal Alternative	Six Dam Removal Alternative	Three Dam Removal Alternative
Decommissioning Costs	$0	$1,689[1]	$0	$2,799	$1,422
Environ Compliance, Monitoring and Mitigation	$0	$1,016	$1,016	$1,016	$1,016
MLTF Pathogen Problem Resolution	$0	$326	$326	$326	$326
Future Water Acquisition	$0	$420	$420	$420	$420
Construction Outage Costs	$0	$122	$93	$82	$77
FERC License Amendment/EIS/EIR	$0	$665	$665	$665	$665
Reimbursed Forgone Power	$0	$202[1]	$0	$0	$0
2003 Power Benefits	$11,798	$8,287	$9,738	$7,003	$8,154
FERC Current Cost Method (Annual net cost in 2003 dollars; $1,000s/year					
Total Cost of Power (including Net Book Value)	$7,111	$7,863 to $16,666[2]	$16,798	$16,218	$15,967
Going-Forward Cost of Power (excluding Net Book Value)	$2,267	$3,019 to $11,822[2]	$11,954	$11,374	$11,123
Total Net Benefits (including Net Book Value)	$4,688	$424 to -$8,379[2]	-$7,060	-$9,214	-$7,813
Net Benefits on a Going-Forward Basis (excluding Net Book Value)	$9,533	$5,268 to -$3,535[2]	-$2,216	-$4,370	-$2,969
Total Cost of Power ($/MWh)	30.8	48.5 to 102.8[2]	88.1	118.3	100.1
Going-Forward Cost of Power ($/MWh)	9.8	18.6 to 72.9[2]	62.7	83.0	69.7

Notes:
[1] These costs are paid by others (not PG&E) under the cost-sharing provisions of the MOU.
[2] First figure in range is with cost-sharing provisions of the MOU; second figure is without.

Table 4.16-9. Average Annual Energy, Dependable Capacity, Power Benefits, and Total Cost of Project Power for the Hydroelectric Project

Alternative	Average Annual Energy (MWh)	Dependable Capacity (MW)	Annual Power Benefits (2003 dollars)	Annual Total Cost of Hydroelectric Project Power (2003 dollars)
No Action Alternative	230,890	13.5	$11,798,000	$7,111,000
Five Dam Removal Alternative	162,170	7.4	$8,287,000	$7,863,000*
No Dam Removal Alternative	190,560	9.1	$9,738,000	$16,798,000
Six Dam Removal Alternative	137,050	6.3	$7,003,000	$16,218,000
Three Dam Removal Alternative	159,570	7.4	$8,154,000	$15,967,000

* With cost-sharing agreement of the MOU.

Summary of Effects

Estimated Generation, Power Benefits, and Cost of Project Power

Table 4.16-9 summarizes the estimated average annual energy, dependable capacity, annual power benefits, and the annual cost of power from the Hydroelectric Project under the various alternatives. Modeled energy production ranges from 230,890 MWh under the No Action Alternative to 137,050 MWh under the Six Dam Removal Alternative. Because the Hydroelectric Project is operated as a base-loaded facility, dependable capacity trends are similar to those for energy production. Dependable capacity ranges from about 13.5 MW under the No Action Alternative to 6.3 MW under the Six Dam Removal Alternative. Annual power benefits of the entire Hydroelectric Project range from $11,798,000 under the No Action Alternative to $7,003,000 under the Six Dam Removal Alternative. The total cost of project power ranges from $7,111,000 per year under the No Action Alternative to $16,798,000 per year under the No Dam Removal Alternative.

Table 4.16-10 summarizes the forgone generation and the increased cost of power for California electricity consumers under the various alternatives. The cost of power under the No Action Alternative is already reflected in customer rates and, therefore, has no incremental cost of power. Average annual generation would decrease by 40,330 MWh under the No Dam Removal Alternative, while forgone generation under the Six Dam Removal Alternative would be 93,840 MWh per year. California's electricity consumers would see an increase in the cost of power of about $2.3 million per year under the No Dam Removal Alternative. Under the Six Dam Removal Alternative, California's cost of power would increase by about $4.9 million a year. The increase in the cost of power under the Five Dam, Six Dam, and Three Dam Removal Alternatives would exceed $3 million per year.

Table 4.16-10. Forgone Generation and Increase in Cost of Power for the Hydroelectric Project

		Annual Increase in Cost of Power (2003 dollars)		
Alternative	Forgone Generation (MWh/year)	Replacement Power Cost for Forgone Generation	Increased Operation and Maintenance Costs	Total Increase in Annual Cost of Power
No Action Alternative	0	$0	$0	$0
Five Dam Removal Alternative	68,720	$3,512,000	$106,800	$3,618,800
No Dam Removal Alternative	40,330	$2,061,000	$228,200	$2,289,200
Six Dam Removal Alternative	93,840	$4,795,000	$66,300	$4,861,300
Three Dam Removal Alternative	71,320	$3,644,000	$121,400	$3,765,400

No Action Alternative

Under the No Action Alternative, the Hydroelectric Project would operate according to the provisions of its current FERC license. The Interim Agreement would cease, and the license-required minimum instream flows below dams of 3 cfs in North Fork Battle Creek and 5 cfs in South Fork Battle Creek would resume. Existing fish ladders would continue to be operated and maintained. Fish screening would not be included. PG&E would continue to maintain license-required stream gages, documentation, and operations criteria. Ongoing operation, maintenance, and capital expenditures would not change. All costs associated with this alternative would be the responsibility of PG&E. This alternative would not result in any effects to the cost of power.

Five Dam Removal Alternative (Proposed Action)

Effect—Increased cost of project power. Table 4.16-11 shows the incremental generation and cost-of-replacement-power effects of the Five Dam Removal Alternative as measured against the No Action Alternative. Average annual energy production is estimated to decrease by 68,720 MWh, and the dependable capacity would decrease by 6.1 MW. This decrease in energy production would likely increase the operation of fossil-fueled generating resources. The additional replacement power costs and increase in Hydroelectric Project operation and maintenance costs would, under cost-of-service ratemaking, increase California's annual cost of power by $3,618,800. The increased annual total and going-forward cost of Hydroelectric Project power, with the cost-sharing agreement, would still be less than the annual power benefits, demonstrating that the Hydroelectric Project would continue to be a low-cost source of electricity. Table 4.16-12 shows the cost of Hydroelectric Project power relative to the annual power benefits. The Five Dam Removal Alternative would not have an adverse effect on power generation and economics.

Table 4.16-11. Incremental Generation and Cost Effects of the Five Dam Removal Alternative as Measured against the No Action Alternative

		Change in California's Annual Cost of Power (2003 dollars)		
Change in Average Annual Energy (MWh)	Change in Dependable Capacity (MW)	Replacement Power Cost for Change in Generation	Increased Operation and Maintenance Cost	Total Change in Annual Cost of Power
(68,720)	(6.1)	$3,512,000	$106,800	$3,618,800

Table 4.16-12. Annual Cost of Hydroelectric Project Power and Power Benefits under the Five Dam Removal Alternative (2003 dollars)

Annual Cost of Hydroelectric Project Power[12]	Annual Power Benefits	Net Annual Power Benefits
$7,8635,000 total	$8,287,000	$424,000
$3,019,000 going forward	$8,287,000	$5,268,000

No Dam Removal Alternative

Effect—Increased cost of project power. Table 4.16-13 shows the incremental generation and cost-of-replacement-power effects of the No Dam Removal Alternative as measured against the No Action Alternative. Average annual energy production is estimated to decrease by 40,330 MWh, and the dependable capacity would decrease by 4.4 MW. This decrease in energy production would likely increase the operation of fossil-fueled generating resources. The additional replacement power costs and increase in Hydroelectric Project operation and maintenance costs would, under cost-of-service ratemaking, increase California's annual cost of power by $2,289,200. Table 4.16-14 shows the cost of Hydroelectric Project power relative to the annual power benefits.

Table 4.16-13. Incremental Generation and Cost Effects of the No Dam Removal Alternative as Measured against the No Action Alternative

		Change in California's Annual Cost of Power (2003 dollars)		
Change in Average Annual Energy (MWh)	Change in Dependable Capacity (MW)	Replacement Power Cost for Change in Generation	Increased Operation and Maintenance Cost	Total Change in Annual Cost of Power
(40,330)	(4.4)	$2,061,000	$228,200	$2,289,200

Table 4.16-14. Annual Cost of Hydroelectric Project Power and Power Benefits under the No Dam Removal Alternative (2003 dollars)

Annual Cost of Hydroelectric Project Power	Annual Power Benefits	Net Annual Power Benefits
$16,798,000 total	$9,738,000	($7,060,000)
$11,954,000 going forward	$9,738,000	($2,216,000)

The increased annual going-forward cost of project power would be more than the annual power benefits, demonstrating that the Hydroelectric Project would not be a source of low-cost electricity. In addition, the increased annual total cost of project power would be more than annual power benefits (i.e., PG&E would

[12] With cost sharing MOU in place.

not recover all of its past capital investments). The No Dam Removal Alternative would have an adverse effect on power generation and economics.

Six Dam Removal Alternative

Effect—Increased cost of project power. Table 4.16-15 shows the incremental generation and cost-of-replacement-power effects of the Six Dam Removal Alternative as measured against the No Action Alternative. Average annual energy production is estimated to decrease by 93,840 MWh, and the dependable capacity would decrease by 7.2 MW. This decrease in energy production would likely increase the operation of fossil-fueled generating resources. The additional replacement power costs and increase in the Hydroelectric Project's operation and maintenance costs would, under cost-of-service ratemaking, increase California's annual cost of power by $4,861,300. Table 4.16-16 shows the cost of Hydroelectric Project power relative to the annual power benefits.

Table 4.16-15. Incremental Generation and Cost Effects of the Six Dam Removal Alternative as Measured against the No Action Alternative

		Change in California's Annual Cost of Power (2003 dollars)		
Change in Average Annual Energy (MWh)	Change in Dependable Capacity (MW)	Replacement Power Cost for Change in Generation	Increased Operation and Maintenance Cost	Total Change in Annual Cost of Power
(93,840)	(7.2)	$4,795,000	$66,300	$4,861,300

Table 4.16-16. Annual Cost of Hydroelectric Project Power and Power Benefits under the Six Dam Removal Alternative (2003 dollars)

Annual Cost of Hydroelectric Project Power	Annual Power Benefits	Net Annual Power Benefits
$16,218,000 total	$7,003,000	($9,214,000)
$11,374,000 going forward	$7,003,000	($4,370,000)

The increased annual going-forward cost of project power would be significantly more than the annual power benefits, demonstrating that the Hydroelectric Project would not be a source of low-cost electricity. The increased annual total cost of Project power would also be more than annual power benefits (i.e., PG&E would not recover all of its past capital investments). The Six Dam Removal Alternative would have an adverse effect on power generation and economics.

Three Dam Removal Alternative

Effect—Increased cost of project power. Table 4.16-17 shows the incremental generation and cost-of-replacement-power effects of the Three Dam Removal Alternative as measured against the No Action Alternative. Average annual energy production is estimated to decrease by 71,320 MWh, and the dependable capacity would decrease by 6.1 MW. This decrease in energy production would likely increase the operation of fossil-fueled generating resources. The additional replacement power costs and increase in the Hydroelectric Project's operation and maintenance costs would, under cost-of-service ratemaking, increase California's annual cost of power by $3,765,400. Table 4.16-18 shows the cost of Hydroelectric Project power relative to the annual power benefits.

Table 4.16-17. Incremental Generation and Cost Effects of the Three Dam Removal Alternative as Measured against the No Action Alternative

		Change in California's Annual Cost of Power (2003 dollars)		
Change in Average Annual Energy (MWh)	Change in Dependable Capacity (MW)	Replacement Power Cost for Change in Generation	Increased Operation and Maintenance Cost	Total Change in Annual Cost of Power
(71,320)	(6.1)	$3,644,000	$121,400	$3,765,400

Table 4.16-18. Annual Cost of Hydroelectric Project Power and Power Benefits under the Three Dam Removal Alternative (2003 dollars)

Annual Cost of Hydroelectric Project Power	Annual Power Benefits	Net Annual Power Benefits
$15,967,000 total	$8,154,000	($7,813,000)
$11,123,000 going forward	$8,154,000	($2,969,000)

The increased annual going-forward cost of project power would be more than annual power benefits, demonstrating that the Hydroelectric Project would not be a source of low-cost electricity. In addition, the increased annual total cost of project power would also be more than the annual power benefits (i.e., PG&E would not recover all of its past capital investments). The Three Dam Removal Alternative would have an adverse effect on power generation and economics.

Socioeconomics

Affected Environment

The project area lies on the border of Tehama and Shasta Counties in northern California. The largest urban areas near the project area are Red Bluff, approximately 25 miles southwest in Tehama County, and Redding, approximately 30 miles northwest in Shasta County. The unincorporated community of Manton is located in Tehama County on the eastern edge of the project area near the border with Shasta County. The unincorporated community of Shingletown is located approximately 3 miles north of the project area in Shasta County. Table 4.16-19 summarizes the demographic characteristics of California, Tehama and Shasta Counties, Red Bluff, and Redding.

Table 4.16-19. State and County Demographics (2000)

	California	Tehama County	Shasta County	Red Bluff	Redding
Total population	33,871,648	56,039	163,256	13,147	80,865
Median household income in 1999 ($)	47,493	31,206	34,335	27,029	34,194
Median age	33.3	37.8	38.9	33.7	36.7
Unemployment (%)	4.0	6.4	5.6	6.6	4.5

Source: U.S. Census Bureau 2001a, 2001b

Regional Setting

Tehama County

Tehama County encompasses 2,951 square miles (1,888,670 acres) and is located in the north-central part of California, approximately 120 miles north of Sacramento.

Population. In January 2002, the California Department of Finance estimated the population of Tehama County at 56,900, which represented approximately 0.2% of the estimated California population. Tehama County ranks forty-first in population among California’s 58 counties. The majority of the population lives in rural areas or unincorporated cities. The largest city, Red Bluff, has a population of 13,350. The population has been relatively stable and is below the experienced average growth in California.

Demographics. Tehama County’s ethnic composition is 82.6% White; 12.1% Hispanic or Latino; 1.8% American Indian, Eskimo, or Aleut; 0.5% Black; 0.7% Asian; and 2.3% other. The median age in Tehama County is 37.8 years, about 4.5 years older than the median age in California as a whole (U.S. Census Bureau 2001b).

Employment and Income. Of the 34,537 people in the Tehama County civilian work force in 2000, 23,620 were employed (California Department of Finance 2002). The unemployment rate was 6.4%, 2.4% higher than the California average. Manufacturing, trade, and services were the largest non-government industries, employing approximately 10,050 people, or 40% of the employed work force. State and local government employed 3,260 workers, or 13% of total employment. Approximately 1,440 workers, or 6.1% of the employed work force, were involved in agricultural services.

In 1999, Tehama County had a per capita personal income of $18,879, ranking it fiftieth among California’s 58 counties. This figure was 83.1% of the state average of $22,711, and 87.5% of the national average of $21,587 (California

Department of Finance 2003). In 1988, the per capita personal income in Tehama County was $12,377, ranking the county fifty-fifth in California. Over the past 10 years, the average annual growth rate of per capita personal income was 3.6%. During this same period, the average annual growth rate for California was 3.6% and for the United States, 4.6%.

In 1998, Tehama County had a total personal income of $950,664,000, ranking it forty-third in California and accounting for 0.1% of the state total. In 1988, total personal income in Tehama County was $583,855,000 and ranked forty-third in California. Over those 10 years, the average annual growth rate of total personal income was 5.0%. During this same period, the average annual growth rate for California was 5.1% and for the United States, 5.6%.

Total personal income includes the earnings (wages and salaries, other labor income, and proprietors' income), transfer payments, dividends, interest, and rent received by the residents of Tehama County. In 1998, earnings constituted 55.0% of total personal income (compared with 57.1% in 1988); dividends, interest, and rent, 20.0% (compared with 21.8% in 1988); and transfer payments, 25.0% (compared with 21.2% in 1988). From 1988 to 1998, earnings increased an annual average of 4.6%; dividends, interest, and rent, 4.1%; and transfer payments, 6.7%.

Earnings of persons employed in Tehama County increased from $310,556,000 in 1988 to $488,503,000 in 1998, an average annual growth rate of 4.6%. The largest industries in 1998 were services, with 20.2% of earnings; state and local government, 19.0%; and retail trade, 17.1%. In 1988, the largest industries were durable goods manufacturing, with 19.0% of earnings; state and local government, 18.1%; and services, 16.7%. Of the industries that accounted for at least 5% of earnings in 1998, the slowest-growing industry from 1988 to 1998 was durable goods manufacturing (12.8% of earnings in 1998), which increased at an average annual rate of 0.6%. The fastest-growing industry was retail trade, which increased at an average annual rate of 8.1%.

Estimated nonagricultural wage and salary employment and number of establishments are indicated in Table 4.16-20.

Proprietors' employment and farm employment accounted for the additional 8,040 employees, or approximately 35.6% of the employed civilian work force not included in the wage and salary category. Farm employment totaled 2,741 workers in 1998, or approximately 1.2% of the employed work force.

Table 4.16-20. Tehama County Labor Statistics

Industry	Number of Establishments	Number of Employees
Construction and mining	116	380
Manufacturing	64	2,550
Transportation–utility	55	430
Trade	292	4,430
Finance, insurance, real estate	89	670
Services	354	2,900
Federal government		250
State and local government		2,950

Source: Bureau of Labor Statistics 1999

Sales. In 1998, total taxable sales were $397.6 million, of which $280.7 million was attributable to retail sales.

Housing and Social Services. Tehama County has more than 40 hotels, motels, and trailer parks; one hospital; and 120 health care and social assistance centers, including three emergency facilities. Red Bluff, the largest city in the county, has a housing inventory of 3,415 single-family residences, 1,727 multifamily residences, and 304 mobile homes (California Department of Finance 2000b).

Agriculture. Tehama County is predominantly rural in nature with approximately 47% of the total land area in agricultural production. In 1997, there were 1,362 farms; approximately 57% of these farms operated on 50 acres or less. Total farm production for 1997 was $107,102,000, an increase from the 1992 figure of $95,041,000. Approximately 51% of the farms sold $10,000 or less of market production in 1997. This indicates that farming was not the sole revenue source for the majority of operators. Table O-1 in Appendix O compares 1992 and 1997 agricultural production statistics for Tehama County.

Shasta County

Shasta County encompasses 3,786 square miles (2,422,820 acres) and is located in the extreme northern end of the Sacramento Valley, equidistant from Los Angeles and Seattle on Interstate 5. It is 160 miles north of Sacramento and 230 miles northeast of San Francisco. The incorporated cities in Shasta County are Anderson, City of Shasta Lake, and Redding, the county seat. Bisected by the Sacramento River, Redding is a growing center of commerce and industry and the nationally recognized metropolitan marketplace of northern California, serving the adjacent counties of Tehama, Trinity, and Siskiyou.

Population. The 2002 population of 169,200 ranked Shasta County twenty-ninth among California's 58 counties. The growth rate for 2001 was 1.5%. The population in 1990 was 147,036, indicating an average annual growth rate between 1990 and 2002 of 1.4%.

Demographics. Shasta County's ethnic composition is 88.9% White; 4.4% Hispanic or Latino; 2.2% American Indian and Alaska Native; 0.6% Black; 1.5% Asian; and 2.4% other. The median age in Shasta County is 38.9 years, 5.6 years older than the median age in California as a whole. (U.S. Census Bureau 2001a.)

Employment and Income. In 1999, the civilian work force was composed of 75,000 workers; 69,800 of these workers were employed. The unemployment rate was 6.9%, which was higher than the California average of 4%.

In 1998, Shasta County residents had a per capita personal income of $21,986, which ranked the county thirty-first of California's 58 counties. This figure was 78% of the state average of $28,163, and 81% of the national average of $27,203. In 1988, the per capita personal income of Shasta County was $15,301, ranking the county thirty-fifth in California. The average annual growth rate of per capita personal income in Shasta County over the past 10 years was 3.7%. The average annual growth rate for California was 3.6% and for the United States, 4.6%.

In 1998, Shasta County had a total personal income of $3,609,108,000, ranking the county thirtieth in California and accounting for 0.4% of the state total. In 1988, the total personal income in Shasta County was $2,090,568,000 and ranked thirty-first in California. Over those 10 years, the average annual growth rate of total personal income in Shasta County was 5.6%. During this same period, the average annual growth rate for California was 5.1% and for the United States, 5.6%.

In 1998, earnings constituted 58.7% of total personal income (compared with 60.8% in 1988); dividends, interest, and rent, 19.7% (compared with 20.6% in 1988); and transfer payments, 21.6% (compared with 18.7% in 1988). From 1988 to 1998, earnings increased an annual average of 5.2%; dividends, interest, and rent, 5.2%; and transfer payments, 7.2%.

Earnings of persons employed in Shasta County increased from $1,352,812,000 in 1988 to $2,249,599,000 in 1998, an average annual growth rate of 5.2%. The largest industries in 1998 were services, with 30.3% of earnings; state and local government, 15.9%; and retail trade, 12.5%. In 1988, the largest industries were services, with 24.6% of earnings; state and local government, 16.6%; and retail trade, 12.5%. Of those industries that accounted for at least 5% of earnings in 1998, the slowest-growing industry from 1988 to 1998 was durable goods manufacturing (6.2% of earnings in 1998), which increased at an average annual rate of 1.3%. The fastest-growing industry was services, which increased at an average annual rate of 7.4%.

Estimated nonagricultural wage and salary employment and number of establishments are indicated in Table 4.16-21.

Table 4.16-21. Shasta County Labor Statistics

Industry	Number of Establishments	Number of Employees
Construction and mining	568	3,600
Manufacturing	245	4,200
Transportation–utility	227	3,900
Trade	1,280	14,500
Finance, insurance, real estate	348	1,800
Services	1,631	18,500
Federal government		1,200
State and local government		9,800

Source: Bureau of Labor Statistics 1999

Proprietors' income and farm employment accounted for the additional 10,300 employees, or about 15.2% of the employed civilian work force not included in the wage and salary category. In 1998, farm employment totaled 1,584 workers, or approximately 2.3% of the employed work force.

Sales. Total taxable sales in 1998 were $1,654,100,000; retail sales accounted for $1,161,500,000 of that amount.

Housing and Social Services. In 1999, the housing stock in Shasta County was composed of 71,042 units (47,633 single family residences; 11,136 multifamily residences; and 12,273 mobile homes and trailers). The vacancy rate was 7.4% and the standard housing cost of living index was 101.65%.

Shasta County has approximately 40 motels and hotels, 12 major shopping areas, and two major hospitals (with 368 physicians and surgeons).

Agriculture. Shasta County is predominantly rural in nature with approximately 13% of the total land area in agricultural production. In 1997, there were 850 farms with approximately 61% on 50 acres or less. Total farm production for 1997 was $31,349,000, a decrease from the 1992 figure of $33,198,000. Seventy percent of these farms sold $10,000 or less of market production in 1997. This indicates that farming was not the sole family revenue source for the majority of operators. Table O-2 in Appendix O compares 1992 and 1997 agricultural production statistics for Shasta County.

Local Setting

Demographics

The study area falls within two census tracts (CTs): CT 1 in Tehama County and CT 126.02 in Shasta County. Two census designated places (CDPs) occur within or near the study area. The Manton CDP includes a portion of the study area near the community of Manton. The Shingletown CDP is located outside of the study area, but is included because of its close proximity. Tables 4.16-22 and 4.16-23 provide a summary of the demographics of CT 1, CT 126.02, Manton CDP, and Shingletown CDP.

Table 4.16-22. Local Area Demographics (2000 Census)

	Census Tract 1, Tehama County	Census Tract 126.02, Shasta County	Manton CDP	Shingletown CDP
Total Population	4,636	5,807	372	2,222
Per capita income in 1999 ($)	17,279	18,796	19,127	16,303
Median Age	43.1	45.3	50.7	45.9
Unemployment (%)	5.7%	6.6%	7.3%	7.2%

Table 4.16-23. Local Area Racial Composition (2000 Census)

	Census Tract 1, Tehama County	Census Tract 126.02, Shasta County	Manton CDP	Shingletown CDP
White alone	87%	92%	90%	93%
Hispanic or Latino	8%	3%	<1%	2%
Black or African American alone	<1%	<1%	0%	<1%
American Indian and Alaska Native alone	2%	3%	2%	2%
Asian alone	<1%	<1%	<1%	<1%
Native Hawaiian and Other Pacific Islander alone	<1%	<1%	<1%	0%
Other	2%	2%	6%	2%

Local Businesses. **Trout Farm Operations.** MLTF is a private aquaculture venture that raises and sells rainbow trout primarily for stocking private, fee-fishing lakes (Figure 4.16-3). In the past, MLTF sold live rainbow trout eggs; however, it no longer serves this market. MLTF operates 12 flow-through trout culture facilities, nine of which may be affected by the Restoration Project. Six facilities are located in the Battle Creek watershed, and three are in the Paynes Creek watershed, approximately 5–7 air miles south of South Fork Battle Creek.

MLTF leases land at freshwater spring sites from local landowners and has a substantial investment in hatcheries, rearing pens, and water treatment equipment. The rent that local landowners receive from MLTF is, in some cases, a substantial portion of their annual incomes. MLTF employs 20 workers.

Environmental Consequences

Summary of Effects

No adverse social effects are expected to occur in Shasta and Tehama Counties under the No Action Alternative or the Action Alternatives (i.e., Five Dam Removal, No Dam Removal, Six Dam Removal, and Three Dam Removal). The actions would not alter the social environment. Potential change in employment and income associated with any of the alternatives is not expected to result in a substantial change in regional economic activity. However, the Action Alternatives could have an adverse effect on the local economy, employment, and income as a result of potentially ceasing operations at the MLTF's Willow Springs, Jeffcoat East, and Jeffcoat West facilities.

No Action Alternative

Under the No Action Alternative, no substantial change in regional or local employment or income levels is expected because no restoration activities would occur. No change in power production, operation of private fish-rearing facilities, or other economic activities associated with the continued operation of the Hydroelectric Project are expected. In addition, no change in agricultural production from lands crossed by the project or adjacent to project facilities is expected.

As described in Section 4.1 "Fish," the continued introduction of anadromous fish to the upper watershed as part of other ongoing programs could increase the potential for IHN virus to spread to some of the fish-rearing facilities of MLTF. Currently, MLTF diverts flow from two springs as the primary source of flowing water to three of their fish culture operations: Willow Springs, Jeffcoat East, and Jeffcoat West. Historically, the spring flow has supported the production of relatively disease-free (i.e., IHN-free) rainbow trout. The flow diverted from the springs, however, includes seepage from Eagle Canyon, Inskip, and perhaps other canals. Seepage from Eagle Canyon and Inskip canals potentially contains pathogens that are conveyed by water diverted from North Fork and South Fork Battle Creek. Steelhead and chinook salmon that are present in Battle Creek carry pathogens, including IHN.

The pathogens will continue to be present under the No Action Alternative and continue to place the cultured fish at risk of contracting diseases from the spring water supply that receives canal seepage. The No Action Alternative would substantially increase the abundance of chinook salmon and steelhead in Battle Creek (Section 4.1, "Fish"). Increased abundance of chinook salmon and steelhead and occurrence upstream of Eagle Canyon, North Battle Creek Feeder, Inskip, and South diversion dams potentially increases the occurrence of pathogens in the water diverted from South Fork and North Fork Battle Creek. In this event, production from the MLTF facilities could cease, resulting in an adverse effect on regional and local employment and income.

Five Dam Removal Alternative (Proposed Action)

Effect—Potential decrease of regional and local employment and income. As described in Section 4.1 "Fish," increasing the habitat available to anadromous fish within the Battle Creek watershed could increase the potential of IHN virus to spread to MLTF's Jeffcoat East, Jeffcoat West, and Willow Springs fish-rearing facilities. Increased abundance of chinook salmon and steelhead and occurrence upstream of Eagle Canyon, North Battle Creek Feeder, Inskip, and South diversion dams potentially increases the occurrence of pathogens in the water diverted from South Fork and North Fork Battle Creek. The number of adult steelhead and chinook salmon spawning in Battle Creek may increase to several thousand adults under the Five Dam Removal Alternative, at least an order of magnitude greater than existing abundance. Increased levels of pathogens conveyed to the springs by canal seepage would increase the potential for infecting rainbow trout reared by MLTF.

The potential for exposure of aquaculture-reared rainbow trout (or other salmonid species) at MLTF is positively correlated with the number of anadromous salmonids entering Battle Creek above the intakes to Eagle and Inskip canals, which have waters that cross-connect via seepage to spring-fed water supplies servicing MLTF Jeffcoat and Willow Springs facilities. Once exposed to pathogens such as IHNV, these cultured fish will be unmarketable because of DFG codes and regulations prohibiting the planting of diseased fish or fish carrying serious pathogens. The economic consequences of pathogen exposure (even without apparent disease) are very serious for MLTF.

In the event these fish-rearing facilities were to become infected with the IHN virus, fish production most likely would cease. The effect on employment and income is difficult to estimate because it is not known whether MLTF would continue operation of its other fish-rearing facilities. In the event MLTF completely ceased operation, it is estimated that up to 20 employees would lose their jobs with an estimated combined annual income of $380,000. Some secondary economic effects also may occur because MLTF would no longer purchase supplies needed for operation of the fish-rearing facilities from local or regional suppliers and would no longer pay lease payments to local land owners where facilities are located.

The jobs lost in the event MLTF ceases operation represent less than 1% of the 23,620 persons employed in Tehama County in 2000. However, the loss of the operation would adversely affect MLTF and would result in the loss of an important employment source to the local economy. The 1999 MOU signatories are currently discussing measures with the MLTF to minimize potential adverse effects the IHN virus may have on the trout farms.

Effect—Slight increase of regional sales/receipts during construction. The estimated combined regional sales/receipts for Tehama and Shasta Counties were approximately $5.8 billion in 2002. If labor costs are assumed to comprise approximately 35% of the total construction budget (Table 4.16-24), a potential amount of $9.4 million would be expended on material and equipment during the implementation of the Five Dam Removal Alternative, and most activity would occur in the first few years of the project. If these expenditures were made within Tehama and Shasta Counties, they would represent an increase of less than 0.2% in regional sales/receipts. These expenditures would benefit the regional economy by maintaining or increasing employment and income levels in those sectors that would supply goods and services to contractors during the construction phase of the Restoration Project.

Table 4.16-24. Estimated Construction Costs for the Restoration Project ($ Million)

Restoration Project Feature	Five Dam Removal Alternative	No Dam Removal Alternative	Six Dam Removal Alternative	Three Dam Removal Alternative
North Battle Creek Feeder Diversion Dam	$3.14	$3.14	$3.14	$3.14
Eagle Canyon Diversion Dam	$3.68	$3.68	$2.00	$2.00
Wildcat Diversion Dam	$1.02	$1.67	$1.02	$1.02
South Diversion Dam	$1.62	$4.32	$1.62	$4.32
Soap Creek Feeder	$0.050	$0.00	$0.050	$0.00
Inskip Diversion Dam/South Powerhouse	$10.92	$7.74	$10.92	$10.04
Lower Ripley Creek Feeder	$0.020	$0.00	$0.020	$0.00
Coleman Diversion Dam/Inskip Powerhouse	$6.36	$5.40	$5.95	$2.40
Total Construction Costs	$26.810	$25.95	$24.720	$22.92

Estimated construction costs provided by Reclamation, June 2003.

Effect— Slight increase of construction-related jobs during Restoration Project construction. The 1999 regional civilian labor force comprised 97,130 workers, with unemployment around 6.85%, split evenly between Tehama and Shasta Counties. The size of the labor force has remained relatively constant on an annual basis. Assuming a stagnant labor force growth rate and further assuming that the existing regional labor pool would accommodate the Restoration Project's labor requirements, there could be a shift in employment of approximately 42 full-time job equivalents to the Restoration Project from the existing labor pool of 97,130 workers. However, should the labor requirements for the Restoration Project call for a specialization not found regionally, up to 42 full-time job equivalents could originate from other areas. If all of these 42 full-time job equivalents originated from other areas, this would represent an increase to the regional labor force of 0.04% during the Restoration Project's peak year labor requirement. New workers entering the labor force would benefit the regional economy by increasing expenditures for goods and services.

There would not be a substantial indirect or secondary effect because the region contains sufficient housing, lodging, food services, transportation, and health care to accommodate the 42 new full-time job equivalents.

No Dam Removal Alternative

Rather than removing Wildcat, Coleman, Lower Ripley Creek Feeder, Soap Creek Feeder, and South Diversion Dams, as under the Five Dam Removal Alternative, the No Dam Removal Alternative would install fish screens and fish ladders at Wildcat, Coleman, and South Diversion Dams, and Lower Ripley Creek Feeder and Soap Creek Feeder would be left in place.

Effect—Potential decrease of regional and local employment and income. Under the No Dam Removal, diversions from South Battle Creek and diversions from North Battle Creek would continue to supply flow to the Inskip Canal and other up-slope canals. Seepage from the canals would potentially contaminate the spring supplying the Willow Springs facility. The increased abundance and upstream extent of steelhead and chinook salmon would increase the potential for infecting the spring flow supplying the Willow Springs facility. Eagle Canyon diversions would continue under the No Dam Removal alternative. Seepage from Eagle Canyon Canal would continue to potentially contaminate the flows supplying the Jeffcoat East and West facilities. The increased abundance and upstream extent of steelhead and chinook salmon would increase the potential for infecting the spring flow supplying the Jeffcoat East and West facilities. These effects on the MLTF facilities are similar to effects described above for the Five Dam Removal Alternative. The 1999 MOU signatories are currently discussing potential measures with the MLTF to minimize potential adverse effects the IHN virus may have on the trout farms.

Effect—Slight increase of regional sales/receipts during construction. The estimated combined regional sales/receipts for Tehama and Shasta Counties were approximately $5.8 billion in 2002. If labor costs are assumed to comprise approximately 35% of the total construction budget (Table 4.16-24), a potential amount of $9.1 million would be expended on material and equipment during the implementation of the No Dam Removal Alternative, and most activity would occur in the first few years of the project. If these expenditures were made within Tehama and Shasta Counties, they would represent an increase of less than 0.2% in regional sales/receipts. These expenditures would benefit the regional economy by maintaining or increasing employment and income levels in those sectors that would supply goods and services to contractors during the construction phase of the Restoration Project.

Effect—Slight increase of construction-related jobs during Restoration Project construction. The No Dam Removal Alternative would employ approximately 70 construction workers, as opposed to the 90 workers anticipated to be employed under the Five Dam Removal Alternative as described above. Beneficial socioeconomic effects are anticipated to be slightly less because fewer workers would be required during the construction phase and the short-term expenditures for goods and services would be lower.

Six Dam Removal Alternative

Rather than installing a fish screen and fish ladder at the Eagle Canyon Diversion Dam, as with the Five Dam Removal Alternative, the Six Dam Removal Alternative would remove the dam, which would require a lower cost and less effort than installing a fish screen and fish ladder. Once the dam has been removed, diversions to the Eagle Canyon Canal would be terminated.

Effect—Potential decrease of regional and local employment and income. The Six Dam Removal Alternative would substantially increase the abundance of chinook salmon and steelhead in Battle Creek (Section 4.1, "Fish"). Increased abundance of chinook salmon and steelhead and occurrence upstream of North Battle Creek Feeder, Inskip, and South diversion dams potentially increases the occurrence of pathogens in the water diverted from South Fork and North Fork Battle Creek. Increased levels of pathogens conveyed to the springs by canal seepage would increase the potential for infecting rainbow trout reared by MLTF.

The springs supplying Jeffcoat East and West are potentially contaminated by seepage from the Eagle Canyon Canal. Eagle Canyon Diversion Dam would be removed under the Six Dam Removal alternative. The diversion and flow in Eagle Canyon Canal would cease and no longer contribute seepage to the springs that supply Jeffcoat East and West. The Six Dam Removal alternative would eliminate the existing and future potential for infecting spring flows supplying the Jeffcoat East and West facilities. Therefore, implementing the Six Dam Removal Alternative would have similar effects on the Willow Springs facility as the Five Dam Removal Alternative and no effect on the Jeffcoat East and West Facilities. The effect on the Willow Springs facility would be similar to that described above for the Five Dam Removal Alternative. The 1999 MOU signatories are currently discussing potential measures with the MLTF to minimize potential adverse effects the IHN virus may have on the trout farms.

Effect—Slight increase of regional sales/receipts during construction. The estimated combined regional sales/receipts for Tehama and Shasta Counties were approximately $5.8 billion in 2002. If labor costs are assumed to comprise approximately 35% of the total construction budget (Table 4.16-24), a potential amount of $8.65 million would be expended on material and equipment during the implementation of the Six Dam Removal Alternative, and most activity would occur in the first few years of the project. If these expenditures were made within Tehama and Shasta Counties, they would represent an increase of less than 0.2% in regional sales/receipts. These expenditures would benefit the regional economy by maintaining or increasing employment and income levels in those sectors that would supply goods and services to contractors during the construction phase of the Restoration Project.

Effect—Slight increase of construction-related jobs during Restoration Project construction. The Six Dam Removal Alternative would employ approximately the same number of construction workers as the Five Dam Removal Alternative. Beneficial socioeconomic effects are anticipated to be essentially the same as those described above for the Five Dam Removal Alternative.

Three Dam Removal Alternative

Socioeconomic effects would be similar to those described for the Five Dam Removal Alternative. Rather than removing Lower Ripley Creek Feeder, Soap Creek Feeder, and South Diversion Dams, as under the Five Dam Removal Alternative, the Three Dam Removal Alternative would install fish screens and fish ladders at the South Diversion Dam, and Lower Ripley Creek Feeder and Soap Creek Feeder would be left in place.

Effect—Potential decrease of regional and local employment and income. Under the Three Dam Removal Alternative, rather than installing a fish screen and fish ladder at Eagle Canyon Diversion Dam, this dam would be removed. Diversions from North Fork and South Fork Battle Creek under the Three Dam Removal alternative would continue to supply flow to the Inskip Canal and other up-slope canals. Seepage from the canals would potentially contaminate the spring supplying the Willow Springs facility. The increased abundance and upstream extent of steelhead and chinook salmon would increase the potential for infecting the spring flow supplying the Willow Springs facility.

The springs supplying Jeffcoat East and West are potentially contaminated by seepage from the Eagle Canyon Canal. Eagle Canyon Diversion Dam would be removed under the Six Dam Removal alternative. The diversion and flow in Eagle Canyon Canal would cease and no longer contribute seepage to the springs that supply the Jeffcoat East and West facilities. This alternative would eliminate the existing and future potential for infecting spring flows supplying the Jeffcoat East and West facilities.

Therefore, implementing the Three Dam Removal Alternative would have similar effects on the Willow Springs facility as the Five Dam Removal Alternative, and no effect on the Jeffcoat East and West Facilities. The effect on the Willow Springs facility would be similar to that described above for the Five Dam Removal Alternative. The 1999 MOU signatories are currently discussing potential measures with the MLTF to minimize potential adverse effects the IHN virus may have on the trout farms.

Effect—Slight increase of regional sales/receipts during construction. The estimated combined regional sales/receipts for Tehama and Shasta Counties were approximately $5.8 billion in 2002. If labor costs are assumed to comprise approximately 35% of the total construction budget (Table 4.16-24), a potential amount of $8.0 million would be expended on material and equipment during the implementation of the Three Dam Removal Alternative, and most activity would occur in the first few years of the project. If these expenditures were made within Tehama and Shasta Counties, they would represent an increase of just above 0.1% in regional sales/receipts. These expenditures would benefit the regional economy by maintaining or increasing employment and income levels in those sectors that would supply goods and services to contractors during the construction phase of the Restoration Project.

Effect—Slight increase of construction-related jobs during Restoration Project construction. The Three Dam Removal Alternative would employ fewer construction workers than the Five Dam Removal Alternative (77 workers vs. 90 workers). Beneficial socioeconomic effects are anticipated to be slightly less than the Five Dam Removal Alternative, as described above, because fewer workers would be required during the construction phase and the short-term expenditures for goods and services would be lower.

Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires each federal agency to identify and address disproportionately high and adverse human health or environmental effects of their actions on minorities and low-income populations and communities. It requires federal agencies to adopt strategies to address environmental justice concerns within the context of agency operations.

The mission of the California Environmental Justice Program is to accord the highest respect and value to every individual and community; it requires that the California Environmental Protection Agency and its boards, departments and offices conduct their public health and environmental protection programs, policies, and activities in a manner that is designed to promote equality and afford fair treatment, full access, and full protection to all Californians, including low-income and minority populations. The California Environmental Protection Agency is firmly committed to the achievement of environmental justice. Environmental justice for all Californians is a priority for the California Environmental Protection Agency.

The California Government Code (Section 65040.12) defines environmental justice as "The fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations and policies." This statute obligates the SWRCB as state lead agency for CEQA to do the following:

- Conduct all programs, policies, and activities in a manner that ensures the fair treatment of people of all races, cultures, and income levels, including minority populations and low-income populations of the State.

- Promote enforcement of all health and environmental statutes within its jurisdiction in a manner that ensures the fair treatment of all Californians, irrespective of race, culture, and income.
- Ensure greater public participation from environmental justice stakeholders in the development, adoption, and implementation of environmental regulations and policies.
- Identify among people of different socioeconomic classifications any differential patterns of consumption of natural resources.

Affected Environment

The dams to be removed and the fish screens, ladders, and related water conveyance facilities to be improved as part of the Restoration Project are located on lands managed for grazing, fisheries restoration, and hydropower generation. As discussed in Section 4.6, "Land Use," and the socioeconomics discussion provided above in this section, construction operation, and maintenance activities associated with the Restoration Project are not expected to result in a substantial changes to, or conflict with, existing land uses or result in substantial change in the socioeconomic characteristics of the study area. The restoration project could benefit employment and income in the study area as a result of enhancing the anadromous fishery. Conversely, the Restoration Project could adversely affect employment and income in the study area by reducing or eliminating production from the MLTF, a privately owned fish hatchery with some operations located within the study area.

As indicated in the socioeconomics discussion provided above, the study area falls within Tehama County CT 1 and Shasta County CT 126.02. Because of the large area encompassed by CT 1 and CT 126.02, the environmental justice analysis was based on the demographic information reported for the Manton CDP. The Manton CDP is located within and adjacent to the study area and, because of its smaller size, provides a more accurate representation of the ethnicity and income level of persons living within the study area.

The 2000 U.S. Census indicates 372 persons reside within the Manton CDP. The ethnic composition of the Manton CDP is 95 percent White, followed by American Indian (3%), and Black or African American (1%) (U.S. Census Bureau 2003a). The ethnic composition of Tehama County is 85% White, followed by American Indian, Eskimo, or Aleut (2%); Asian and Black or African American (both less than 1%); and other (12%) (U.S. Census Bureau 2001b). The ethnic composition of Shasta County is 89% White, followed by American Indian, Eskimo, or Aleut (3%); Asian (2%); Black or African American (1%); and other (5%) (U.S. Census Bureau 2001a).

Per capita income within the Manton CDP was $19,127 (U.S. Census Bureau 2003b). Per capita income in Tehama County and Shasta County was $15,793 and $17,738, respectively (U.S. Census Bureau 2003c and 2003d). Approximately 9% of families residing within the Manton CDP have incomes below the poverty level, whereas 13% of the families residing within Tehama County and 11% of the families residing within Shasta County have incomes below the poverty level. This suggests that income levels within the Manton CDP are similar to income levels for Shasta and Tehama counties as a whole.

Most workers residing within the Manton CDP are employed in management, professional, and related occupations (24 persons) or the sales and office occupations sector (43 persons) (U.S. Census Bureau 2003b). Only six workers were employed in the farming, fishing, or forestry occupations. Average one-way commute time for workers originating from the Manton CDP was 34 minutes. The one-way commute time and the predominate occupation types suggests that most workers commute to places of work outside of the study area (possibly Red Bluff or Redding).

Environmental Consequences

As discussed above, the study area does not have a high minority or low income population. Most workers commute outside the study area to their places of employment and income levels are similar to county averages. Construction, operation, and maintenance of the Restoration Project would not result in a disproportionate effect on a minority and/or low-income communities.

In addition, the lead agencies have engaged stakeholders for input at all levels of the project decision-making process to ensure early, accessible, and meaningful participation. By their participation in ongoing local watershed efforts, the agencies have included stakeholders in the decision-making process and have explored opportunities to address environmental justice within current statutory and regulatory structures.

Indian Trust Assets

Indian trust assets are legal interests in assets held in trust by the Federal government for Indian tribes or individuals. The trust relationship usually stems from a treaty, executive order, or act of Congress. Assets are anything that holds monetary value, and can be real property, physical assets, or intangible property rights. Examples of trust assets are lands, minerals, hunting and fishing rights, and water rights. Indian rancherias, reservations, and public domain allotments are frequently placed in trust status.

Reclamation's Indian trust asset policy states that Reclamation will carry out its activities in a manner that protects Indian trust assets and avoids adverse effects when possible. When Reclamation cannot avoid adverse effects, it will provide appropriate mitigation or compensation.

Affected Environment and Environmental Consequences

A search of the geographical information system coverage for California Indian reservations and public domain allotments failed to show any tribal or Indian lands in the vicinity of the Restoration Project area (Reclamation and USFWS 1999). Given the absence of Indian lands within or near the Restoration Project area, there will be no adverse effects to Indian trust assets from the Restoration Project.

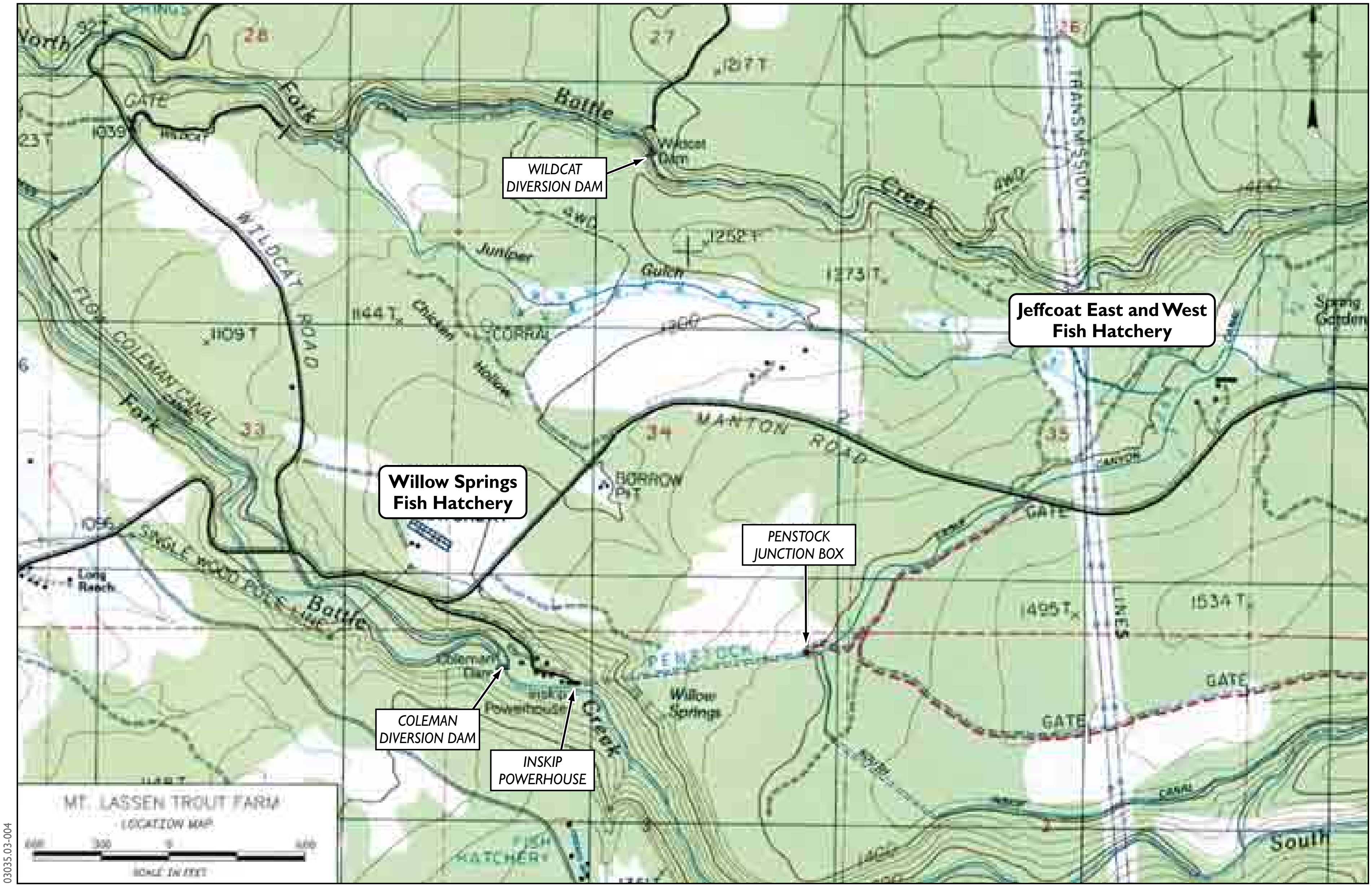


Figure 4.16-3
Mount Lassen Trout Farm Hatcheries

4.17 Other Required Analyses

This section discusses other required impact analyses required by NEPA and CEQA. It includes discussions regarding the areas of potential controversy, the potential for growth-inducing impacts, irreversible and/or irretrievable commitments of resources, the relationship between short-term uses and long-term productivity of the environment, and energy conservation.

Areas of Potential Controversy

The primary areas for potential controversy in implementing the Restoration Project include the compatibility of the Proposed Action and the other alternatives with ongoing and planned operations at the Coleman National Fish Hatchery, especially with respect to fish restoration upstream of the hatchery, the focus of the adaptive management process being used for Battle Creek fish restoration, the level of community involvement, long-term impacts on land use as they relate to potential restrictions associated with ESA and CESA compliance, and potential effects on trout farming. These related projects are described in detail in Chapter 6. Areas of potential controversy associated with these projects are discussed and summarized below.

Compatibility of the Restoration Project with Ongoing and Planned Operations at the Coleman National Fish Hatchery

The BCWC includes representation from all landowners, except PG&E and the federal government (USFWS, BLM, USFS), that could be affected by the Restoration Project. In the past few years, the BCWC has expressed several concerns regarding Restoration Project implementation and its compatibility with ongoing and planned operations at the Coleman National Fish Hatchery.

In their September 20, 2001, letter to Mr. Leland Davis, president of the BCWC, Reclamation, the USFWS, DFG, and NOAA Fisheries proposed a problem-solving approach to address the concerns the local community has voiced through BCWC over some of the activities of agencies (i.e., Reclamation, USFWS, DFG, and NOAA Fisheries) in the Battle Creek watershed (Four-Agency Letter (Appendix B). These concerns relate to the Restoration Project and the operations of the Coleman National Fish Hatchery. The BCWC has expressed a vote of opposition to the Restoration Project conditioned on defining a way forward on several issues relating to the future operation of the Coleman National Fish Hatchery (Appendix C).

As stated in the Four-Agency Letter, the BCWC's concerns are important to the agencies, which have been exploring ways to resolve these issues through a process that will provide meaningful input by all parties including the BCWC and CALFED. The collective goal, as defined in the Four-Agency Letter, is to restore the salmon and steelhead habitats of the Battle Creek watershed upstream to its waterfall barriers to maximize naturally reproducing runs, with a priority on the listed species (winter-run chinook salmon, spring-run chinook salmon, and steelhead). The Four-Agency Letter is discussed in greater detail in Chapter 6, “Related Projects.”

Concerns about Focus of the Adaptive Management Process Used for Battle Creek Fish Restoration

The BCWC had expressed concern that the focus of the draft Adaptive Management Plan (Appendix D) for the Restoration Project is narrow and needs to operate at the watershed level using a community-based approach. The Four-Agency Letter stated that the agencies have committed to an Adaptive Management Plan that would have an open decision-making process with many criteria, including one requiring that community acceptance be considered when making modifications in the Hydroelectric Project area. The agencies recognize that the draft Adaptive Management Plan for the Restoration Project has a narrow focus on the Hydroelectric Project. However, this is seen as a necessary constraint resulting from the dedicated budget for adaptive management of structures and properties licensed by FERC.

The agencies have committed to work with the BCWC to develop a broader framework that can coordinate community-based restoration actions in the watershed with the Restoration Project and actions at the Coleman National Fish Hatchery, especially if, or when, management actions are subjected to adaptive management. The Four-Agency Letter also states that the agencies’ environmental document for the Restoration Project (i.e., this EIS/EIR) will include the belief that the different projects now occurring in the watershed have to be closely coordinated to ensure the full success of the Restoration Project. The Four-Agency Letter states that it would appear that the Battle Creek Working Group and the BCWC are both good candidates for assuming a long-term role in coordinating the various activities in the watershed. The four agencies support stakeholder leadership and involvement in this broader forum, with the understanding that the federal and state agencies cannot abrogate their statutory decision-making authorities and responsibilities.

Inadequate Level of Community Involvement and Opportunities for Community-Based Implementation

The agencies are currently seeking to hire a coordinator to assist them and the BCWC in the cooperative development of a broader science- and community-based framework for completing projects throughout the watershed, not just the Restoration Project area. The agencies believe that they share the BCWC’s goals for restoring Battle Creek, as expressed in their respective strategy documents (the BCWC's "Battle Creek Watershed Community Strategy" [June 2000] [Appendix B] and the agencies' efforts beginning with the Upper Sacramento River Fisheries and Riparian Habitat Management Plan [1989], the Final Restoration Plan for the AFRP [January 9, 2001], the USFWS's April 3, 1998 position paper on Battle Creek watershed [USFWS 1998a], and the CALFED Programmatic Record of Decision [August 2000] [CALFED 2000c]).

The agencies continue to support the BCWC's leadership role on land and water management issues in the watershed outside of the Hydroelectric Project license amendment process. The BCWC received a grant through the CALFED/CVPIA grant process and currently has the lead in addressing watershed issues through the CALFED/CVPIA grant.

In the Four-Agency Letter, the agencies invited the BCWC to pursue its interests in examining Battle Creek fish management issues within the regional context of the upper Sacramento River basin. The agencies suggested using the CALFED Programmatic Record of Decision, in association with the CALFED Science Program, for this regional approach. The goals of these programs are to provide financial and technical assistance for watershed activities that help achieve fish restoration goals and to promote collaboration and integration among existing and future local watershed programs.[1]

Long-Term Impacts on Local Land Use as a Result of Potential Restrictions Associated with Endangered Species Act Compliance

The agencies expressed in the Four-Agency Letter that they would like to work with the local landowners to evaluate the risk they believe would exist if the Restoration Project should fail to meet its long-term objective of maintaining viable populations of anadromous fish in Battle Creek. The agencies understand that the local landowners believe that in the event of such a failure, the landowners may somehow be made to assume the burden to restore the fish through restrictions on land uses, water rights, or other economic activities.

As stated in the Four-Agency Letter, the objective of the Restoration Project is based on using the bed and banks of Battle Creek in their existing condition and providing needed water and passage through modifications to the Hydroelectric Project. The agencies believe that the current land use practices and activities in the Battle Creek watershed have maintained the bed and bank of the creek in good condition, especially considering the low-flow conditions in the creek resulting from the Hydroelectric Project. In terms of water use for the

[1] In the Four-Agency Letter, the agencies express strong feelings that the Restoration Project proceed on schedule. They agencies believe that the Restoration Project can be implemented using the established environmental decision-making processes based upon providing full disclosure and addressing the concerns of the stakeholders and the public. They intend to address in this EIS/EIR the main issues of concern that the BCWC has expressed because they are related to the Restoration Project.

Hydroelectric Project, the agencies have determined that over the past decades, PG&E and its predecessors have collected all the water rights needed for reallocation to the Restoration Project, thus providing the basis for the MOU.

As stated in the Four-Agency Letter, the agencies support measures to assist landowners to continue their current land uses, such as conservation easements consistent with the Battle Creek Watershed Community Strategy. Because they cannot predict the future, the agencies state that all involved parties must recognize that there may be major changes in land use practices that are incompatible with laws on keeping the water clean or the bed and bank of the stream in adequate condition. As further stated in the Four-Agency Letter, the public trusts the appropriate agencies to monitor the fish and wildlife resources, properly review proposals for new projects under environmental decision-making processes, recommend mitigation, and conserve salmon, steelhead, and their habitats. The agencies must follow these conservation mandates while working cooperatively with all parties, including the local landowners, to conserve these resources.

Adverse Effects on Trout Farming and Related Local Economics as a Result of Fish Restoration

Currently, MLTF divert flow from two springs as the primary source of flowing water to three of their fish culture operations: Willow Springs, Jeffcoat East, and Jeffcoat West. Historically, the spring flow has supported the production of relatively disease-free (i.e., IHN-free) rainbow trout. The flow diverted from the springs, however, includes seepage from Eagle Canyon, Inskip, and perhaps other canals. Seepage from Eagle Canyon and Inskip canals potentially contains pathogens that are conveyed by water diverted from North Fork and South Fork Battle Creek. Steelhead and chinook salmon that are present in Battle Creek carry pathogens, including IHN. The pathogens will continue to be present under the No Action Alternative and continue to place the cultured fish at risk of contracting diseases from the spring water supply that receives canal seepage. The Action Alternatives, however, could increase this disease problem by introducing anadromous fish carrying the IHN pathogen to North Fork and South Fork Battle Creek. The impact that the pathogen problem could have on Mount Lassen Trout Farms is discussed further under the Socioeconomics discussion in Section 4.16, “Other NEPA Analyses.” Reclamation is committed to work with Mount Lassen Trout Farms to help provide an appropriate solution for this problem.

Growth-Inducing Impacts

Implementation of the Restoration Project would not induce significant development or economic growth in the vicinity. Dam removals, fish screen and fish ladder improvements, and other construction and operation activities associated with the Restoration Project would be implemented in remote, privately held lands with restricted access. The opportunities for economic growth and development would, therefore, be limited to those independent land use decisions made by the landowners controlling this access. The objective of the Restoration Project is based on using the bed and banks of Battle Creek in their existing condition and providing needed water and passage through modification of the Hydroelectric Project. The agencies believe that the current land use practices and activities in the Battle Creek watershed have maintained the bed and bank of the creek in good condition, especially considering the low flow conditions in the creek resulting from the Hydroelectric Project. Because current access restrictions and land use practices are consistent with this Restoration Project objective, the agencies will cooperate with the BCWC to ensure that development and economic growth do not occur to its detriment.

Irreversible and/or Irretrievable Commitment of Resources

Concrete, Gravel, and Other Rock and Earthen Materials

Construction materials, including concrete, gravel, and other rock and earthen materials, would be irretrievably committed toward the construction of the facilities needed for Restoration Project implementation. Most of these materials would be imported to the site from nearby commercial sources, which have been subject to separate environmental review before they could extract and process such materials for construction use. Soil materials taken from nearby sites and used as fill would be irretrievably committed to Restoration Project construction. Gravels and cobbles used for temporary cofferdam construction, however, would be returned to their sources at the end of construction.

Renewable Hydroelectric Generation Capability

Renewable hydroelectric generation capability would be lost because of permanently altered flow regimes on Battle Creek and removal of diversion dams and canals. This reduction in hydroelectric generation capability could result in increased operation of fossil-fueled electricity resources, with associated air emissions, and a relatively small increase in cost of power to California's electricity consumers. Lost generation and increases in cost of power are described under the power generation and economics discussion in Section 4.16, "Other NEPA Analyses."

Scenic Quality

Under the Five Dam Removal Alternative, the South Powerhouse tailrace connector and bypass channel would substantially reduce scenic quality along this section of South Fork Battle Creek. Views of the wooded, undeveloped hillside from the Oasis Springs Lodge creek bank frontage would be replaced with views of the bypass channel and revetments. This loss in scenic quality would be irreversible since there is no feasible mitigation to reduce the visibility of the channel and revetments.

Relationship between Short-Term Uses and Long-Term Productivity of the Environment

The Restoration Project is intended to begin the development of a long-term solution to fish restoration in Battle Creek. Short-term uses, including ongoing interim flow agreements, PG&E commitments to suspend diversions to Wildcat Canal and to block the downstream entrances to the Eagle Canyon and Coleman Diversion Dam fish ladders, and other improvements being made at the Coleman National Fish Hatchery, are intended to be fully compatible with the long-term fish productivity of Battle Creek. These short-term uses and improvements will be evaluated using adaptive management principles developed and revised consistent with CALFED guidelines to maximize the possible long-term environmental productivity of Battle Creek.

Energy Conservation

The Restoration Project purpose includes minimizing the loss of clean, renewable energy produced by the Hydroelectric Project and accounting for the energy and related generation capacity that California will need to meet its current and future energy demands. Because of this fundamental consideration of energy conservation, the Restoration Project has, from the outset, placed a high priority on energy conservation in balance with restoration.