

Chapter 1

Introduction, Organization, and Process



The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and the California State Water Resources Control Board (SWRCB) are proposing the Battle Creek Salmon and Steelhead Restoration Project (Restoration Project). The proposed Restoration Project presents an opportunity to reestablish approximately 42 miles of prime salmon and steelhead habitat on Battle Creek, plus an additional 6 miles of habitat on its tributaries (Figure 1-1). Restoration would be accomplished primarily through the modification of the Battle Creek Hydroelectric Project (Federal Energy Regulatory Commission [FERC] Project No. 1121) (Hydroelectric Project) facilities and operations, including instream flow releases. Any proposed changes to the Hydroelectric Project trigger the need for the Pacific Gas and Electric Company (PG&E)¹ to seek a license amendment from FERC.

Because of the federal and state actions associated with the Restoration Project, compliance with both the National Environmental Policy Act (NEPA) (42 USC 4321-4347) and the California Environmental Quality Act (CEQA) (Public Resources Code 21000 *et seq.*) is required. This joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) has been prepared to fulfill the requirements of both NEPA and CEQA. Because the Restoration Project is an action directed within the CALFED Bay-Delta Program Final Programmatic EIS/EIR (CALFED 2000a) environmental review of this EIS/EIR will tier from that document.

The purpose of this EIS/EIR is to disclose the impacts associated with the Restoration Project Proposed Action alternative and other project alternatives in order to reach a decision on the alternative to be implemented.

¹ Pacific Gas & Electric Company (PG&E) is the owner and licensee of the Battle Creek Hydroelectric Project (FERC Project No. 1121) at the time of publication of this document.

Reclamation, the lead federal agency, is responsible for ensuring overall NEPA compliance, while FERC, a cooperating federal agency, is responsible for ensuring that proposed changes to the Hydroelectric Project comply with NEPA prior to issuing a license amendment for the Hydroelectric Project. Because this FERC license requires Clean Water Act (CWA) (33 USC 1251 *et seq.*) Section 401 water quality certification from the SWRCB, the SWRCB is the state lead agency responsible for ensuring CEQA compliance.

This document was developed through the contributions and efforts from the public, interested parties, the Battle Creek Working Group (BCWG), the Battle Creek Watershed Conservancy (BCWC), the CALFED Bay-Delta Program (CALFED), Reclamation, the U.S. Fish and Wildlife Service (USFWS), Pacific Gas & Electric Company (PG&E), the California Department of Fish and Game (DFG), SWRCB, FERC, and the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries). Chapter 5, “Consultation and Coordination,” contains details on public, agency, and PG&E involvement associated with the Restoration Project.

Organization of This EIS/EIR

This EIS/EIR is organized into the following seven chapters:

1. Introduction, Organization, and Process
2. Purpose and Need, Project Description, and Project Background
3. Project Alternatives
4. Affected Environment and Environmental Consequences
5. Consultation and Coordination
6. Related Projects
7. Summary
8. List of Contributors
9. References

Environmental Impact Statement/ Environmental Impact Report Process

The NEPA/CEQA process for this EIS/EIR is summarized as follows:

- issuance of a Notice of Preparation/Notice of Intent (NOP/NOI) for the EIS/EIR;
- public scoping of the EIS/EIR and receipt of public and agency comments;

- preparation of a draft EIS/EIR;
- issuance of a Notice of Availability of the draft EIS/EIR, filing of the Notice of Completion of the draft EIS/EIR with the State Clearinghouse, and circulation of the draft EIS/EIR for a 60-day public and agency review and comment period;
- preparation of a final EIS/EIR (includes responses to comments received) and identification of the recommended project alternative;
- filing of the final EIS/EIR with the U.S. Environmental Protection Agency (EPA) and publication of the Notice of Availability of final EIS/EIR in the Federal Register;
- final EIS/EIR 30-day no action period; and
- filing of a Federal Record of Decision (ROD) and State of California Notice of Determination (NOD) regarding the project alternative to be implemented.

Because the Restoration Project would involve modifications to the Hydroelectric Project facilities and operations, including instream flow releases, PG&E is required to obtain a license amendment from FERC for the Hydroelectric Project. PG&E proposes to use a hybrid of the consultation requirements specified in 18 CFR 4.38 for its license amendment application. In addition to the requirements in 18 CFR 4.38, PG&E will be using elements of the alternative licensing and amendment procedures described in FERC Order 596, which permits other approaches to licensing and amendments, including the use of collaborative teams, settlements, and mediation. This EIS/EIR serves as part of PG&E's application for a license amendment; it is a substitute for Exhibit E.

Before FERC can make a decision on whether to grant or deny a license amendment for the Restoration Project, PG&E must request and receive a CWA Section 401 water quality certification for the Restoration Project from the SWRCB. Accordingly, PG&E will be pursuing a water quality certification for the Restoration Project. Any water quality certification issued by the SWRCB will be based on information in the final EIS/EIR and the administrative record. Implementation of the Restoration Project can begin only after the SWRCB has issued the water quality certification and FERC has granted a final order for a license amendment for the Hydroelectric Project.

NEPA and CEQA are very similar in that both laws require the preparation of a detailed environmental study to evaluate the environmental effects of proposed governmental activities. However, there are several differences between the two regarding terminology, procedures, environmental document content, and substantive mandates to protect the environment. For the environmental evaluation of the proposed Restoration Project, the more rigorous of the two laws was applied in cases in which NEPA and CEQA differ. For example, CEQA does not require the analysis of socioeconomic impacts in an EIR, whereas NEPA does require an analysis of socioeconomic impacts in an EIS. Consequently, this document contains a socioeconomic impact analysis (Section 4.16). Other analyses required by NEPA but not CEQA can be found in

Section 4.16, and analyses required by CEQA but not NEPA can be found in Section 4.17.

Many concepts are common between NEPA and CEQA; however, the laws sometimes have differing terminology for these common concepts. Because Reclamation (the NEPA lead agency) is the project proponent for the proposed Restoration Project, this document will use NEPA standard language where terminology differs between NEPA and CEQA.

NEPA Terminology	CEQA Terminology
Cooperating Agency	Responsible Agency
Environmental Impact Statement	Environmental Impact Report
Notice of Intent	Notice of Preparation
Record of Decision	Findings
Proposed Action	Proposed Project
Project Purpose and Need	Project Objectives
No Action Alternative	No-Project Alternative
Affected Environment	Environmental Setting
Environmental Consequences	Impact Assessment

Relationship of This Document to the CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report

The CALFED ROD (CALFED 2000c) states,

For actions contained within the Preferred Program Alternative that are undertaken by a CALFED Agency or funded with money designated for meeting CALFED purposes, environmental review will tier from the Programmatic EIS/EIR. These actions will be carried out in a manner consistent with the ROD and incorporate mitigation strategies contained in Appendix A to this ROD.

This EIS/EIR is tiered from the CALFED Final Programmatic EIS/EIR and the ROD issued August 28, 2000 (including CEQA Certification). Tiering is provided for in NEPA (U.S. Council on Environmental Quality [CEQ]) Regulations Section 1502.20 and CEQA Guidelines Section 15152. The actions composing the Restoration Project were included in these documents, and funding for this project has been provided in part by CALFED. This EIS/EIR includes information on and has considered the conclusions regarding the environmental consequences and mitigation strategies from the CALFED Final Programmatic EIS/EIR and the ROD. The project-specific analyses contained in

this EIS/EIR, however, have been conducted independently by the lead agencies, and the conclusions reached are their own.

The Programmatic EIS/EIR can be reviewed at CALFED, 650 Capitol Mall, Sacramento, California, or on the CALFED web page (http://calfed.water.ca.gov/CALFEDDocuments/Final_EIS_EIR.shtml).

Relationship of the Restoration Project to the CALFED Bay-Delta Program

Projects and activities implementing the Preferred CALFED Alternative require separate, project-level environmental analyses tiering from the Final Programmatic EIS/EIR. This Restoration Project EIS/EIR tiers from the CALFED Final Programmatic EIS/EIR. The Restoration Project is directed by several actions needed to implement the CALFED Ecosystem Restoration Program (ERP), which is part of the Preferred Alternative for the CALFED Final Programmatic EIS/EIR.

The goals of the ERP are to improve and increase aquatic and terrestrial habitats and to improve the Bay-Delta system, which includes the Sacramento River Basin, to support sustainable populations of diverse and valuable plant and animal species. In addition, the ERP, along with the water management strategy, is designed to achieve or contribute to the recovery of listed species found in the Bay-Delta and thus achieve the goals of the Multi-Species Conservation Strategy (MSCS) dated July 2000. The MSCS was developed for CALFED in accordance with the federal Endangered Species Act (ESA), California Endangered Species Act (CESA), and California's Natural Community Conservation Planning Act (NCCPA). Implementation of the MSCS is intended to ensure that entities implementing CALFED actions will satisfy the requirements of these three acts.

The Restoration Project tiers from key elements of the CALFED ROD associated with ERP implementation. These elements are expressed as Stage 1 actions evaluated in the CALFED Final Programmatic EIS/EIR and Science Program actions expressed as ERP–MSCS milestones. Actions specifically referenced in the CALFED ROD (CALFED 2000c) and included in the CALFED Final Programmatic EIS/EIR call for the ERP to:

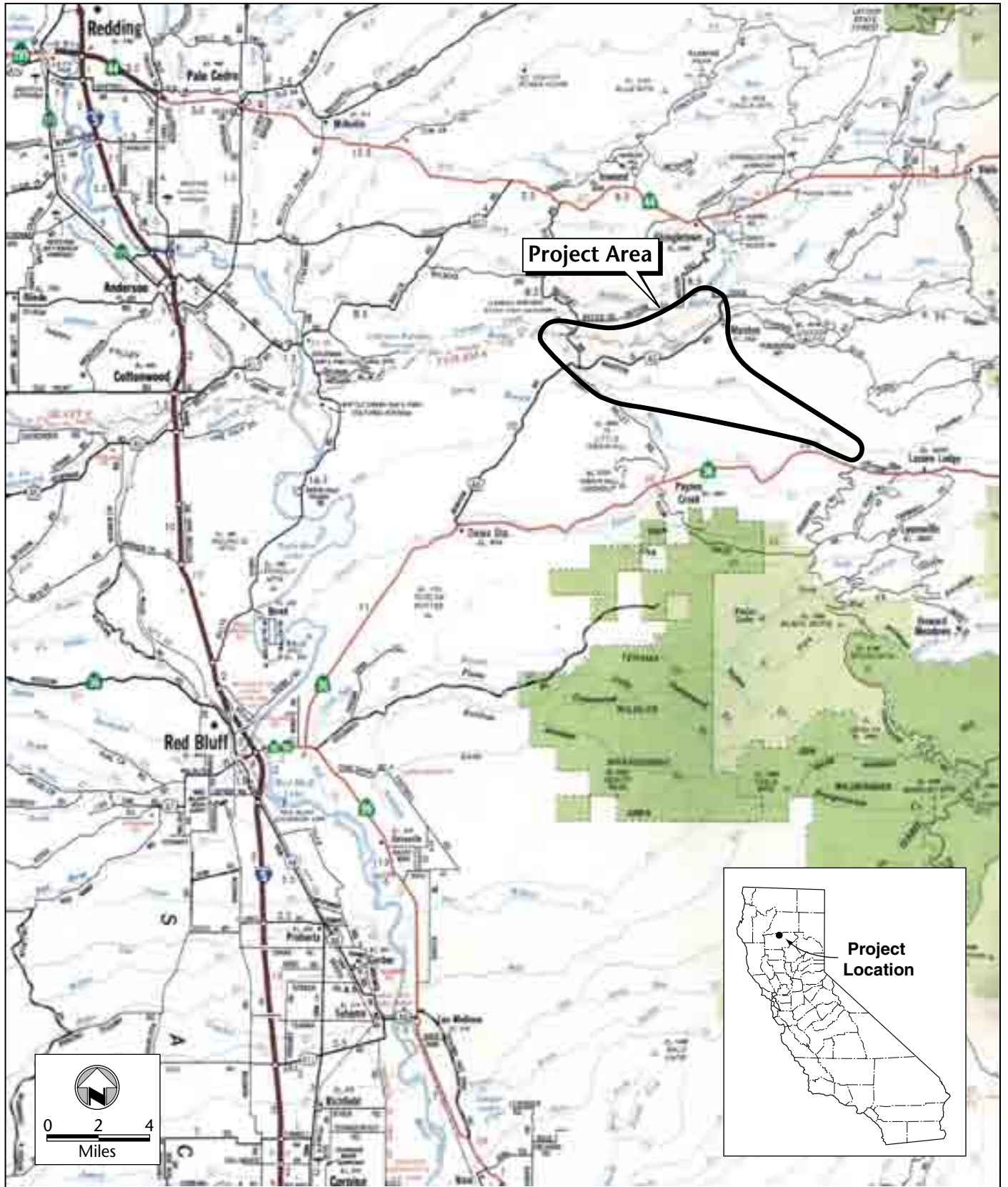
- improve fish passage through modifications or removal of eight PG&E diversion dams on Battle Creek, and
- improve salmon spawning and juvenile survival in upstream tributaries as defined by the ERP and Strategic Plan by purchasing up to 100,000 acre-feet (af) per year by the end of Stage 1 of the CALFED Program implementation.

More specifically, the ERP Strategic Plan for Ecosystem Restoration (CALFED 1999) identifies three Battle Creek Stage 1 Actions from which the Restoration Project tiers, including:

- Action 1: Improve fish migration by removing diversion dams, upgrading fish passage facilities, and screening diversions.
- Action 2: Improve instream flows in lower Battle Creek to provide adequate passage flows.
- Action 3: Develop and implement a watershed management plan to reduce the amount of fine sediments introduced to the creek channel, to protect and restore riparian habitat, to improve base flows, and to reduce water temperatures.

The Natural Community Conservation Plan Determination (Attachment 7 to the CALFED ROD) reiterates, “To ensure that the ERP is implemented in a manner and to an extent sufficient to sustain programmatic ESA, CESA, and NCCPA compliance for all CALFED Program elements, the USFWS, NOAA Fisheries, and DFG have developed milestones for ERP implementation.” (CALFED 2000c). The MSCS–ERP milestones include Science Program actions that are relevant for ERP implementation and that are intended to improve ecological processes and habitat in the Sacramento River Basin. The Restoration Project, therefore, also tiers from the following MSCS–ERP milestones:

- Design and begin implementation of an ecologically based stream flow regulation plan for Yuba River, Butte Creek, Big Chico Creek, Deer Creek, Mill Creek, Antelope Creek, Battle Creek, Cottonwood Creek, and Clear Creek.
- Develop and implement a solution to improve passage of upstream migrant adult fish and downstream migrant juvenile fish in Battle Creek.



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Figure I-1
Location of the Battle Creek Salmon
and Steelhead Restoration Project

Purpose and Need, Project Description, and Project Background

This chapter states the purpose of and need for the Restoration Project, describes the Restoration Project, and provides Restoration Project background information.

NEPA requires that an EIS include the underlying purpose and need for the proposed action because this statement explains why the federal agency and project proponents are undertaking the proposed action and what objectives they intend to achieve. The statement of purpose and need is also used to determine the appropriate range of alternatives to be evaluated in the EIS. CEQA requires that an EIR include the project objectives because the statement of objectives is important in helping the lead agency develop a reasonable range of alternatives to evaluate in the EIR and will aid the decision makers in preparing findings and a statement of overriding considerations, if necessary.

Background information includes a timeline and summary of events leading to the development of the Restoration Project, discussion of the significance of Battle Creek, development of a Memorandum of Understanding (MOU), and discussion of the ecological restoration and energy production considerations associated with the Restoration Project.

Purpose and Need

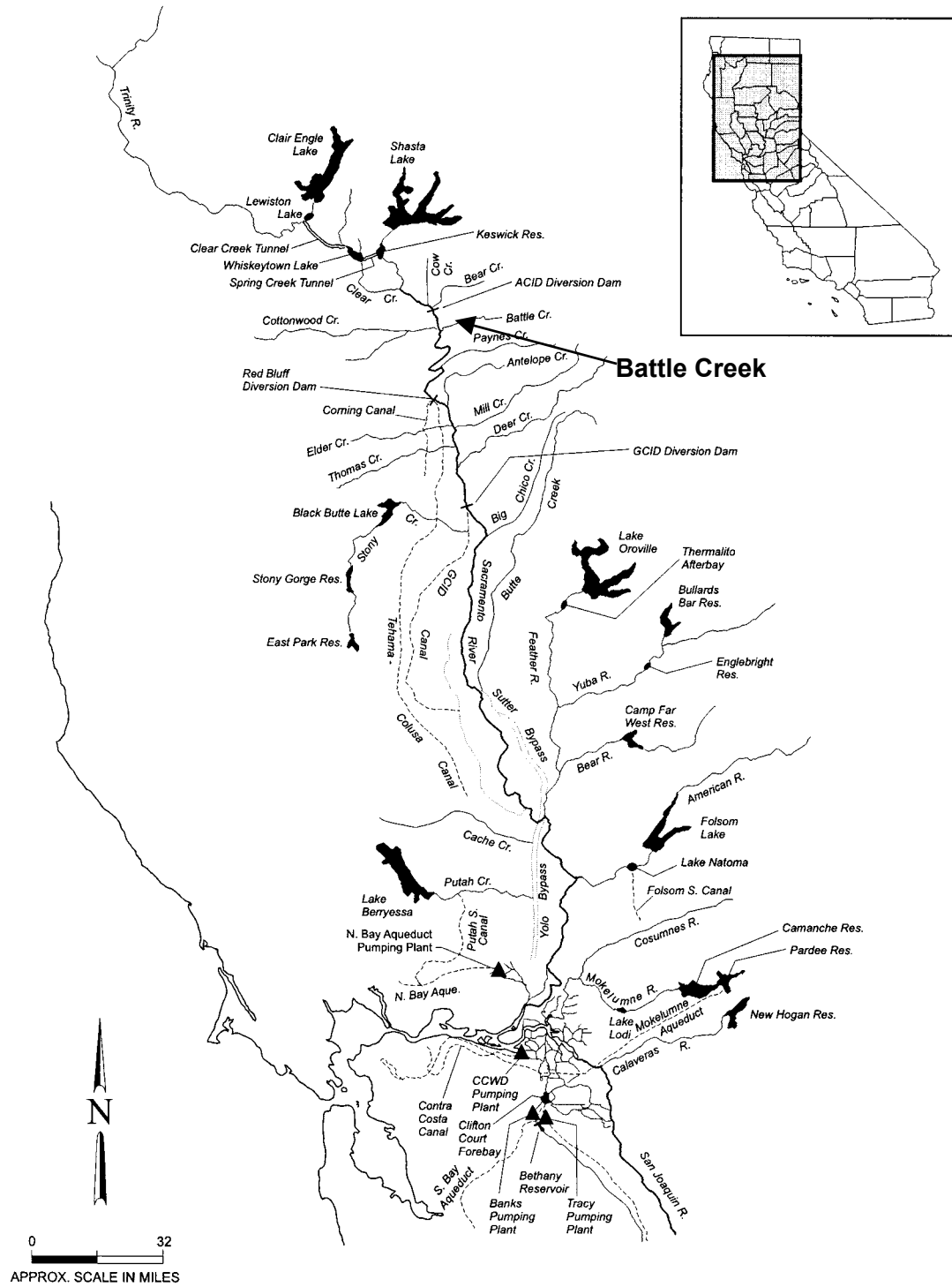
Within the past century, anadromous salmonid fish species in the Sacramento River system have declined because of a number of factors, including the loss and degradation of spawning habitat as a result of changes in hydrologic regimes caused by water management for flood control, irrigation, and hydropower production. In order to preserve and enhance current salmonid populations within the Sacramento River system, habitat restoration efforts are needed. An opportunity to restore uniquely valuable habitat exists in Battle Creek, a tributary to the Sacramento River.

The purpose of the Restoration Project is to restore approximately 42 miles of habitat in Battle Creek and an additional 6 miles of habitat in its tributaries while minimizing the loss of clean and renewable energy produced by the Hydroelectric Project.

The Restoration Project will be accomplished through the modification of Hydroelectric Project facilities and operations, including instream flow releases. Habitat restoration would enable safe passage for naturally produced salmonids and would facilitate their growth and recovery in the Sacramento River and its tributaries. These salmonids include Central Valley spring-run chinook salmon, state- and federally listed as threatened; Sacramento River winter-run chinook salmon, state- and federally listed as endangered; and Central Valley steelhead, federally listed as threatened.

The timely restoration of a drought-resistant, spring-fed system like Battle Creek is especially important to species such as winter-run and spring-run chinook and steelhead, which are dependant on cool water stream habitats. Winter-run chinook is actually obligated to habitats like Battle Creek that have reaches kept constantly cool year-round by springs. Historically, winter-run Chinook salmon populations occurred in the creek, but at present, the only significant population of winter-run chinook occurs in the main stem of the Sacramento River below Shasta Dam (Yoshiyama et. al. 1998). This section is kept cool by releases from the deepest portion of the reservoir. However, periods of extended drought exhaust this cold water reserve, leaving the fish susceptible to reproductive failure. The current population is at risk of total reproductive failure due to lethal water temperatures at least 2 years out of every 100 and partial reproductive failure 1 year out of every 10 (U.S. Bureau of Reclamation 1991). Because it is inevitable that serious drought conditions will again affect Shasta Lake, it is necessary to have drought resistant refugia available in the upper Sacramento River system for populations sensitive to drought conditions like winter-run and spring-run chinook.

The Restoration Project facilitates a timely restoration of the stream compared with waiting until 2026 for the expiration of the existing FERC license of the Battle Creek Hydroelectric project. One of the most valuable aspects of hydropower is that it is renewable through annual snowmelt and rainfall. Hydropower's fuel, water, is replenished with precipitation. Unlike fossil fuel technologies, hydropower's fuel is reused because it is not consumed in the production of electricity. Hydropower produces no greenhouse gases or other air pollutants. The use of hydropower makes it possible to avoid the additional burning of natural gas or other fossil fuels, which in turn avoids the release of the following air emissions: carbon dioxide, nitrogen oxide, carbon monoxide, and the production of ozone or smog.



Source: Reclamation and USFWS 1999

Figure 2-1
 Sacramento River Basin

Project Objectives

Specific project objectives were developed to expand on the purposes of the Restoration Project and to help develop project alternatives. A variety of alternatives that propose various combinations of steps to be taken to improve fish habitat and fish passage (e.g., dam removal, flow increases) are described in this document. The project objectives are consistent with recovery plans for listed anadromous fish species. The alternatives evaluated in this EIS/EIR are consistent with the following specific objectives:

- restore self-sustaining populations of chinook salmon and steelhead by restoring their habitat in the Battle Creek watershed and access to it through a voluntary partnership with state and federal agencies, a third party donor(s), and PG&E;
- establish instream flow releases that restore self-sustaining populations of chinook salmon and steelhead;
- remove selected dams at key locations in the watershed where the hydroelectric values were marginal due to increased instream flow;
- dedicate water diversion rights for instream purposes at dam removal sites;
- construct tailrace connectors and install fail-safe fish screens and fish ladders to provide increased certainty about restoration components;
- restore stream function by structural improvements in the transbasin diversion to provide a stable habitat and guard against false attraction of anadromous fish away from their migratory destinations;
- avoid Restoration Project impacts on species of wildlife and native plants and their habitats to the extent practicable, minimize impacts that are unavoidable, and restore or compensate for impacts;
- minimize loss of clean and renewable energy produced by the Battle Creek Hydroelectric Project;
- implement restoration activities in a timely manner;
- develop and implement a long-term adaptive management plan with dedicated funding sources to ensure the continued success of restoration efforts; and
- avoid impacts on other established water users/third parties.

The Restoration Project is a proactive, cooperative undertaking among the public, interested parties, the BCWG, BCWC, state and federal agencies, and PG&E to help restore the anadromous fishery in the Sacramento River watershed, where funding and restoration potential are uniquely promising.

Project Description

The Restoration Project consists of the portion of the Hydroelectric Project below the natural fish barriers (Figure 2-2). The upper project limit on North Fork Battle Creek is the absolute natural fish barrier above North Battle Creek Feeder Diversion Dam, 14 miles upstream of the confluence. The upper project limit on South Fork Battle Creek is the natural fish barrier above South Diversion Dam. The lower project limit is the confluence of the Coleman Powerhouse tailrace channel and the mainstem of Battle Creek.

Restoration efforts would occur at Hydroelectric Project sites along North Fork and South Fork Battle Creek and their tributaries, including North Battle Creek Feeder, Eagle Canyon, Wildcat, Coleman, Lower Ripley Creek Feeder, Inskip, Soap Creek Feeder, and South Diversion Dams; the Eagle Canyon, Wildcat, Inskip, and South Canals; and the Inskip and South Powerhouses. Complete descriptions of each site, as well as each project alternative, are in Chapter 3 of this EIS/EIR.

The Restoration Project provides the following modifications to the Hydroelectric Project that would achieve the restoration of ecological processes important to anadromous fish.

- Adjustments to Hydroelectric Project operations, including allowing cold spring water to reach natural stream channels, decreasing the amount of water diverted from streams, and decreasing the rate and manner in which water is withdrawn from the stream and returned to the canals and powerhouses following outages.
- Modification of facilities such as fish ladders, fish screens and bypass facilities, diversion dams, and canals and powerhouse discharge facilities.
- Changes in the approach used to manage the Hydroelectric Project to balance hydroelectric energy production with habitat needs, using ecosystem-based management that protects and enhances fish and wildlife resources and other environmental values using adaptive management, reliable facilities, and water rights transfers, among other strategies.

The Restoration Project intends to restore the ecological processes that would allow the recovery of steelhead and chinook salmon populations in Battle Creek and minimize the loss of clean and renewable electricity through modifications to the Hydroelectric Project. The ecological processes in Battle Creek that have been affected to varying degrees by Hydroelectric Project facilities and operations include:

- physical processes that operate within the stream channels, such as streamflow effects on aquatic habitat, coarse sediment routing, and maintenance of subsurface water levels in riparian habitat;
- heating and cooling processes in the streams; and

- biological processes such as fish migration, homing and straying of anadromous salmonids, and fish spawning and rearing.

The alteration of these processes has affected steelhead and salmon populations in a number of ways, including:

- limiting the amount of habitat available for spawning and rearing,
- limiting access to available habitat, and
- causing warmer water temperature above levels tolerable to sensitive life stages of salmon and steelhead and altering the stability of the temperature regime on the South Fork by making the powerhouse operations such a dominant dynamic influence on temperature.

Restoration of these ecological processes is expected to facilitate the recovery of steelhead and winter-, spring-, fall-, and late fall–run chinook salmon because it would provide:

- improved amounts of otherwise production-limiting spawning and rearing habitat;
- unimpeded access of anadromous salmonids to their preferred habitats,
- instream water temperature profiles that are improved and approach the magnitude and thermal continuity of those conditions under which anadromous fish populations have evolved in Battle Creek, and
- unambiguous environmental cues used by salmon and steelhead to navigate that reflect the magnitude and distribution of those conditions under which anadromous fish populations have evolved in Battle Creek.

Project Background

Figure 2-3 presents a timeline and summary of events leading to the development of the Restoration Project. The Restoration Project is supported by and consistent with the following acts, programs, and plans:

- Central Valley Project Improvement Act (CVPIA) (Title 34 of Public Law 102-75, 1992) Anadromous Fish Restoration Program.
- California State Salmon, Steelhead Trout, and Anadromous Fisheries Program Act (California Senate Bill 2261, 1990).
- CALFED Bay-Delta Ecosystem Restoration Program Plan (CALFED 2000b).
- Upper Sacramento River Fisheries and Riparian Habitat Management Plan (California Senate Bill 1086, 1989). *
- Central Valley Salmon and Steelhead Restoration and Enhancement Plan, prepared by the DFG (1990a). *

- Steelhead Restoration Plan and Management Plan for California, prepared by the DFG (1990b). *
- Restoring Central Valley Streams: A Plan for Action, prepared by the DFG (1993b). *
- Proposed Recovery Plan for Sacramento River Winter-Run Chinook Salmon, prepared by NOAA Fisheries (1997b).
- Actions to Restore Central Valley Spring-Run Chinook Salmon, prepared by the DFG (1996f).

The following information is intended to provide an understanding of why Battle Creek is a rare and valuable opportunity to effect significant habitat restoration. It also provides the key considerations used to develop the comprehensive plan identified as the Restoration Project. Further, it provides background on particular attributes of Battle Creek, biological factors pertinent to the anadromous fishery restoration, renewable energy production considerations, and other important aspects associated with the Restoration Project.

Battle Creek Significance

In recent decades, California has experienced a statewide decline in its salmon and steelhead populations, particularly wild stocks. The decline has been attributed to multiple causes, most notably the development of federal, state, municipal, and private water projects to meet growing societal demands. In the Sacramento River drainage, large projects that provide domestic water supplies, irrigation, flood control, and power generation have in some cases irretrievably blocked anadromous fish access to natal streams. Actions to offset permanent stream habitat loss, such as establishing hatchery facilities, have maintained adequate stocks of some species. However, these actions have not been able to mitigate fully the loss of habitat used by species such as winter-run chinook salmon, spring-run chinook salmon, and steelhead that evolved life strategies to make use of the headwaters of major river systems in the Central Valley where natural barriers were absent.

The continuing decline in numbers of several species of chinook salmon and steelhead has resulted in their listing under ESA and CESA as threatened or endangered. Before the species' listing, resource agencies and interest groups were aware of the declines and had initiated efforts aimed at arresting the decline and rebuilding these populations to levels above thresholds of concern set by ESA and CESA. While a number of those efforts broadly address the issues, specific actions significant to the restoration of Battle Creek include the Upper Sacramento River Fisheries and Riparian Habitat Management Plan, the CVPIA, and the ERP of the CALFED Bay-Delta Accord.

* qualified as a comprehensive plan under section 10(a) (2) (A) of the Federal Power Act (FPA)

A common strategy to arrest the decline of the various anadromous salmonid stocks has been to recognize that some habitat has been permanently lost and to focus on finding other suitable habitat that is, or could be, ecologically equivalent, accessible to these species, and that could be restored to offset the permanent losses. In pursuit of that strategy, the use of partnerships among governmental agencies, stakeholders, and the private sector is viewed as the most efficacious and timely means to identify these restoration opportunities and share the costs necessary to bring them to fruition. This approach is the genesis of Battle Creek being identified as an extraordinary opportunity and the initiation of a partnership to effect a comprehensive restoration project for the watershed.

When compared to other upper Sacramento River tributaries, Battle Creek offers an extraordinary restoration opportunity because of its geology, hydrology, habitat suitability for several anadromous species, historical water allocation, and land uses compatible with a restored stream environment. The geology of the Battle Creek watershed, located at the southern end of the Cascades, is primarily volcanic in nature (Figure 2-4). This type of terrain provides deeply incised, shaded, cool stream corridors. Its ruggedness limits the extent of human activities that typically occur around more readily accessible streams. While substantial quantities of water have been diverted for hydroelectric production since the early 1900s, other activities that could have potentially detrimental impacts on the stream and surrounding riparian environment have been effectively precluded by the nature of the terrain.

Perhaps the most important feature of Battle Creek supporting its potential for restoration is its hydrology, which results from the volcanic nature of the drainage. Seasonal precipitation does not rapidly run off the watershed as with streams situated farther south in the Sierra Nevada. Instead, a large portion of the annual water charge percolates through the underlying volcanic strata and emerges throughout the watercourse as cold springs that ensure a relatively high and stable base flow throughout the year. The naturally regulated stable base flow and cold water temperature offer drought resistance not found elsewhere in the present range of anadromous fish and ensure that the watershed can provide refugia for species when they may become distressed in other watersheds more vulnerable to drought conditions. These hydrologic and geologic attributes of Battle Creek are representative of streams permanently blocked by water development projects. In terms of a restoration opportunity, Battle Creek offers the natural habitat conditions conducive to the recovery of species no longer able to access all of their ancestral streams.

In addition to the nature of Battle Creek's hydrology, its geomorphic processes are relatively undisturbed. No large onstream reservoirs impede upstream and outmigration of anadromous fish. Lack of such storage features and the relatively small capacity of the hydroelectric diversions allow seasonally high spill flows to pass through the watershed, providing the necessary flows for gravel and stream channel maintenance in virtually the same manner as has occurred historically. This natural, seasonal rejuvenation of the streambed has maintained Battle Creek's relatively pristine condition, another important factor in its high potential for successful restoration

The suitability of Battle Creek to support the recovery of several anadromous species is exhibited in the type of habitat it offers and the historical use by the listed, naturally occurring anadromous salmonid species in the watershed. Despite the development that has occurred since the early 1900s and the fragmented habitat that exists, remnant populations are still present in the watershed. It is the only upper Sacramento River tributary that has the potential to support winter-run chinook salmon.

The demonstrated persistence of the various anadromous species inhabiting Battle Creek is a key factor in concluding that wild populations could again flourish if habitat improvements are made to better support the various fish life stages. Establishment of an assemblage of several recovered species in Battle Creek would contribute significantly to reversal of the decline of these populations as a whole.

The private ownership of lands bordering Battle Creek is another attribute that would discourage potential human impacts on recovered species. Existing land uses and relatively low consumptive water use are compatible with stream restoration. The terrain itself also precludes development that could have adverse effects. The scale of the Hydroelectric Project is such that modifications to its facilities and operation can be made to meet habitat improvement goals without excessive loss of this renewable resource that is ever more critical to California.

Development of a Memorandum of Understanding

The compatibility of continuing existing land uses and the limited impact on the Hydroelectric Project have facilitated the formation of partnerships supportive of restoration activities throughout the watershed. In particular, the formal partnership among federal and state agencies and PG&E to modify and reoperate the Hydroelectric Project is the key element in the restoration of stream reaches. The collaboration among these partners and the other stakeholders has been the hallmark in the development of the widely supported Restoration Project involving the hydroelectric facilities.

In early 1999 this cooperative effort led to the signing of an Agreement in Principle by Reclamation, NOAA Fisheries, USFWS, DFG, and PG&E to pursue a restoration project for Battle Creek (Appendix D). In mid-1999, the parties signed a detailed, formal MOU in conformance with the Agreement in Principle, allowing the release of \$28 million in CALFED funding for the agencies' responsibilities in the partnership. Since the signing of the MOU in 1999, costs have increased to \$62 million.¹

The MOU called for contributions from PG&E in the form of forgone energy generation, pursuit of an amendment to the Hydroelectric Project's FERC

¹ Additional CALFED funding is being sought. If additional funds are not made available for physical implementation of the project, it will be suspended until said additional funds are made available.

license, transfers of certain water rights to the DFG, and a variety of other requirements. Flow determinations for the Restoration Project used in the MOU were initially developed by the BCWG biological technical team. The MOU also provided for the partial funding of adaptive management through a separate third-party funding agreement for an additional \$3 million. The plan discussed in the MOU is the Proposed Action alternative, which is being evaluated along with other Action Alternatives in this EIS/EIR.

Social Context

The Restoration Project has been supported in the community and is consistent and compatible with other related restoration initiatives in the watershed. The BCWG has served as a catalyst to explore various actions to carry forth the Restoration Project. The BCWG supports the Restoration Project, pending the appropriate consideration and resolution of other watershed actions, notably, the operation of Coleman National Fish Hatchery.

In addition to the Restoration Project, restoration actions in the watershed include the evaluation of the fish hatchery's operations to ensure their compatibility with recovery efforts for wild anadromous species in Battle Creek above the hatchery; the acquisition of conservation easements along the watershed stream corridors from willing landowners; the development of a Battle Creek Watershed Community Strategy (Appendix B) through CALFED funding; and the watershed restoration measures identified in the Anadromous Fish Restoration Plan (AFRP) associated with the CVPIA. In addition, the Draft Greater Battle Creek Watershed Adaptive Management Framework and Organization has been developed by the stakeholders of the BCWG (Appendix B). The BCWG stakeholders have also developed a draft MOU, the purpose of which is to coordinate the planning, implementation, and evaluation of all fisheries, restoration, and watershed projects among public agencies, nonprofit organizations, and private landowners within the Greater Battle Creek (Appendix B). The stakeholders of the BCWG have also voiced their concerns regarding Battle Creek watershed activities through written correspondence with various agencies (Appendix B).

Coordination of Restoration Project measures with broader local watershed management initiatives and those of a basinwide nature would ensure that restoration of the anadromous fishery in Battle Creek is maintained and would contribute significantly to population recovery goals.

Ecological Restoration Considerations

Consistent with having an ecosystem approach to conservation of salmon and steelhead, the essential goal of salmonid restoration in Battle Creek is to reconnect and improve the important habitat values in the stream system, especially the drought-resistant refugia found in spring-fed reaches. This would

allow for the expansion of existing populations of spring-run and winter-run chinook salmon and steelhead native to the upper Sacramento River Basin (Spence et al. 1996). The most important element of this approach is achieving an adequate minimum level of instream flows that would meet the various life stage needs of the anadromous species. Priority should also be given to the release of water from available coldwater springs into the natural channels in preference to release from surface water sources. With partnerships coalescing, stakeholders have pursued an evaluation of habitat needs in Battle Creek to restore the anadromous fishery through various forums. This evaluation focused on minimum instream flow requirements, release of cold spring water to adjacent stream sections, management of those instream flows, upstream and downstream fish passage, restoration of stream function to mimic the natural hydrography in its undeveloped state, and adaptive management to monitor and refine restoration actions. In addition, the availability of significant public funding through the CALFED ERP has allowed for design of restoration project facilities and flows expected to have biological performance exceeding those typically attained in the normal FERC process.

Instream Flow

Because the stream contains a diversity of species and their life stages, substantial effort was directed toward identifying which stream reaches were best suited to the recovery of a particular species. Minimum instream flow schedules were then developed to best serve their life stages through the year.

Recognizing the importance of instream flows for restoration of Battle Creek anadromous fisheries, the USFWS in coordination with state and federal agencies, stakeholders, and interested parties, identified preliminary increases in minimum flows. The preliminary increased minimum flows were developed pursuant to the CVPIA's AFRP and were included in the Revised Draft Restoration Plan for the AFRP (USFWS 1997b). The AFRP's prescription for increased flows considered relationships between streamflow and the physical habitat available to various life stages of anadromous fish for several reaches of Battle Creek (Thomas R. Payne and Associates 1998a) with the objective of providing adequate holding, spawning, and rearing habitat. The AFRP-developed minimum flows were offered as indicators of magnitude needed to optimize anadromous fish production, subject to revision after additional analysis (USFWS 1995a).

In general, these minimum flows were characterized as flows capable of developing 70–75% of the life stage that is potentially most limiting to a population's production in a given stream reach. The AFRP flow schedule did not include releases from the major cold spring water-bearing formations at the Eagle Canyon and Bluff Springs.

Following additional analysis of instream flow data, the BCWG's biological technical team, composed of experts from resource agencies, PG&E, and stakeholders, increased the minimum flows prescribed by the AFRP and

incorporated them into the Restoration Project MOU. A substantial body of work directed at quantifying stream habitat, gravel recruitment, passage at natural barriers, and water temperatures was completed in 1998 by Thomas R. Payne and Associates under contract to the DFG with assistance of a technical team composed of PG&E, USFWS, and other participants in the SB 1086 Program (Thomas R. Payne and Associates 1998a, 1998b, 1998c). The information contained in one of those reports, *A 1998 Instream Flow Study: 1 of 8 Components* (Thomas R. Payne and Associates 1998a), formed the scientific basis for evaluating instream flow needs.

The biological technical team also assessed species' needs by using a limiting life stage analysis to determine appropriate minimum flows (Kier Associates 1999b). Simply stated, this approach looks at the potential habitat availability in a particular stream reach and the related flows required to support different life stages such as adult spawning, fry development, and juvenile rearing. The life stage found to be most limiting to fish production in a given stream reach is used to identify the optimal instream flow conditions for that stream, thereby maximizing potential production. The focus of the flow prescription for the limiting life stage was to provide approximately 95% of the estimated habitat that could be created by flow increases. Typically, the two most common life stages competing as a limiting factor were spawning habitat and juvenile rearing habitat. In some reaches, spawning habitat is the limiting factor for production, and in others, juvenile rearing habitat limits production.

In addition to differing life stage flow needs for a single species in a given stream reach, the likely presence of other species added complexity to determining appropriate flows (Kier Associates 1999b). During certain periods of the year, the needs of competing species can conflict. Some accommodation for competing life stages is possible through short-term minimum flow adjustments during transition periods. However, this accommodation involves a compromise between species and cannot be optimal for any species' life stage. Where unavoidable habitat need conflicts occurred, the biological technical team prioritized species based on the availability of their associated habitat in the watershed. This criterion was used to meet species' needs for natural reproduction and to effect their recovery. Because of scarcity of habitat, winter-run chinook salmon was the highest priority followed by spring-run chinook salmon, steelhead, late fall-run chinook salmon, and fall-run chinook salmon.

The greatest divergence of seasonal flow needs occurs between steelhead and the various species of chinook salmon. Because steelhead have greater opportunities available to them for suitable habitat elsewhere in the upper Sacramento River basin, the technical team decided to provide a less-than-optimal flow regime for steelhead. This ensures better habitat conditions for winter-run and/or spring-run chinook salmon. This view was deemed appropriate by the resource agencies, in light of the rather limited habitat opportunities available elsewhere for winter-run and spring-run chinook salmon.

Flow Management

In addition to assessing the optimal flow from a limiting–life stage perspective, the biological technical team recognized the need to manage flows effectively to address concurrent considerations (Kier Associates 1999b). An important consideration that affected the selection of an appropriate minimum flow in some stream reaches was passage over natural barriers. In some cases, ensuring this passage required elevating flows to higher values than those optimal for life stage consideration. Typically, even with this passage accommodation, the minimum flows prescribed by the biological technical team were designed to achieve 95% or more of the biologically optimal restoration flow for a potential limiting life stage.

Water temperature was also an important factor in developing the Restoration Project. The AFRP considered temperature and hydrology in prescribing its minimum instream flows; however, a temperature model for Battle Creek was not available during development of the AFRP Revised Draft Restoration Plan (USFWS 1997b). In response, the biological technical team analyzed water temperature using the SNTMP Model applied initially by Thomas R. Payne and Associates then refined by PG&E (PG&E 2001a). The model was used primarily to determine which stream reaches might be most sensitive to temperature effects caused by changes in flow. The temperature model can also be used to determine the extent of habitat available for the various life stages under certain meteorological and water year conditions.

Rapid abnormal flow fluctuation in the natural stream channels associated with hydroelectric power system operation has the potential to adversely affect the habitat. Minimizing the occurrence of these fluctuations was addressed through ramping rate and new hydroelectric water conveyance facilities. These tools ensure that both planned maintenance activities and unanticipated power system disruptions would avoid instream flow disturbances to the extent practicable.

Passage

A key consideration in encouraging an increase in restored habitat is ensuring upstream and downstream passage beyond both natural barriers and artificial barriers such as dams. As noted previously, accommodation of natural barrier passage was addressed during the biological team’s assessment of minimum instream flow requirements, primarily as a consideration for adult fish migrating upstream to their spawning and holding areas (Kier Associates 1999b). In some cases, these natural barriers would need to be modified to improve passage conditions at prescribed flows. Because the stream is a dynamic environment and floods may create new natural barriers, monitoring for these occurrences should be performed regularly. In these cases, appropriate action would need to be taken either to modify a new barrier or to adjust instream flows to improve passage.

The BCWG fish passage technical team determined that fish passage facilities at the diversion dams would be designed as state-of-the-art installations, incorporating resource agency design criteria/guidelines for ladders and screens and geometries known to provide reliable performance (Kier Associates 1999a). Particular attention in fish ladder design would be directed toward providing attraction flows through the range of instream flows needed by adult fish to move upstream. Ladder configurations known to provide reliable performance in the field also would be used. The ladders would incorporate features to allow flow adjustment during abnormally low water conditions to ensure that effective passage conditions are maintained. Protective structures to minimize the potential for damage during floods would be included. The relatively low height of the dams to be passed via a fish ladder, coupled with the conservative approach to their design, is expected to provide high passage reliability. Removal of select dams would eliminate any concerns about fish passage at those sites.

Preventing the entrainment of outmigrating juvenile fish in Hydroelectric Project water conveyance facilities would be accomplished by installing fish screens at the diversion points (Kier Associates 1999b). As with fish ladders, the fish screens would meet current applicable resource agency criteria and known reliable configurations to allow small fish to continue downstream past water diversion points. Fish screens would be designed to shut off the water diversion automatically whenever the fish screen fails to meet design or performance criteria until the fish screen is functioning again. Similar to the fish ladders, protective structures would be incorporated to prevent damage to the screens during floods.

Restoration of Stream Function

An important feature of the current Hydroelectric Project is the cross-basin transfer of North Fork Battle Creek water to two powerhouses located on South Fork Battle Creek and the subsequent discharge of water into the natural stream channel for recapture at the next downstream diversion point. This mixing of North Fork and South Fork Battle Creek water and infusion of relatively cool powerhouse discharge water at discrete locations into the stream channel deviate from naturally occurring conditions. This unusual situation could negatively affect successful species recovery by interfering with the successful migration of adult salmon and steelhead to their natal streams—a phenomenon known as *false attraction* (Kier Associates 1999b).

One aspect of false attraction is associated with the interbasin transfers of water in the stream. Migrating winter-run and spring-run salmon returning to North Fork Battle Creek may be drawn into the South Fork of Battle Creek as a result of their sensing North Fork Battle Creek water mixed with South Fork Battle Creek flow at the stream confluence. South Fork Battle Creek is considered less desirable during drought to winter-run and spring-run chinook salmon that are natal to the North Fork. North Fork Battle Creek has higher resistance to drought conditions, and it may be important to maintain the fidelity of the fish natal to

this fork to ensure survival of the population during adverse conditions affecting streams elsewhere in the Sacramento River drainage. Loss of individuals to South Fork Battle Creek by false attraction at the confluence could compromise population survival during droughts. Guarding against false attraction may keep South Fork Battle Creek from becoming a drain on winter-run and spring-run chinook salmon populations produced in the North Fork, thus leaving this important refugia in the North Fork under-seeded during a drought. Specifically, should false attraction limit the rate and/or size of population growth in the North Fork, fewer returning adults would seed this refugia. The South Fork is very desirable habitat to restore in the Battle Creek watershed because it has the largest capacity to produce salmon outside of drought years, when it has limited capabilities to produce spring-run and winter-run chinook except in the higher elevation reaches.

A second aspect of false attraction has to do with powerhouses discharging relatively large amounts of cool water into the stream at their tailraces (Kier Associates 1999b). Under natural conditions, water temperatures typically become continually cooler as one moves upstream. Migrating adult fish key in on this declining temperature as they seek habitats with water temperatures conducive to successful spawning and rearing of offspring. This natural temperature profile is interrupted where powerhouse discharges enter the stream reaches on South Fork Battle Creek. These localized zones of cooler water may cause adult fish to arrest their upstream movement early and spawn in those zones. Subsequent power system outages or other disruptions that interrupt or alter the normal discharge of the cool powerhouse water could result in stream temperatures rising above maximum threshold temperatures for incubating eggs or fry. Although confined to South Fork Battle Creek, this situation is especially important because the cool natural habitat conditions needed to restore spring-run chinook salmon and steelhead are at the distant upstream reaches of this fork. Artificial water temperature phenomena that interrupt the journey of spawning adults to upstream habitat could compromise the recovery of naturally producing spring-run chinook salmon and steelhead populations in South Fork Battle Creek.

The BCWG biological technical team determined that restoration of stream function to avoid false attraction would be achieved through the construction of conveyance facilities that would avoid the introduction of North Fork Battle Creek water into South Fork Battle Creek. The mixed North Fork and South Fork Battle Creek water contained within the hydroelectric water conveyance system would enter Battle Creek about 5 miles downstream of the forks' confluence, where the waters have already naturally mixed. Tailrace connectors at South and Inskip Powerhouses and a water bypass feature at Inskip Powerhouse would convey the water to Coleman Canal in lieu of discharging it into South Fork Battle Creek. The facilities would address both the false attraction and flow fluctuation issues. The false attraction would be addressed by the isolation of North Fork Battle Creek water from South Fork Battle Creek flow.

Flow fluctuations associated with power system operations would be contained within the Hydroelectric Project's conveyance features rather than causing

disruptions in the natural stream channels. The system of power plants and canals on the South Fork is subject to both planned and unplanned outages. During these outages the water that cannot be conveyed through the power plant or the canal is released to the stream at any one of a number of spill outlets either at the dam or at numerous points along the length of the canals. In general, the power system water is released as far downstream as possible to reduce the effects on the stream environment, and routine planned outages are scheduled at the high flow period. The amount of water released from the power system is up to five times the minimum amount released to the stream for fish. This addition of hundreds of cfs of water to the creek during minimum flow conditions has the potential to disrupt the stability of the stream as the power system water is added and then removed after the outage period. The stream function effects are more widespread the closer to the diversion the spill of power system waters occurs.

Adaptive Management

Recognizing that there are likely to be unanticipated influences on fishery restoration or that initial actions may not produce expected results because of unforeseen factors, adaptive management can be an important tool to monitor results and refine the actions being taken. Adaptive management is a formal, science-based, well-defined process that identifies goals, specifies parameters to be monitored, sets protocols for data assessment, proposes trigger points to initiate action, identifies actions to be taken, and continually recycles with the aim of successfully achieving restoration of the fishery. The initial restoration actions would be comprehensive and based on the best scientific information now available. The application of adaptive management principles is an important tool to continually refine those initial actions, based on subsequent acquisition of fishery response data and/or improved scientific information.

A comprehensive draft Adaptive Management Plan (Appendix D) has been developed for the Proposed Action pursuant to the MOU. This document will be dynamic and part of an evolving multi-agency team approach (see Chapter 3 for additional information on the Adaptive Management Plan). Not only does this plan meet the desired criteria for adaptive management, but it also includes dedicated funding sources, notably a sizable third party contribution and funding provided by CALFED to facilitate any additional modifications to the Restoration Project and/or the acquisition of additional water to meet instream needs determined appropriate through the plan's protocols. Similar adaptive management plans would be developed for the other action alternatives.

Power Production Considerations

To minimize the loss of clean, renewable power production from the Hydroelectric Project, careful consideration has been given to power production issues while meeting habitat needs. Key among these are instream flow requirements, maintaining existing system operating flexibility, designing new

highly reliable facilities, ensuring that operating and maintenance requirements are reasonable, and achieving regulatory certainty to the extent feasible in light of the sensitivity of the anadromous species inhabiting the watershed. The following sections describe features associated with the Hydroelectric Project, including Hydroelectric Project facilities, water routing, stream diversions, water bypass provisions, facility reliability, operations and maintenance, regulatory certainty, and key elements to consider in order to maintain efficient hydroelectric operations.

Hydroelectric Project Facilities

PG&E's Hydroelectric Project was initially developed in the early 1900s (Figure 2-2). The Hydroelectric Project consists of five powerhouses (Volta 1, 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.

Hydroelectric development began on Battle Creek with the construction of the Volta Powerhouse by Keswick Electric Power Company in 1901 (Upper Sacramento River Fisheries and Riparian Habitat Advisory Council (USRFRHAC) 1989). Volta was one of the earliest hydroelectric developments in northern California. The Volta Powerhouse is supplied by two diversions from North Fork Battle Creek. The most upstream diversion is from Al Smith Diversion Dam at North Fork Battle Creek mile 16.5 at an elevation of 3,800 feet. The Al Smith Canal has a capacity of about 64 cubic feet per second (cfs) and ends at Lake Grace at an elevation of 3,480 feet, which serves as a forebay for one of the Volta penstocks. The second diversion is from Keswick Diversion Dam located at approximately North Fork Battle Creek mile 14 at elevation 3,650. The Keswick Canal also has a capacity of 64 cfs and ends at Lake Nora at elevation 3,430, which serves as a forebay for the other Volta penstock. The Volta Powerhouse (9 megawatts [MW]), with a capacity of 120 cfs, is located at elevation 2,240 feet, so the head is about 1,200 feet. There are two small reservoirs located upstream of the Al Smith diversion that provide a small amount of seasonal storage and flow regulation.

The tailwater from the Volta 1 Powerhouse flows in a canal about $\frac{3}{4}$ of a mile to the Volta 2 Powerhouse located on the north bank of North Fork Battle Creek at elevation 2,082 feet, just downstream of North Battle Creek Feeder Diversion Dam at North Fork Battle Creek mile 9.6. The Volta 2 Powerhouse (1 MW), constructed in 1980, operates with a head of only about 125 feet and has a capacity of 128 cfs. The Volta 2 tailwater flows in a pipe across the North Fork Battle Creek into the Cross Country Canal. The Cross Country Canal has a capacity of 150 cfs that flows about 4 miles to the South Powerhouse located on South Fork Battle Creek.

The South and Inskip Powerhouses were constructed in 1910, and the Coleman Powerhouse was completed in 1911. South Diversion Dam is located at South Fork Battle Creek mile 14.4 at an elevation of 2,030 feet. The South Canal capacity is about 100 cfs, but because Soap Creek (including Bluff Springs) is diverted into South Canal, the maximum diversion from South Diversion Dam is only about 85 cfs. South Canal joins with the Cross Country Canal to form Union Canal, which flows to the South Powerhouse penstock at elevation 1,960 feet. South Powerhouse (7 MW) has a capacity of 190 cfs with an operating head of about 500 feet.

Inskip Diversion Dam is located immediately downstream at South Fork Battle Creek mile 8.0 at an elevation of 1,415 feet. The Inskip Canal has a hydraulic capacity of 222 cfs and generally rediverts the South Powerhouse discharge. A small diversion from Ripley Creek flows into the Inskip Canal. At the Inskip penstock at elevation 1,400 feet, the Inskip Canal is joined by the Eagle Canyon Canal with a capacity of 70 cfs. The Eagle Canyon Canal flow is diverted from the North Fork Battle Creek at Eagle Canyon Diversion Dam located just downstream of Digger Creek at North Fork Battle Creek mile 5.3 at elevation 1,470 feet. The Inskip Powerhouse (8 MW) has a hydraulic capacity of 270 cfs with an operating head of about 380 feet.

Coleman Diversion Dam is located just downstream of the Inskip Powerhouse tailrace at elevation 1,000 feet at South Fork Battle Creek mile 2.5. The Coleman Canal capacity is about 340 cfs and generally rediverts the Inskip Powerhouse discharge. The Wildcat Canal joins the Coleman Canal just east of the confluence of the North Fork and South Fork of Battle Creek. The Wildcat Canal has a capacity of 18 cfs and diverts water from the North Fork Battle Creek at Wildcat Diversion Dam located at elevation 1,070 feet at North Fork Battle Creek mile 2.5. Two diversions on Baldwin Creek join the Coleman Canal. The Pacific Power Canal has a capacity of 15 cfs, and the Asbury pipe has a capacity of 35 cfs but must be pumped about 80 feet in height from Asbury Diversion Dam to the Coleman Canal. The Coleman Canal ends at the Coleman forebay at an elevation of 940 feet. The Coleman Powerhouse (13 MW) is located at elevation 460 feet, with a hydraulic capacity of about 380 cfs and an operating head of about 480 feet.

This system of powerhouses was acquired by PG&E in 1919. The project initially was licensed by the Federal Power Commission in 1932 and was relicensed in 1976 for a period of 50 years. The minimum flow requirement below each of the North Fork Battle Creek diversion dams is 3 cfs. The minimum flow requirement below each of the South Fork Battle Creek diversion dams is 5 cfs.

Hydroelectric Project Water Routing

The Hydroelectric Project diverts water within the Restoration Project area from North Fork and South Fork Battle Creek and several tributaries. Diversions from North Fork Battle Creek are made at North Battle Creek Feeder, Eagle Canyon,

and Wildcat Diversion Dams; diversions from South Fork Battle Creek are made at South, Inskip, and Coleman Diversion Dams. Diversions from Battle Creek tributaries include Soap Creek Feeder and Lower Ripley Creek Feeder on Soap Creek and Ripley Creek, respectively. PG&E's vested water rights on Battle Creek and Battle Creek tributaries are presented in Appendix F.

North Fork water is conveyed from its natural drainage and across the upper plateau through a series of tunnels, flumes, and open channels. South Fork water is similarly conveyed, although it remains within its natural drainage. The water from the two forks is ultimately collected into penstocks (large pipes) and dropped down to the South, Inskip, and Coleman Powerhouses situated on the north bank of South Fork Battle Creek and the mainstem of Battle Creek.

After passing through the South and Inskip Powerhouses, the mixed North Fork and South Fork water is discharged into South Fork Battle Creek. The mixed water is then diverted with additional South Fork water at Inskip and Coleman Diversion Dams, located just below the South and Inskip Powerhouses, respectively. Ultimately, all of this diverted water reaches Coleman Powerhouse, situated farther downstream on the mainstem of Battle Creek, where it is used again to generate electricity.

Occasionally, the powerhouses are shut down because of maintenance, lightning strikes, transmission grid disruptions, or other emergencies. When this occurs, the associated penstock collection facilities at the top of the plateau may be shut off. Diverted water traversing the plateau is then released into penstock bypass channels that enter the natural stream channel and is recaptured at the next downstream diversion dam. With these bypass systems, a shutdown of one powerhouse does not affect the continued operation of downstream powerhouses.

Stream Diversions

As addressed earlier, minimum instream flow requirements are aimed at optimizing habitat conditions to the extent practicable with competing needs in the stream at any given time. Flows in excess of those needed for habitat for priority species fish production are retained for energy production. Flexibility can be provided through adaptive management processes that adjust these flows as appropriate, based on information gained through comprehensive monitoring. Conceivably, this could result in increased or decreased minimum flows based on documented observation of fishery response over time. Additionally, instream flows can be temporarily increased to meet unusual situations, such as rising water temperatures during extreme hot weather conditions. The thoughtful determination of minimum flows, coupled with flexibility, ensures meeting habitat needs while minimizing the loss of renewable energy production.

Water Bypass Provisions

The flexibility of the five powerhouses making up the Hydroelectric Project is essential to maintaining reliability of this energy source and minimizing the loss of production. In order to maintain this flexibility, it would be best if water can be routed around any of the five powerhouses such that a plant being out of service does not affect the others. Attempting to maintain a separation of North Fork and South Fork waters could disrupt this operating flexibility and reliability. However, this disruption would be avoided by routing the South Powerhouse bypass into the proposed South Powerhouse–Inskip Canal connector tunnel and constructing an Inskip Powerhouse water bypass facility. These features would ensure continued flexibility of the energy production of the Hydroelectric Project while meeting biological goals that address false attraction and instream flow stability. In addition, water would be safely routed through these new conduits in the event of a sudden powerhouse shutdown. Otherwise, uncontrolled water would be released from the water conveyance facilities into the South Fork and mainstem of Battle Creek.

Facility Reliability

To maintain energy production, all facilities must be reliable. Robust design and protection from damage are especially important to ensure that the facilities operate as designed for fish passage without disrupting the energy production system. For example, any facility improvements that minimize the amount of water screened at a diversion will increase dependability of the powerhouse's water supply (tailrace connectors). Reliability is addressed through the application of state-of-the-art criteria, actual field experience to the design of the new facilities, and implementation of proactive measures to protect fish screens and fish ladders from damage caused by high flow events or debris in the water.

Operation and Maintenance

Hand in hand with robust designs, reasonable operating and maintenance requirements are critical to ensuring the reliable operation of the energy production system and salmon restoration facilities. The best design of the facilities will take this need and the need for biological reliability into account. The need for reliable operation should also be a consideration when recommending decommissioning and removal of several more remote installations. For the remaining energy production facilities, measures have been incorporated into the design of the facilities to produce cost-effective maintenance and operating requirements, thereby ensuring their reliable operation to meet both habitat and energy production goals.

Regulatory Certainty

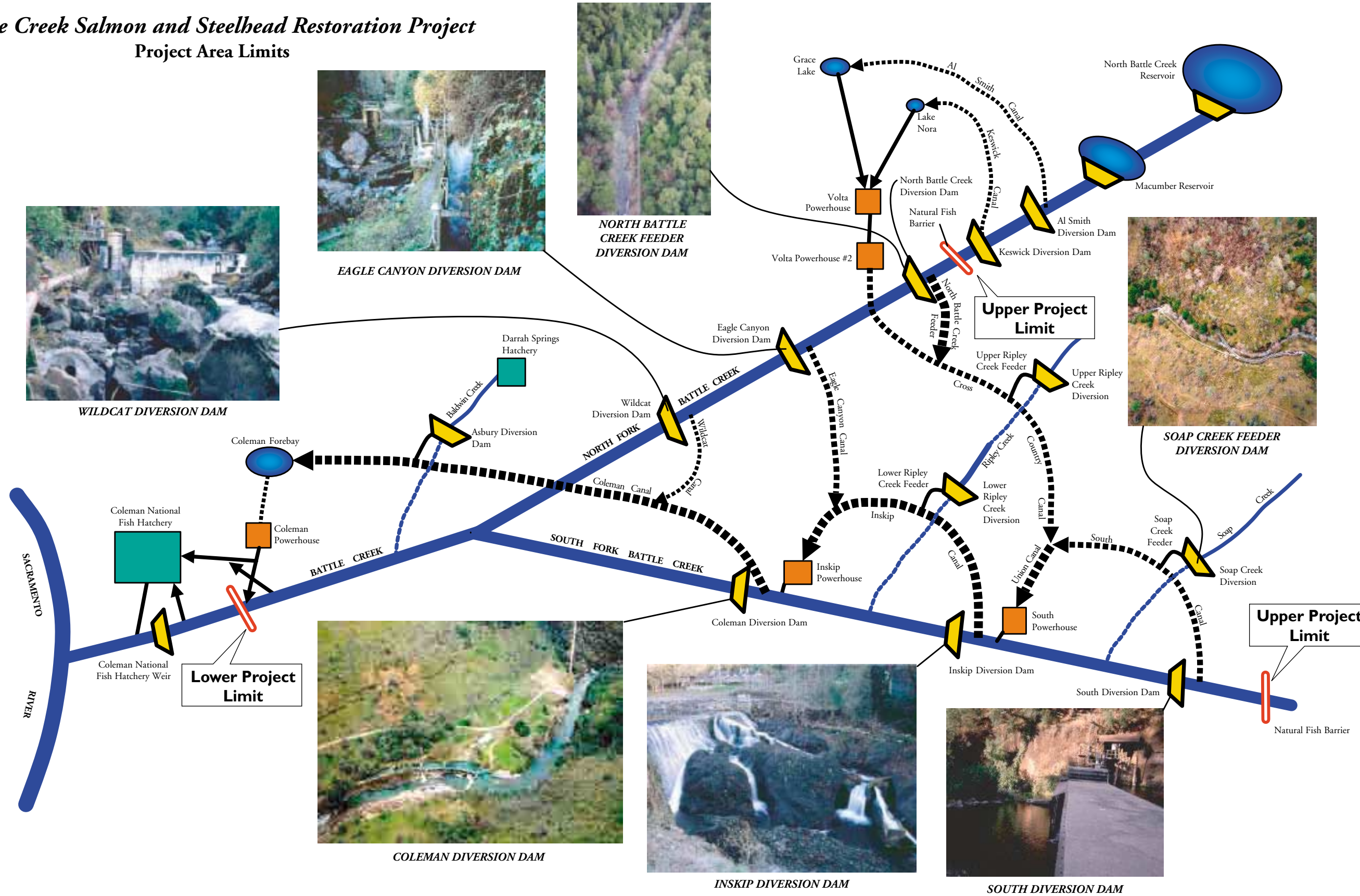
The Restoration Project will provide future regulatory certainty. The decline in populations of certain anadromous salmonid species that is the basis of the restoration effort also heightens sensitivity to preserving the remaining stocks and implementing successful measures for species recovery. The operation of facilities to meet human needs in this environment can involve a high degree of regulatory uncertainty. A comprehensive array of measures included as part of the Restoration Project effort substantially reduces that uncertainty with regard to continued reliable energy production from the Hydroelectric Project. By targeting minimum instream flows to achieve 95% or more of potential stream habitat, stabilizing flows and temperature regimes, installing reliable passage measures, constructing water conveyance facilities to restore stream function, removing facilities of marginal value postrestoration, and incorporating adaptive management, all known issues that need to be resolved to effect species recovery would be addressed. These measures would ensure that the hydroelectric facilities could continue to operate with minimal regulatory uncertainty regarding ESA issues pertaining to the anadromous fish species in the watershed.

Enhanced Benefits

The Restoration Project includes a number of other measures (beyond the physical issues discussed above) that would enhance and ensure environmental benefits. Among these are:

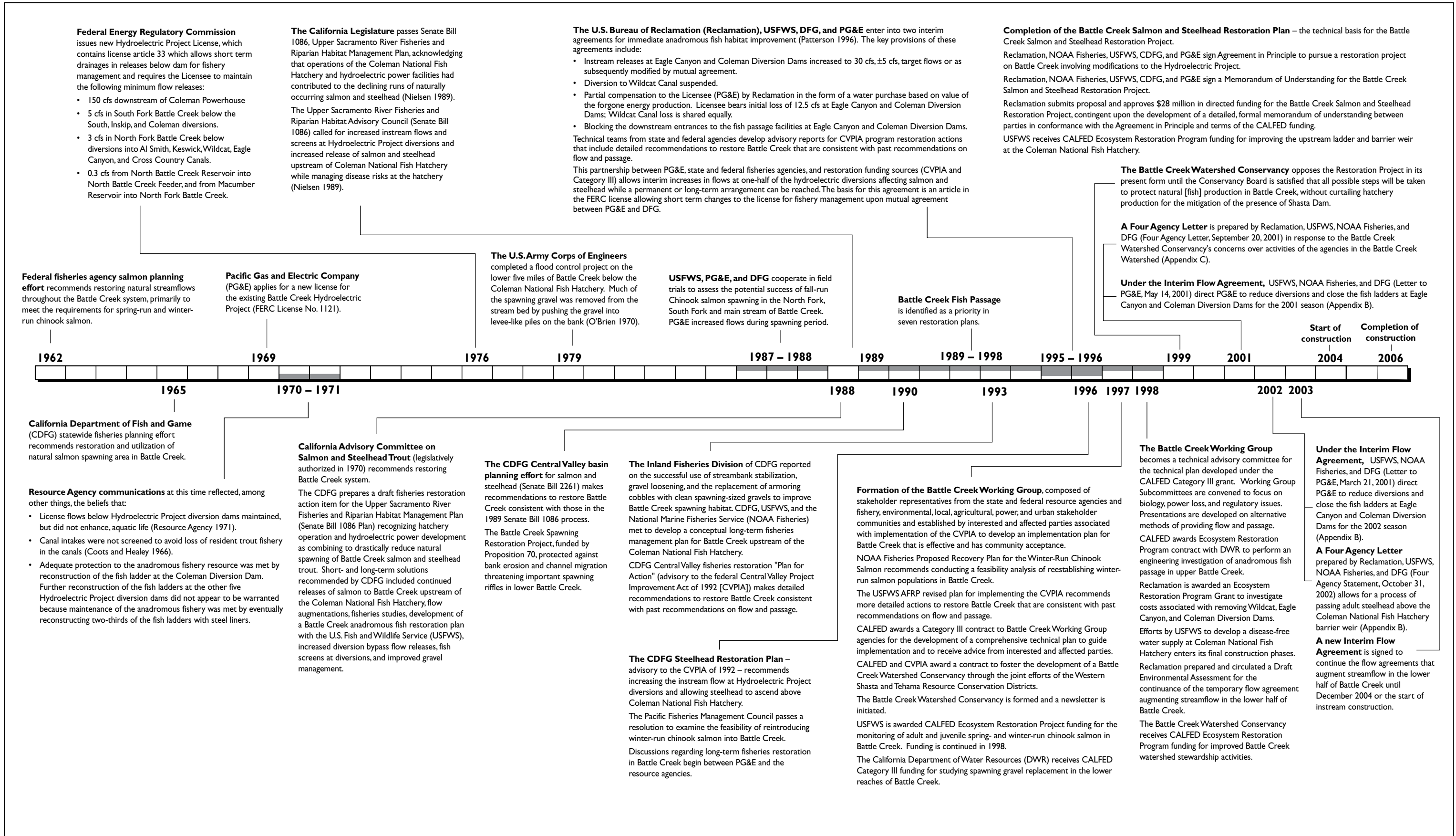
- transferring water rights at removed diversion dams to the DFG,
- supporting the dedication of those rights for instream use,
- creating a Water Acquisition Fund to facilitate additional instream flows should the adaptive management process determine that it would be appropriate, and
- using funds from a third party to create an Adaptive Management Fund to accommodate modifications to hydroelectric production facilities or the acquisition of additional water for increased instream flow determined by the Adaptive Management Plan protocols. A total of \$6 million is funded for adaptive management through scheduled use of funds derived from a third party and the CALFED water acquisition program.

Battle Creek Salmon and Steelhead Restoration Project
Project Area Limits



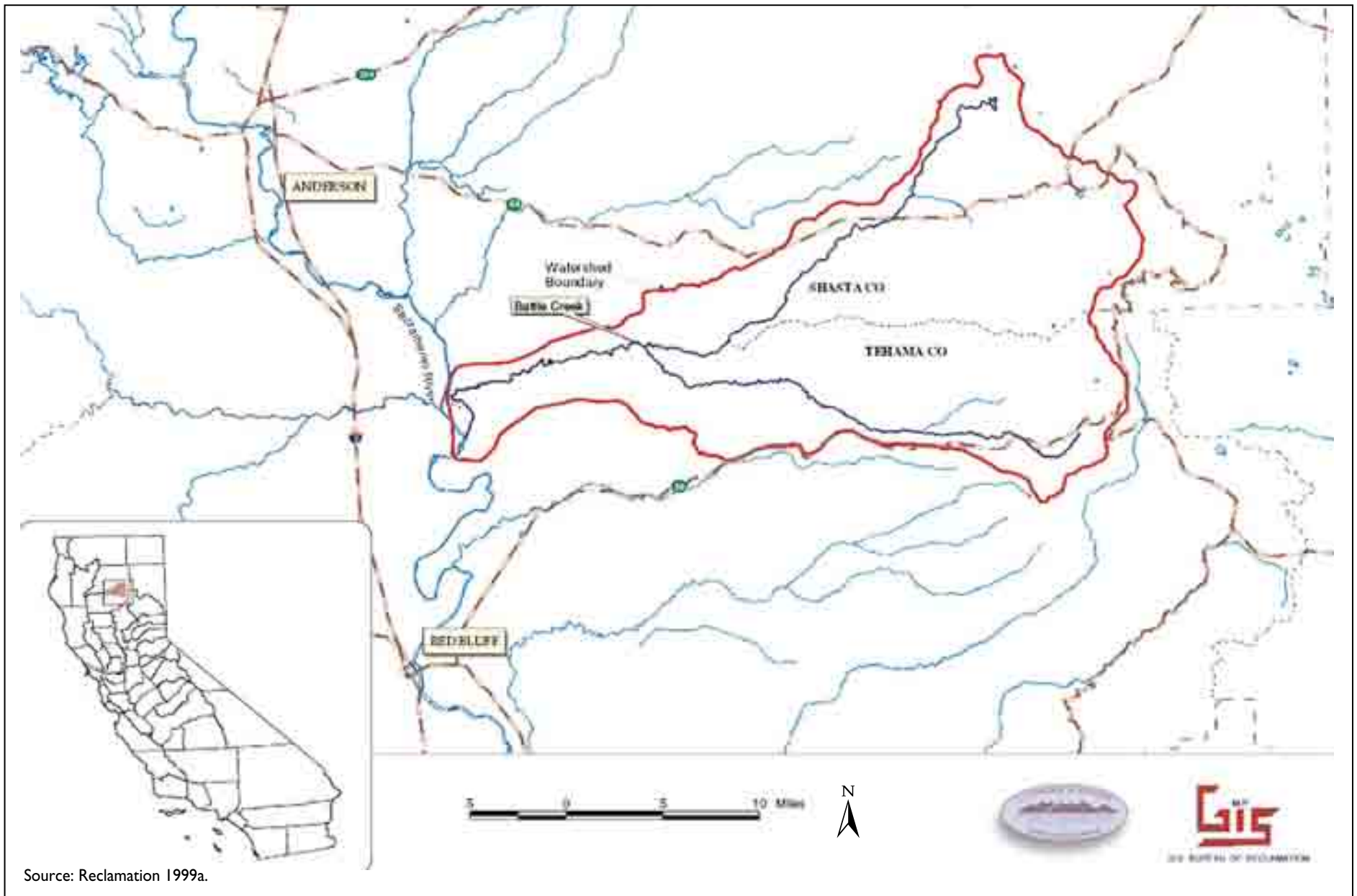
03035-03-001

Figure 2-2
Restoration Project Facilities and Limits



03035-03-001

Figure 2-3
Timeline of Important Milestones Associated with
Battle Creek Anadromous Fish Restoration



Source: Reclamation 1999a.

Figure 2-4
Battle Creek Watershed

03035.03-004

Chapter 3

Project Alternatives

This chapter describes existing facilities at each project site within the Restoration Project area. Following the description of existing facilities, this chapter describes Restoration Project Alternatives.

Existing Facilities

Hydroelectric Project facilities and operations are discussed in Chapter 2. The Restoration Project consists of the portion of the Hydroelectric Project below the natural fish barriers, as shown in Figure 2-2. The upper project limit on North Fork Battle Creek is the absolute natural fish barrier above North Battle Creek Feeder Diversion Dam, 14 miles upstream of the confluence. The upper project limit on South Fork Battle Creek is the natural fish barrier above South Diversion Dam. The lower project limit is 9 miles upstream of the confluence of Battle Creek and the Sacramento River at a location just below the confluence of Coleman Powerhouse tailrace channel and the mainstem of Battle Creek. The following sections describe the nine project sites that are within the Restoration Project area. A description of a tenth site that is within the project area, the Coleman Powerhouse site, is not included here because no modifications are proposed at the facility.

All powerhouses and diversion dams, except Soap Creek Feeder and Lower Ripley Creek Feeder, have electrical power service. Electrical features will not be described in detail. In general the powerhouse sites include switchyards which are connected to a network of overhead power transmission lines that traverse between sites within and outside the Restoration Project area. Power is brought to the diversion dam sites on overhead lines or along existing structures and is used to operate mechanical features, such as sluice gates, to provide lighting or to power various instrumentation used to monitor operating conditions (e.g. water level gauges).

PG&E either owns the land occupied by the project sites or has legal easement of the area. The project sites are located in remote areas. Generally, road access to the project sites is over private property to which PG&E has legal easement. For several sites, the last several hundred feet of access is by foot trail.

In the following descriptions the words *left* and *right* are used to indicate the direction of a feature pertaining to a dam or canal while facing downstream. For

example, a canal intake that is on the right abutment means that it is on the right side of the dam for a person looking in the downstream direction of flow.

North Battle Creek Feeder Diversion Dam (North Fork Battle Creek)

North Battle Creek Feeder Diversion Dam and Canal

North Battle Creek Feeder Diversion Dam and Canal were constructed around 1910 to divert 55 ft³/s of North Fork water into Cross Country Canal for generating power at South Powerhouse, located about 5 miles to the south. The dam is a rock-filled masonry type, 8 feet in height, with an overall length of approximately 93 feet at crest elevation 2082.4. A 5-foot-wide hydraulic sluice gate is set near the middle of the dam to allow sluicing of sediments that periodically accumulate behind the dam. This prevents sediments from blocking the canal headworks structure and fish ladder. Water is diverted through the concrete headworks structure located on the left side of the dam through a 36-inch-wide-by-48-inch-high electrically controlled slide gate that transitions into a metal flume. The left side of the dam is approximately 3 feet higher than the central overflow section to provide protection to the headworks area from flood flows. The feeder “canal” is actually a steel flume (ARMCO #96), semi-circular in shape and about 5 feet in diameter. The flume is supported by steel trestle structures as high as 11 feet above the original ground with concrete footings anchored into bedrock. The flume extends approximately 700 feet downstream of the dam where it discharges into an energy dissipation box, which also receives water from the Volta 2 Powerhouse. Cross Country Canal begins at this point. Volta 2 Powerhouse is located approximately 150 feet directly across the creek from the box. To the right of the sluice gate but still near the center of the dam is a metal Alaska Steeppass fish ladder, set inside an original concrete pool and weir fish ladder. The ladder structure is blocked to prevent upstream fish passage at the request of DFG. The canal does not have any fish screening system.

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 incorporates 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. PG&E owns the land on the northwest side of the creek. Flat areas at the top of the plateau above the dam have been used to stage construction operations for performing various maintenance activities. There is no access from the opposite side of the creek.

Eagle Canyon Diversion Dam (North Fork Battle Creek)



Eagle Canyon Diversion Dam

Eagle Canyon Diversion Dam and Canal were constructed in 1910 to divert up to 70 ft³/s of North Fork water into Eagle Canyon Canal for generating power at Inskip Powerhouse, located about 3 miles to the southwest. The dam is of rock masonry construction, 15 feet in height, with an overall length of approximately 70 feet at crest elevation 1430.2. A 4-foot-wide, 10-foot high manually operated radial gate is set near the middle of the dam to allow sluicing of sediments that periodically accumulate behind the dam. A weir also stems off of the dam upstream of the fish ladder and canal entrance area on the left abutment. The radial sluice gate and weir help prevent sediments from blocking the fish ladder and canal entrance. The canal consists of an entrance channel about 7 feet wide controlled by a 3.5-foot-wide-by-6-foot-high slide gate. The left wall of the channel is the vertical rock of the right abutment. The right wall is of reinforced concrete and rock masonry construction. The handwheel for operating the radial gate is located along this wall about 75 feet from the radial gate. This wall supports the left side of the Alaska Steeppass fish ladder, which is located between the canal entrance channel and the radial sluice gate. The canal channel

extends approximately 120 feet downstream of the dam before entering a 7-foot wide-by-12-foot-high tunnel, which is Tunnel No. 1 of Eagle Canyon Canal. A 3-foot-wide-by-6-foot high slide gate is located in the canal wall immediately upstream of the tunnel, which is used for sluicing and regulating diversion flows. A channel returns this discharged water back into the North Fork approximately 150 feet downstream of the dam. The outlet portal of an abandoned 6-foot-wide-by-6-foot-high tunnel joins the canal channel approximately 25 feet downstream of the dam. This tunnel was used during original construction to divert the creek to allow construction of the dam. Its inlet portal is located about 125 feet upstream of the dam. The tunnel is filled with water nearly to its crown and has a concrete wall within the tunnel, which prevents the creek from flowing through. A significant amount of spring water cascades off of the left abutment wall at almost all times of the year and is captured by the canal channel. An Alaska Steeppass fish ladder, about 2 feet wide and extending about 40 feet downstream of the dam, has been closed at the request of DFG. The canal does not have any fish screening system.

The south canyon wall is a significant source of spring-fed water. The amount of water varies with the time of year with a maximum of around 10 ft³/s. PG&E has collected this spring water with a system of troughs and pipes which convey the water into Eagle Canyon Canal. These collection facilities extend approximately 3000 feet downstream of the dam and about half way up the canyon wall.

Eagle Canyon Canal begins at Eagle Canyon Diversion Dam and extends approximately 2.6 miles to combine with flows from Inskip Canal immediately upstream of the penstock headworks for Inskip Powerhouse. The first 0.9 mile of canal is actually a series of tunnels and flumes that follow the south canyon rim. The tunnels are unlined and 7 feet wide by 8 feet high. The flumes are metal ARMCO #108, supported by steel trestle structures founded on concrete footings. Beyond this point, the water is conveyed in an open channel for another 1.7 miles to the penstock headworks. Another approximately 8 ft³/s of spring water is intercepted by the canal over an approximate 2,000-foot stretch in the vicinity of an area called Spring Gardens, located about 0.5 mile north of Manton Road. Most of the open channel sections of the canal are unlined. However, several stretches of the 8-foot-wide-by-4-feet-deep channels have been lined with gunite (pneumatically applied concrete) in areas that are experiencing high leakage or are susceptible to erosion. A number of spillways are spaced along the canal at both the tunnel/flume and open-channel sections. These spillways are either gated or contain flashboards that are adjusted as required to ensure that the canal does not become overcharged with water. Occasionally, during periods of intense rain runoff, the canal receives more water than it can contain. The spillways provide a controlled means of releasing this water, which returns to the North Fork. The corridor along the canal is not fenced.

Eagle Canyon Diversion Dam is 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.

Wildcat Diversion Dam (North Fork Battle Creek)



Wildcat Diversion Dam and Pipeline

Wildcat Diversion Dam and Canal were constructed in 1912 to divert around 20 ft³/s of North Fork water into Coleman Canal for generating power at Coleman Powerhouse, located about 8 miles west of the dam. The dam is a masonry gravity structure 8 feet in height, with a 2-foot crest width, vertical upstream face and a downstream slope of about 0.5:1, and a 27-foot overflow crest length at elevation 1074.7. The overall structure length is about 55 feet including the abutment sections. The upstream face has a concrete gunite facing. A gated sluiceway is set into the right side of the dam between the overflow crest and the headworks for the diversion pipe. The sluiceway is controlled by an upstream 24-inch-diameter slide gate, which is opened to allow sluicing of sediments that periodically accumulate behind the dam. Water is diverted through a 30-inch-diameter steel pipe in the right abutment section. The steel pipe diversion includes a 6.5-foot-long upstream apron of masonry, a 4-foot-wide sloping metal trashrack, and a 36-inch-diameter slide gate with a manually operated pedestal lift and an intake sill. A 37.5-foot-long concrete steppool fish ladder structure is located on the left abutment of the dam and contains an Alaska

Steeppass fish ladder. The ladder is not blocked but has been determined to be inefficient and undersized. The diversion pipeline does not have any fish screening system.

Wildcat Canal extends 1.9 miles from Wildcat Diversion Dam to its confluence with Coleman Canal. The initial approximately 1.0 mile of the canal actually consists of 24-inch-diameter welded steel pipe. The first 0.2 mile of pipe are located on the north side of the North Fork Battle Creek. At this point the pipe crosses the creek and continues the remaining 0.8 mile on the south side of the creek. The entire length of pipe is aboveground and supported on various pedestal arrangements. These include 240 concrete saddle supports (from 1 to 7 feet high), 48 timber supports, and 20 steel pipe supports. The pipeline crosses three watercourses (North Fork Battle Creek, Juniper Gulch, and Chicken Hollow) before it terminates in a reinforced concrete transition structure. The remaining 0.9 mile of Wildcat Canal consists of excavated channel sections that are 5 feet wide and 2 feet deep, with occasional masonry or concrete lining, a short corrugated-metal pipe culvert section beneath Wildcat Road, and a 600-foot section of natural channel. The excavated channel intercepts some concentrated, seasonal upslope drainage but there are no spillway structures as at Wildcat Canal to prevent overcharging of the canal. Wildcat Canal finally discharges into an open-channel section of Coleman Canal. No diversion of flow for power generation has occurred at the site since August 1995, under the terms of an interim agreement with Reclamation. In August 1996, a rockfall damaged a section of the 24-inch-diameter pipe about 500 feet downstream of the dam. Pipeline repairs would be required to return Wildcat Canal to service. Generally, the corridor along the canal is not fenced by PG&E. Some fencing has been erected by landowners at property lines, which are sometimes close to the canal.

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.

South Diversion Dam (South Fork Battle Creek)



South Diversion Dam

South Diversion Dam and Canal were constructed in 1910 to divert up to 100 ft³/s of South Fork water into South Canal for generating power at South Powerhouse, located about 6 miles to the west. The structure has been rebuilt several times; the current structure has been in place since 1981. The dam is a gravity structure of steel “bin-wall” construction with vertical upstream and downstream faces 16 feet in height, with an overflow crest length of 100 feet and a crest width of 16.5 feet at elevation 2028.2. The left abutment non-overflow section of the dam is 45 feet long and 7 feet above the overflow section, and the right abutment non-overflow section is 10 feet long and 5 feet above the overflow section. The structure uses a system of adjoining closed-face bins generally 10 feet long, consisting of lightweight galvanized steel members bolted together and backfilled with gravel and cobbles obtained from the creek channel. The original reinforced concrete overflow crest is now covered with a ½-inch-thick welded-steel plate to provide protection against abrasion, which is severe during flood flows. A 12-foot-wide-by-8-foot-high radial sluice gate is set near the right abutment within a reinforced concrete structure to allow the sluicing of sediments that periodically accumulate behind the dam. The radial sluice gate helps prevent sediments from blocking the canal entrance and fish ladder. The South Canal intake structure is located to the right of the radial sluice gate and includes a steel trashrack on a concrete sill, and a 60-inch-diameter slide gate at the inlet portal of an unlined tunnel section (Tunnel No. 1). The trashracked exit of a denil type fish ladder is located to the left of the radial sluice gate. The ladder extends downstream 16 feet through the dam then turns left to follow and descend along the downstream face of the bin wall an additional 51 feet. The ladder structure is attached to the bin wall. A metal roof covers the portion of ladder paralleling the bin wall to prevent water and debris that overflows the dam from entering the ladder. The ladder is functional but does not meet current standards for fish ladder design. The canal does not have any fish screening system.

The South Canal extends approximately 5.7 miles to its confluence with the Cross Country Canal, where the canals combine to form the 3,555-foot-long

Union Canal before entering the South Powerhouse penstock. The South Canal consists of ten tunnel sections with a total length of 7,613 feet; nine metal flume sections with a total length of 2,384 feet; and 20,175 feet of excavated channel sections and concrete transitions. The tunnels are unlined and 8 feet wide by 8 feet high. The metal flumes are ARMCO #132, supported by steel trestle structures up to 37 feet high, founded on concrete footings. The excavated channel sections are 7 feet wide by 5 feet deep. Approximately 20 percent of the channel sections are concrete lined. Runoff from upslope of the canal enters the canal from natural drainages and from smaller disperse sources along the canal. Eleven spillways are spaced along the canal to prevent the canal from becoming overcharged. The spillways vary in their configuration. Some spillways are concrete-capped low spots in the canal bank, sometimes with flashboards. Other spillways are large, gated reinforced concrete structures involving diversion gates in-line with the canal and through the canal bank. All of the spillways release water back to the South Fork. Soap Creek Diversion, which is a major contributor of side channel water to South Canal, is discussed below.

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 in heavily rutted conditions, 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 No. 1. At this point, a steep, narrow trail rises above the tunnel and ends at the top of a 25-foot-tall ladder, which 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 near the parking/turnaround area were 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, which 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 two 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 No. 5 and to Soap Creek Diversion Dam. This road then continues westerly approximately 1.2 miles along the canal (portions are well above the canal, other portions are along the canal bank) to the inlet of Tunnel No. 6 where it deadends. 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 No. 6 begins about 1.3 miles west of the Bluff Springs branch and heads south about 0.4 mile where it dead ends. Vehicle access does not exist between the outlet of Tunnel No. 6 and 600 feet downstream of the outlet of Tunnel No. 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 No. 10) to the west of the private South Powerhouse Access Road, an access road extends 0.1 mile to the outlet of Tunnel

No. 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 contains several gates along its route.

Soap Creek Feeder Diversion Dam (Soap Creek, Tributary to South Fork Battle Creek)



Soap Creek Feeder Diversion Dam

Soap Creek Feeder Diversion Dam and Pipeline were constructed in the 1900s to divert up to 15 cfs of water from Soap Creek into South Canal for generating power at South Powerhouse located about 4 miles to the west. The dam was possibly replaced in 1936. The dam is located on Soap Creek about 4 miles southeast of Manton, California, and about 1 mile upstream of its confluence with the South Fork of Battle Creek. The dam consists of a concrete gravity structure 10 feet in height, with an overall length of 41 feet at a maximum crest elevation 2,025.2. A 20-foot-long overflow section is provided in the middle portion of the dam at elevation 2,023.1. A 42-inch-square slide gate is set near the left abutment to allow sluicing of sediments that periodically accumulate behind the dam that might block the entrance to the pipeline. Water is diverted through a 24-inch-diameter hydraulically operated slide gate into a 24-inch-diameter steel pipe in the right abutment section. The pipeline extends along the right canyon wall approximately 300 feet before discharging into the South Canal flume located immediately downstream of the Tunnel No. 5 outlet. The entire length of pipe is aboveground and supported on various concrete saddle supports up to 4 feet high. The junction box at the discharge point includes a stilling well, venturi flume and a 27-foot-long No. 72 metal flume. There are no fish passage facilities at this site.

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 paralleling 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 No. 5. The corridor along the pipeline is not fenced.

Inskip Diversion Dam/South Powerhouse (South Fork Battle Creek)



Inskip Diversion Dam

Inskip Diversion Dam, South Powerhouse, and Inskip Canal were originally constructed in 1910. South Powerhouse generates power from water delivered to the penstock from the North and South Forks of Battle Creek. South Powerhouse is located on the north bank of the South Fork of Battle Creek approximately 1,100 feet upstream of Inskip Diversion Dam. The powerhouse receives up to about 190 cfs of water at 515 feet of head via an approximately 1,750-foot-long steel penstock from Union Canal. Union Canal receives water from the upper portion of South Fork Battle Creek via South Canal and from the upper portion of North Fork Battle Creek via the Cross Country Canal. After passing through the turbines or Howell-Bunger bypass valve, powerhouse flows are released back into the South Fork through the tailrace. The tailrace contains a 40-foot-long, 10-foot-wide, reinforced concrete structure with vertical walls. Discharged water continues downstream in a tailrace channel that extends downstream about 600 feet, where it discharges into the South Fork Battle Creek. Water released into South Fork Battle Creek at this point is a mixture of South Fork and North Fork Battle Creek waters. A peninsula area is formed between the tailrace channel and the South Fork creek channel that extends about 450 feet downstream of South Powerhouse. The elevation of the peninsula is somewhat lower than adjacent ground and has been overtopped and breached during flood events over the years. PG&E last rebuilt the peninsula after the 1997 floods.

At the top of the penstock is a forebay with a sediment basin and an overflow spillway. The spillway serves as a bypass for the penstock whenever water flow through the powerhouse is stopped or when Union Canal water deliveries exceed

penstock/powerhouse capacity. Overflow situations can occur when the powerhouse experiences a sudden unscheduled shutdown, during a scheduled powerhouse shutdown but deliveries are still required from the North Fork into the South Fork system (i.e., to Inskip Canal), during minor operational flow mismatches between the canal deliveries and the powerhouse, and during overcharging of the canal system because of high precipitation events. Bypassed water is released to an open gully that flows down the hillside to the powerhouse tailrace channel and South Fork Battle Creek.

Inskip Diversion Dam diverts approximately 220 ft³/s of water from the South Fork Battle Creek (a mixture of North and South Fork water) to Inskip Canal, which conveys the water to the Inskip Powerhouse located approximately 5.4 miles downstream. Inskip Diversion Dam is a rock-filled masonry structure 28 feet in height with a steel-capped dam crest approximately 80 feet long at crest elevation 1,439. A 6-foot-wide, 17-foot-high radial sluice gate is set near the right abutment to allow the sluicing of sediments that periodically accumulate behind the dam. The radial sluice gate helps prevent sediments from blocking the adjacent canal entrance. The Inskip Canal intake structure diverts water on the north side of the dam through an 11-foot-wide radial gate. Diverted water passes through a 100-foot-long, 8-foot-wide-by-8-foot-high, unlined Tunnel No. 1 and a sediment trap before entering Inskip Canal. The sediment trap is a 6-foot-deep basin between the tunnel outlet and the canal, which captures sediment before it can enter the canal system. The basin incorporates a side channel radial sluice gate that is 6 feet wide and 15 feet high. The gate is periodically opened to sluice sediments out of the basin and into the South Fork at a point about 200 feet downstream of the dam. Inskip Canal extends 650 feet downstream of the sediment basin before entering Tunnel No. 2. The canal is an open channel approximately 8 feet wide and 6 feet deep and is unlined for most of its length. Portions have been lined with gunite in areas of high leakage or severe erosion. The portions of Inskip Canal further downstream are not described because there are no proposed modifications until the header box area above Inskip Powerhouse. Near the left side of the dam is an Alaska Steeppass fish ladder set within the walls of the original concrete pool and weir ladder. The canal does not have any fish screening system.

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 1.2 miles on South Powerhouse Road. From this intersection of South Powerhouse 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 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.

An abandoned access road is located about 2,000 feet east of the residence. This road extends from the intersection of Hazen Road and Manton School Road in a southerly direction about 0.8 mile and reconnects with the South Powerhouse Access Road south of the residence. This road will require upgrading to allow construction equipment to safely bypass the residential area.

Lower Ripley Creek Feeder Diversion Dam (Ripley Creek, Tributary to South Fork Battle Creek)

Lower Ripley Creek Diversion Dam is located on Ripley Creek about 3.5 miles southwest of Manton, California, and about 1 mile upstream of its confluence with South Fork Battle Creek. The diversion dam provides up to 3 cfs to Inskip Canal, from an open canal, for power generation at Inskip Powerhouse (near Coleman Diversion Dam). The existing dam was constructed in 1944, replacing an older concrete structure constructed in 1929, which in turn had replaced the original wooden structure constructed before 1918. A concrete measuring weir was added to the diversion canal in 1952. The existing dam consists of a 17-inch-thick concrete wall with a maximum structural height of about 5 feet and a crest length of 44 feet at elevation 1,404.4. An 8-foot-wide overflow section with wooden flashboards is provided for releases to Ripley Creek. Diversion releases are made through a 22-by-35-inch wooden slide gate near the left abutment (invert elevation 1,401.5). The feeder canal extends 384 feet downstream from the dam and discharges into a short open-channel section of Inskip Canal between the outlet of a tunnel and the inlet of a flume. Immediately adjacent to the feeder canal outlet is a reinforced concrete uncontrolled overflow weir spillway that discharges excess Inskip Canal water back into Ripley Creek. There are no fish passage facilities at this site.

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 worksite 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 worksite. For both routes, road conditions vary seasonally, but are generally flat, narrow, in heavily rutted condition and require the use of four-wheel-drive vehicles. The dam is about 50 feet off of the road and can be easily reached 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.

Coleman Diversion Dam/Inskip Powerhouse (South Fork Battle Creek)



**Coleman Diversion Dam and
Inskip Powerhouse**

Coleman Diversion Dam, Inskip Powerhouse and Coleman Canal were originally constructed around 1912. Inskip Powerhouse generates power from water delivered to the penstock from the North and South Forks of Battle Creek. Inskip Powerhouse is located on the north bank of the South Fork of Battle Creek approximately 900 feet upstream of Coleman Diversion Dam. The powerhouse receives up to about 293 ft³/s of water at 378 feet of head via an approximately 3,200-foot-long, 72-inch-diameter steel penstock. The penstock receives combined North and South Fork water from Inskip Canal and North Fork water from Eagle Canyon Canal at an inlet upstream of the penstock header box. The header box is of masonry construction approximately 40 feet square by 15 feet tall, incorporating trashracks and a small basin with a sloping floor to capture sediments. Valves in the header box wall allow sand and grit to be flushed periodically. This discharged water flows northwestward initially down a series of shallow braided channels that eventually combine into a single channel called Chicken Hollow. This flow continues for about 2 miles, crossing under Manton Road and finally entering the North Fork of Battle Creek. The initial 2,200 feet of penstock crosses the somewhat flat upland, while the final 1,000 feet descends the valley hillside down to the powerhouse. Near this change in slope, the penstock crosses a 24-inch-diameter corrugated metal pipe culvert that supplies water to a trout hatchery located on the north side of Manton Road. The source of this water is the area called Willow Springs, which is located about 1,000 feet east of the penstock. After passing through the turbines or Howell-Bunger bypass valve, powerhouse flows are released back into the South Fork through the tailrace outlet, which consists of a 31-foot-long, 12-foot-wide, curved concrete structure with vertical walls. The structure floor slopes upward from the turbine draft tube sump to the Battle Creek streambed. Water released into South Fork Battle Creek at this point is a mixture of South Fork and North Fork Battle Creek waters.

An uncontrolled overflow wasteway is located on Inskip Canal about 500 feet upstream from the headerbox inlet. The overflow wasteway serves as a bypass for the penstock whenever water flow through the powerhouse is stopped or when Eagle Canyon and Inskip Canal water deliveries exceed penstock/powerhouse capacity. Overflow situations can occur when the powerhouse experiences a sudden unscheduled shutdown, during a scheduled powerhouse shutdown but deliveries are still required from the North Fork into the South Fork system (i.e., to Coleman Canal), during minor operational flow mismatches between the canal deliveries and the powerhouse, and during overcharging of the canal system because of high precipitation events.

Bypassed water flows over a gunite-lined low spot in the canal bank that is about 50 feet wide and 30 feet long. This water is released to an unlined, 0.5-mile-long channel excavated through the plateau area. At the end of this channel the water cascades off of the canyon hillside east of Inskip Powerhouse and enters the South Fork. The wasteway has an estimated capacity of 340 ft³/s.

Coleman Diversion Dam diverts up to 340 ft³/s from the South Fork of Battle Creek (a mixture of North and South Fork water) to Coleman Canal, which conveys the water to the Coleman Powerhouse located about 10 miles to the west. The dam is a masonry gravity structure with a concrete overlay, 12 feet in height, with a crest length of 87.5 feet at elevation 1006.1. The dam structure has a near-vertical upstream face, and a sloping downstream face and apron that provide a maximum base width of about 19 feet. A 14-foot-wide-by-8-foot-high radial sluice gate, located at the right end of the dam, is raised by a hand-operated drum winch on a hoist deck directly above the gate. The gate is opened to allow sluicing of sediments that periodically accumulate behind the dam. A weir wall (described below) also stems off of the dam to the right of the fish ladder and extends upstream of the canal entrance. The radial sluice gate and weir help prevent sediments from blocking the fish ladder and canal entrance. The fish ladder located between the radial sluice gate and the canal entrance is an Alaska Steeppass ladder, with a design capacity of 7 to 10 cfs and a total length of about 54 feet, including two baffled steel flume sections and a 7-foot-long concrete turn box. A 24-inch-wide slide gate controls releases to the fish ladder. The ladder has been closed at the request of DFG.

Diversions into Coleman Canal are controlled by a set of gate structures located within the canal 200 feet downstream of the dam. A masonry gravity weir structure extends upstream from the dam on the right abutment to serve as the intake to Coleman Canal. The intake weir structure has a crest width of about 4 feet, a crest length of 44 feet and rises about 12 feet above the original streambed surface, with near vertical upstream and downstream faces. Between the canal control gates and the intake weir, a 2-foot top width, 200-foot-long masonry gravity retaining wall forms the left bank of Coleman Canal. The elevation of the top of the wall is only slightly higher (0.2 feet) than the overflow section of the dam. It is common during the higher flow times of the year for water to spill over the wall in addition to the dam crest. During flood events, a significant amount of water spills over the wall. Water spilled over this wall returns to the South Fork and is a mixture of North and South Fork water and may reduce the effectiveness of the fish ladder. A second masonry wall forms

the right bank of the canal adjacent to the dam and curves upstream for 34 feet. Coleman Canal extends nearly 10 miles to the Coleman Forebay and Powerhouse, and consists of 389 feet of rock tunnel sections; 83 feet of concrete bench flume; 46,240 feet of excavated channel sections; and 4,518 feet of 90-inch-diameter siphon pipe. The canal does not have any fish screening system.

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 miles 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 only be reached by foot. Between Manton Road and the penstock 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.

Asbury Pump Diversion Dam (Mainstem Battle Creek)

Asbury Pump Diversion Dam is located on Baldwin Creek, just below the Darrah Springs State Fish Hatchery and approximately 0.7 mile above its confluence with Battle Creek. The dam was constructed around 1920. Baldwin Creek has been identified as one of seven tributaries to Battle Creek capable of providing suitable habitat for steelhead. The Darrah Springs facility is a key hatchery of the DFG inland fisheries program and raises catchable trout for sport fisheries. Asbury Pump Diversion Dam is a concrete gravity structure with a maximum height of approximately 7 feet above streambed and a crest length of 100 feet. Two spill gates are provided near the middle of the structure with widths of 6 and 10 feet. An access walkway crosses above the spill gates and allows foot access to both sides of the facility. The Asbury Pump Station is located near the right abutment of the dam and provides a 24-inch centrifugal pump with a rated capacity of 20,000 gal/min (45 cfs). Pump station flows pass over an 8-foot-long intake sill and enter a 26-inch-diameter intake pipe to the electric-motor-operated

pump. The pumped releases enter the 36-inch-diameter Asbury pipe, which extends 1,609 feet to the Coleman Canal siphon. The pipeline crosses Baldwin Creek just downstream of the diversion dam from the pump station on the right abutment to the left bank. The pipeline is supported on reinforced concrete piers. A 36-inch-diameter steel surge pipe is also provided for surge protection. There are no fish passage facilities at this site.

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.

Project Alternatives Descriptions

The project alternatives are described below in detail, beginning with the No Action Alternative and followed by four Action Alternatives that propose various combinations of water management strategies for achieving the purpose of and need for the Restoration Project. The purpose and need for the Restoration Project are described in Chapter 2.

Each alternative is described with respect to its Hydroelectric Project facility modifications. Each alternative description includes a map showing the north and south forks of Battle Creek and the facility modifications that would result from the implementation of that particular alternative. Each map also includes an inset table, the rows of which correspond to different Battle Creek Hydroelectric Project dams and diversions on the map. The values in the table are the minimum instream flow releases that would be maintained downstream of each of the corresponding dams and diversions if that particular alternative were to be implemented and the identified facility modifications completed.

The Action Alternatives were developed through a collaborative effort among agencies, stakeholders, interested parties, and the public. The decision-makers used the following information to develop Action Alternatives to meet the purpose of and need for the Restoration Project:

- flow- and temperature-monitoring data,
- screen and ladder criteria, and
- hydropower operations data.

Additional information was obtained from existing programs and plans:

- CVPIA (Title 34 of Public Law 102-75, 1992) AFRP;
- CALFED California Bay-Delta Ecosystem Restoration Program;
- Upper Sacramento River Fisheries and Riparian Habitat Management Plan (California Senate Bill 1086, 1989);
- Proposed Recovery Plan for Sacramento River Winter-Run Chinook Salmon, prepared by NOAA Fisheries (1997b); and
- Actions to Restore Central Valley Spring-Run Chinook Salmon, prepared by DFG (pers. comm. 1996).

Each of the Action Alternatives¹ is named for the number of dams that it proposes to remove. The Action Alternatives are the:

- Five Dam Removal Alternative—Proposed Action
- No Dam Removal Alternative
- Six Dam Removal Alternative
- Three Dam Removal Alternative

These names were chosen because they can easily be differentiated, and they focus on one water management strategy—dam removal²—that is easy to remember and has the greatest public awareness and familiarity associated with fish restoration. However, it is important to note that the names used for the alternatives refer to only one of many water management strategies included in each Action Alternative. Other water management strategies may include maintaining the dam, installing a fish ladder, and increasing the amount of water released from the dam diversion and selected springs.

A No Action Alternative, as required by NEPA, is also analyzed and discussed in this chapter. A sixth alternative that was considered, but eliminated from further study, is discussed at the end of this chapter.

¹ These names were developed during the preparation of this document. During the public scoping process, the alternatives were referred to by number. The numbered alternatives are referred to in this EIS/EIR as follows: Public Scoping Alternative 1 is now called the No Action Alternative; Public Scoping Alternative 2 is now called the No Dam Removal Alternative; Public Scoping Alternative 3 is now called the Five Dam Removal Alternative (the Proposed Action); Public Scoping Alternative 4 is now called the Six Dam Removal Alternative; and Public Scoping Alternative 5 is now called the Three Dam Removal Alternative.

² Other documents relevant to the Restoration Project use the word *decommissioning* when discussing dam removals on Battle Creek. FERC considers the decommissioning of a hydroelectric project to cover a broad range of activities, from simply locking the powerhouse door and securing the specific hydroelectric project, to complete dam removal and securing all appurtenant conveyance systems and facilities. According to FERC, decommissioning a hydroelectric project can mean lowering a dam or breaching a portion of a dam but not entirely removing the dam. For the purposes of this document, the term *removal* is used when referring to dam decommissioning for the Action Alternatives.

Some of the Action Alternatives involve abandoning project sites. At these locations, the legal easements will need to be modified or retired and the associated responsibilities shifted from PG&E to the landowner. The details of the conditions have not been finalized and are only described to the level of detail known at this time. Other alternatives involve acquiring additional permanent easements. All Action Alternatives involve the need for temporary easements. The acquisition of these easements is in preparation, and they are described only to the level of detail known at this time.

No Action Alternative

The No Action Alternative is required by NEPA (42 USC 4321–4347). The No Action Alternative is also known as the No Project Alternative under CEQA. The No Action Alternative represents conditions under a “no salmon or steelhead restoration project” or “future without salmon and steelhead restoration project” alternative. The No Action Alternative is defined by the existing FERC license conditions for the Hydroelectric Project and other existing environmental and resource conditions. Instream flow releases under the No Action Alternative are the license-required continuous minimum flows of 3 cfs below dams in North Fork Battle Creek and 5 cfs below dams in South Fork Battle Creek. Existing fish ladders would be operated according to the conditions set forth in the Hydroelectric Project’s FERC license. Fish screening of the existing diversion canals is assumed not to be included in the No Action Alternative. PG&E would continue to maintain license-required stream gages, documentation, and operations criteria consistent with the license requirements. PG&E also would continue to be responsible for all costs associated with this alternative. Figure 3-1 displays the facilities and flows that would occur under the No Action Alternative.

Since 1995, Reclamation has maintained interim flow agreements³ with PG&E to maintain higher minimum instream flows until a long-term restoration project can be implemented on Battle Creek. Terms of these agreements include increasing instream releases at Eagle Canyon and Coleman Diversion Dams at up to 30 cfs, suspending diversions at Wildcat Diversion Dam, and blocking downstream entrances to the fish passage facilities at Eagle Canyon and Coleman Diversion Dams. A major portion of the increased release at the Eagle Canyon site would be accomplished by bypassing the Eagle Canyon Springs collection facilities that discharge to the Eagle Canyon Canal. The interim flow agreements represent a short-term set of resource conditions that are not guaranteed to continue and are not conditions of the existing FERC license. Therefore, resource conditions established under the interim flow agreements are not included as part of the No Action Alternative. The resource conditions include

³ The interim agreements between PG&E and Reclamation are discussed in greater detail in Chapter 6, “Related Projects.”

reopening fish ladders now closed at Eagle Canyon and Coleman Diversion Dams under the interim agreement conditions. Wildcat Canal would be rewatered to convey water from North Fork Battle Creek to Coleman Canal, and minimum instream flow releases from the diversion dams would be returned to FERC license conditions.

Five Dam Removal Alternative—Proposed Action

The Five Dam Removal is the Proposed Action that modifies both facilities and operations to provide the water management consistent with the descriptions in the MOU (Appendix A). Table 3-1 lists the individual components of the Five Dam Removal Alternative. Figure 3-2 displays the facilities and flows that would occur under this alternative. The inset table in Figure 3-2 indicates the continuous minimum instream flow releases that would increase below North Battle Creek Feeder, Eagle, Inskip, and Asbury Diversion Dams after completion of facility modifications.

The instream flows are an integral component of the Five Dam Removal Project. The Battle Creek Working Group (BCWG) Biological Technical Team collaboratively developed a detailed minimum flow release schedule for each dam. The Technical Team included biologists from government fishery agencies, PG&E, and participants from the BCWG. The proposed flow schedule prioritized species by stream reach and considered flows providing passage and water temperature. One outside review was completed as a comparison to recently applied methodology at another Central Valley Salmon stream. During the development of the Battle Creek Salmon and Steelhead Restoration Project MOU the flow schedule developed by the Biological Team was reviewed and accepted along with an adaptive management plan that would address future uncertainties.

Table 3-1. Five Dam Removal Alternative Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen Fish ladder
Eagle Canyon Diversion Dam	70-cfs fish screen Fish ladder
Wildcat Diversion Dam	Dam and appurtenant facilities removed
South Diversion Dam	Dam and appurtenant facilities removed
Soap Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
Inskip Diversion Dam and South Powerhouse	220-cfs fish screen Fish ladder Construction of South Powerhouse and Inskip Canal connector (tunnel)

Site Name	Component
Lower Ripley Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
Coleman Diversion Dam and Inskip Powerhouse	Dam removed Construction of Inskip Powerhouse and Coleman Canal connector Inskip Powerhouse bypass replaced
Asbury Diversion Dam	Reoperate Stream gaging station installed Minimum instream flow set for Baldwin Creek

The following sections describe the proposed activities under the Five Dam Removal Alternative for North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, Coleman, Lower Ripley Creek, and Soap Creek Feeder Diversion Dam sites.

Construction under the Five Dam Removal Alternative is anticipated to begin in early 2004 and end by fall 2006. The construction schedule for each project site is as follows:

- North Battle Creek Feeder Diversion Dam—Begin construction in spring 2005 and end by summer 2006.
- Eagle Canyon Diversion Dam—Begin construction in spring 2005 and end by summer 2006.
- Wildcat Diversion Dam—Begin construction in summer 2005 and end by spring 2006.
- South Diversion Dam—Complete construction during fall 2005.
- Soap Creek Feeder—Complete construction during summer 2005.
- Inskip Diversion Dam/South Powerhouse—Begin construction in spring 2004 and end by fall 2006.
- Lower Ripley Creek Feeder Diversion Dam—Complete construction during summer 2005
- Coleman Diversion Dam/Inskip Powerhouse—Begin construction in spring 2004 and end by spring 2006.

North Battle Creek Feeder Diversion Dam

Project Elements

Proposed features at the North Battle Creek Feeder Diversion Dam site include:

- fish ladder,
- fish screen,
- access road improvements,
- raising the left side of the dam, and
- building a footbridge across the stream.

The features proposed for North Battle Creek Feeder Diversion Dam for the Five Dam Removal Alternative are shown on Figure 3-2a.

Fish Ladder

Under this alternative, a new pool and chute fish ladder would be constructed near the center of the existing dam, requiring removal of the steel portion of the Steeppass fish ladder, plugging of the west section in the dam, and removing the sluice gate. The concrete ladder would be left in place to buttress the dam. A section of the left side of the dam would be reconstructed to accommodate the new fish ladder and sluice gate. The new fish ladder is designed in accordance with agency-prescribed parameters in order to function in a “failsafe” manner for creek flows up to 1,100 cfs, the design flow. Generally, a fish ladder is designed to convey 10% of the creek flow (i.e., a maximum of 110 cfs), which will adequately attract the fish to the ladder. The design features a 3-foot-wide contracted weir centered in each of the eight baffles, sloped weirs on both sides of the contracted weir, and 20-inch square orifices below the sloped weirs (the left orifice is furnished with a manually operated gate). The new ladder would be 69 feet long (each pool is 8 feet long and 15 feet wide), including a 5-foot-long bay at the top of the ladder where stanchions and flashboards can be installed to isolate the fish ladder for sluicing and debris removal. To facilitate maintenance, a 3-foot-wide moveable walkway spreads across the ladder walls and can be positioned as needed along the wall to allow workers to make gate adjustments or remove debris. A catwalk is also provided along the left wall for access. The proposed ladder is about 17 feet wide (outer wall to outer wall). A new sluice gate would be installed in the dam immediately to the left (looking downstream) of the new fish ladder. Sensors would be included in the ladder to allow automatic operation of the control gates during high flows. Other sensors would be incorporated in the ladder and fish screen to ensure minimum instream flow requirements are met. Video monitoring equipment would also be included for biological monitoring.

Fish Screen

Under this alternative, the proposed new in-canal, flat-bar fish screen is designed to pass the maximum potential diverted water right of 55 cfs while meeting NOAA Fisheries and DFG salmon and steelhead screening criteria. The existing

diversion concrete headworks structure would be modified with a concrete box section to accommodate the new screen configuration. The new screen box would be placed on the left bank to minimize excavation into the canyon wall. The new screen box would extend for about 140 feet downstream of the dam and varies in width from about 5 feet to about 15 feet. A 3-foot-wide working platform is included along the screen for maintenance purposes. A jib crane will be mounted on top of the raised left headwall of the dam to allow equipment and materials to be lifted from the screen deck to the new footbridge.

The total screen length would be 81 feet, consisting of 27 three-foot-square wedge-wire panels. Louvers would be installed behind the screen to provide uniform velocity control along the face of the screen. The screen includes a 7.5-cfs fish bypass. This bypass feature consists of a 15-inch-wide weir, drop box, and an 18-inch-diameter seamless smooth wall pipe. The fish bypass flow drops 4 feet into an energy-dissipating drop box, from which the bypass pipe exits and dumps into the creek. The exit of the bypass pipe into the creek would be free-flowing and set at an elevation such that adult fish cannot enter the bypass pipe. The bypass pipe then discharges into the creek near the end of the new concrete screen box.

Failsafe fish screen elements are incorporated into the design and operation of the diversion system. The water diversion will be automatically shut off whenever the fish screen fails to meet design or performance criteria until the fish screen is functioning again. The screen would be equipped with stage sensors on both sides of the screen to measure head differential. If a problem is detected, the sensors would trigger an activation of the screen-cleaning mechanism (motorized sweeping brushes), and/or send an alarm. If the problem continues, the diversion will be shut down. Installation of the new screen would require removal of about 130 feet of flume section. The new screen box would transition into the existing flume. This transition section may require reconstruction of a limited number of flume support piers.

Access Road Improvements

Under this alternative, construction of a new access road would be required for heavy equipment to access the dam during construction and for future daily operation and maintenance needs. The proposed new road would begin as an extension of the first leg of the existing access road leading to Volta 2 Powerhouse and would be approximately 554 feet long and 10 feet wide. The road would traverse down the slope for about 370 feet where it switches back, leading to the right abutment of the dam. The road itself would be about 10 feet wide, with cut slopes affecting a footprint up to 40 feet wide. The road would be paved and would include drainage features that would direct runoff to the stream. At the base of the proposed new road a permanent, flat landing area would be developed that allows the operation of heavy construction equipment. This landing area would be approximately 30 feet long and 22 feet wide with the outer edge reaching to the edge of stream. This landing area would be built up with the waterside edge retained either by a vertical concrete wall or by riprap slope protection. The landing area would be paved with asphaltic concrete. At the switchback, a 25-foot spur would be provided to facilitate traffic control and

turning. The road would be all in cut sections, except at the terminus where the landing is developed. The road would be paved with a 6-inch base gravel material overlain by a 4-inch asphaltic concrete.

The flat landing area at the terminus of the new road would incorporate a foot access bridge that crosses the creek at the dam. This footbridge would have a traveler rail that could be used to carry heavy loads (e.g., 200-pound screen panels) from the left side of the dam, where the new screen would be located, to the right abutment of the dam, where the road access would allow removal of any mechanical or other features of the new screen and ladder for off-site maintenance.

Construction Considerations

Construction activities potentially would affect the following areas near North Battle Creek Diversion Dam:

- **The lightly paved access road from Wilson Hill Road to the feeder canal between Volta 1 and Volta 2 Powerhouses.** This road would experience heavy construction traffic. This 3,100-foot-long, 15-foot-wide road would not be widened but would be maintained as necessary during construction and would be repaired to its preproject condition at the end of construction. The total area affected would be approximately 46,000 square feet.
- **Portion of the access road along the feeder canal to the sediment trap at the penstock intake.** This 20-foot-wide-by-900-foot-long, gravel-surfaced road would be heavily used but not widened. It would be maintained by blading and the addition of gravel as necessary. The total area affected would be approximately 18,000 square feet.
- **Staging area near the sediment trap and along the access road.** This area would be used and maintained as required. The total area affected would be approximately 88,000 square feet.
- **Temporary access road.** A 20-foot-wide, 1,200-foot-long road would be constructed to a new 100-foot-by-50-foot temporary staging area on the west canyon rim above North Battle Creek Diversion Dam. This staging area would be used to deploy trucked-in equipment and supplies by helicopter down to the worksite. Vegetation-clearing, site-grading, and addition of gravel-surfacing would be required. The total area affected would be approximately 29,000 square feet.
- **Disposal area between sediment trap staging area and temporary access road.** A 400-foot-by-250-foot area would be used to permanently dispose of soil and rock excavated for the new access road, fish screen and fish ladder. The disposal piles would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures to prevent turbid runoff from escaping the disposal site. Vegetation-clearing, site-grading, and addition of gravel-surfacing

would be required. The total area affected would be approximately 100,000 square feet. Materials containing metal would be disposed of off site.

- **Temporary staging area.** An approximately 1-acre site adjacent to PG&E's Manton Service Office would be used as a temporary staging area for deploying selected materials, such as the prefabricated footbridge. The helipad at this location may also be used. Minimal site-grading may be required to allow use of this site. The total area affected would be approximately 44,000 square feet.
- **The paved "upper" segment of the steep access road to Volta 2 Powerhouse.** This road segment would experience extensive traffic. No improvement is anticipated for this 12-foot-wide-by-400-foot-long segment. The traveled surface may require pothole repair and other maintenance during construction. After construction, additional repairs, including repaving, may be necessary. The total area affected would be approximately 5,000 square feet.
- **The paved "lower" segment of the steep access road to Volta 2 Powerhouse.** This 12-foot-wide-by-500-foot-long segment would experience only limited and light construction traffic. This segment must be kept open and available for PG&E use. The total area affected would be approximately 6,000 square feet.
- **New paved access road.** A new 10-foot-wide, 554-foot-long, paved access road would be constructed from the switchback between the upper and lower segments of the Volta 2 Powerhouse road down to the "landing" area adjacent to the right abutment of North Battle Creek Diversion Dam. Because of the overall steepness of the canyon wall (36-degree slope), a relatively large area would be affected by the excavation cut slopes in order to ensure their stability. Total area affected would be approximately 37,000 square feet.
- **Area within creek channel high-water surface extending about 400 feet upstream of North Battle Creek Diversion Dam.** Diversion banks and other water control systems would be required to allow construction of the fish ladder and fish screen structures in the dry. The total area affected would be approximately 21,000 square feet.
- **Area within creek channel downstream of North Battle Creek Diversion Dam.** This area, extending about 150 feet downstream from the dam, would be disturbed by construction of the fish facilities. The left abutment for the new footbridge would extend up the left canyon wall about 80 feet east of the existing headworks. The total area affected would be approximately 18,000 square feet.
- **Use of helicopters.** The dam site is in a remote area with no nearby vehicular access. Certain construction equipment and materials, and materials to be permanently removed from the site, may be brought to or removed from the site by helicopter. These materials would be picked up or dropped off at identified staging areas.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired or repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

The sequence of construction for the North Battle Creek Feeder site would roughly follow this order:

- construct new access road and landing area;
- build cofferdams and temporary water bypass structures;
- prepare site by demolition of existing facilities, including sluice gate, headworks, and pertinent sections of the dam; excavation for structures, including removing boulders;
- perform concrete work for new screen and ladder;
- install metalwork for screen and ladders;
- install and test mechanical and electrical systems; and
- remove cofferdams and complete site restoration.

Construction at this site would occur over a 15-month period, with a winter shutdown lasting approximately 7 months. Construction is anticipated to begin in spring 2005 and end by summer 2006.

Water diversions into the feeder canal would be interrupted to allow construction to be performed. A 5-month shutdown would take place the first construction season followed by a 1-month shutdown in the second construction season.

Eagle Canyon Diversion Dam

Project Elements

Proposed features at the Eagle Canyon Diversion Dam site include:

- a vertical-slot fish ladder,
- fish screen,

- powerline relocation,
- access trail improvements, and
- spring collection facilities improvements.

The features proposed for Eagle Canyon Diversion Dam for the Five Dam Removal Alternative are shown on Figure 3-2b.

Fish Ladder

Under this alternative, the existing Alaska Steeppass fish ladder would be removed. A section of the south side of the dam, approximately 7 feet deep and 10 feet wide, would be removed where the new fish ladder would be built. A new modified headwall structure would be constructed to accommodate the new ladder as well as the new fish screen. The new modified canal and fish ladder intake area is designed to divert large floating debris away from the headworks so that debris does not collect in the fish ladder and screen system. A floodwall, extending above the 100-year flood event elevation, would be constructed at the upper end of the ladder to protect the new fish passage facilities. The new diversion headworks would include new electric gates, trash racks, electrical controls, and monitoring systems. Sensors would be included in the ladder to allow automatic operation of the control gates in times of high flows. Other sensors would be incorporated into the ladder and creek to ensure minimum instream flow requirements are met. Video monitoring equipment would also be included for biological monitoring.

The new vertical slot type ladder would extend nearly 110 feet downstream from the dam. The combined new canal and ladder would project up to 30 feet into the stream channel and require excavation into the streambed to a depth of between 15 and 20 feet. The ladder is designed to operate properly with a minimum flow of 20 cfs and a maximum flow of 71 cfs, in accordance with agency-prescribed parameters in order to function in a “failsafe” manner for the creek design flow. Two ladder entrance locations are provided for flexibility of operation during varying tailwater conditions. The upstream entrance is designed to be open during low flows when the pool near the base of the dam is stable. When pool conditions are turbulent, the low-flow slot could be closed and the high-flow slot opened. The high-flow slot is designed to attract fish to the entrance pool rather than continue upstream into the shear velocity zone created by the swifter, highly turbulent water near the base of the dam. The entire length of the ladder would be covered with grating to prevent debris from entering the ladder.

Fish Screen

Construction of a new fish screen would require removing the upstream 100-foot section of canal and replacing it with an enlarged canal section. A common wall would be constructed to serve as a canal wall and a side wall for the fish ladder. The new in-canal, flat plate fish screen is designed to divert a flow of up to 70 cfs while meeting screen criteria set by NOAA Fisheries and DFG for both salmon and steelhead. The screen system would incorporate a bypass return system designed to operate with a flow of 5 cfs while meeting screen criteria. The

bypass system is designed to return the fish to a drop well outside of the ladder turning pool. From the drop well, the fish would be able to enter the turning pool of the ladder through a slot. The screen face consists of wedge-wire removable panels with a total length of 63 feet. Fourteen square-shaped fish screen panels 4 feet 6 inches wide and high enclose the entrance. Louvers would be constructed behind the screen to provide uniform velocity control along the full face of the screen. The screen has a reinforced concrete foundation with structural steel frames placed at about 5-foot intervals. Failsafe fish screen elements are incorporated into the design and operation of the diversion system. The water diversion will be automatically shut off whenever the fish screen fails to meet design or performance criteria until the fish screen is functioning again. The screen would be equipped with stage sensors on both sides of the screen to measure head differential. If a problem is detected, the sensors would trigger an activation of the screen-cleaning mechanism (motorized sweeping brushes), and/or send an alarm. If the problem continues the diversion will be shut down.

Powerline Relocation

Currently power is provided to the site by a line extending down into the canyon from a power pole located on the north rim of the canyon. The power pole located at the canyon bottom stands near the base of the access stairway. This pole would be relocated approximately 30 feet downstream from this location and may be temporarily removed during construction. Power to the site during construction would be provided by portable generators. The powerline will be reconnected upon completion of construction.

Access Trail Improvements

Access to the site is currently limited to foot access along an extended trail on the south rim of the canyon, which begins at the top of the plateau and leads down to the creek. For construction, operation, and maintenance, this foot trail would be improved. Improvements include strengthening or adding handrails, strengthening or repairing stair steps, adding foot traffic grip strut grating at selected locations, stabilizing loose rocks in the footpath, providing adequate drainage to improve footing, and equipping the path with lighting. Improvements would occur in the general vicinity of the existing trail.

Improvements to Spring Collection Facilities

Historically, PG&E collected spring water originating from numerous locations along the cliff face of the access trail and conveyed it to the Eagle Canyon Canal flume and Tunnel No. 2. This spring water now bypasses the collection system and is returned to the North Fork under the terms of an interim flow agreement (see Chapter 6). However, many of the collection facilities remain. Under this alternative, broken and abandoned pipe collection facilities would be removed and other collection features would be modified to facilitate drainage along the trail and to ensure that spring water collected is returned to the creek. Some of the existing collection facilities consist of small channels (about 6 inches wide by 3 inches deep) cut along sections of the rock cliff face. These channels will be left in place.

Construction Considerations

Construction activities potentially would affect the following areas near Eagle Canyon Diversion Dam:

- **Primary access road to work site.** Access is from the south over the existing dirt road off Manton Road. This 15-foot-wide, 5,300-foot-long road would be graded, vegetation may be removed or trimmed, and gravel surfacing may be added as necessary to allow all-weather access during construction. The total area affected would be approximately 80,000 square feet.
- **Entrance to primary access road.** The entrance would be modified to ensure safe access to the site because stopping distances for cross traffic are inadequate and the apron is too short. The gate and fences would be widened and set back 100 feet. The culvert pipe that provides drainage along Manton Road would be removed and replaced with a longer section. The entrance area would be graded to promote drainage and compacted to provide an adequate foundation for placement of asphaltic concrete. Vegetation may be removed or trimmed. The total area affected would be approximately 15,000 square feet.
- **Area on the south rim of the canyon at the end of the access road.** This 50-foot-wide-by-480-foot-long area would be cleared of vegetation, graded and graveled as necessary to serve as a staging area. The total area affected would be approximately 24,000 square feet.
- **Access road to the north canyon rim.** This 15-foot-wide-by-4,800-foot-long road may be graded and graveled. The total area affected would be approximately 72,000 square feet.
- **Area on the north rim of the canyon at the end of the access road.** This 120-foot-wide-by-200-foot-long area may be cleared, graded, and graveled to serve as a staging area. The total area affected would be approximately 24,000 square feet.
- **Footpath from the south canyon rim down to Eagle Canyon Diversion Dam.** This footpath would serve as the primary access route for personnel. This 1,000-foot-long trail would be improved to provide safer access during and after construction. The location of the footpath would remain the same; therefore, disturbance to this area would be limited to a maximum 10-foot width. The total area affected would be approximately 10,000 square feet.
- **Improvements to spring collection facilities.** Work required for the removal of the spring collection facilities on the south canyon wall would extend from Eagle Canyon Diversion Dam at Eagle Canyon Canal station 0+00 to station 29+18. At least 21 collection points and 11 discharge points would be modified. Access to these points would be over the existing access road on the canyon rim above the flumes and tunnels and by existing paths, trails, and flume walkways and stairs. These access ways would not be altered to obtain access. The access roads to the turnaround areas at each trailhead may be graded and graveled. The individual improvement areas for

the affected collection elements would vary with the required work. The total area to be affected is estimated to be approximately 9,000 square feet.

- **South canyon face.** Several areas on the south canyon face present a potential rockfall hazard to construction work and the final facilities. The actual amount of affected canyon face would depend on ongoing stability assessments. If work is required at a specific area (e.g., removal by barring and scaling), access may be from above or from the side. A total area of 65,000 square feet has been estimated, but the actual area affected may be substantially less.
- **Area within the creek channel high-water surface extending about 200 feet upstream of the dam.** Diversion banks and other water control systems would be required for construction of the fish ladder and fish screen structures in the dry. The total area affected would be approximately 14,000 square feet.
- **Area within the creek channel downstream of Eagle Canyon Diversion Dam.** This area would be disturbed by the construction of the fish facilities, which would extend about 180 feet downstream of the dam. Total area affected would be approximately 18,000 square feet.
- **Use of helicopters.** There is no vehicular access to the dam site. All construction equipment and materials heavier than can be carried by workers along the footpath would be transported to and from the site by helicopter. Materials to be permanently removed from the sites would be transported by helicopter and dropped off at identified staging areas.
- **Disposal of materials.** Rock, masonry, and concrete materials not containing metal would be broken into 1- to 2-foot size fragments and distributed within the creek channel downstream of the dam. Materials containing metal would be removed and disposed of off site. Common excavation composed of sediments would be temporarily stockpiled in the work zone and then reused as backfill.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired or repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded, and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

The sequence of construction at Eagle Canyon Diversion Dam would roughly follow this order:

- construct new access road entrance and trail improvements;
- build cofferdams and temporary water bypass structures;
- prepare site by demolition of existing facilities, including fish ladder, headworks and pertinent sections of the dam; and by excavation for structures, including removing boulders;
- construct new headworks;
- perform concrete work for new screen and ladder;
- install metalwork for screen and ladders;
- install and test mechanical and electrical systems; and
- remove cofferdams and complete site restoration.

Construction at this site would occur over a 15-month period, with a winter shutdown lasting approximately 7 months. Construction is anticipated to begin in spring 2005 and end by summer 2006.

Water diversions into the canal would be interrupted to allow construction to be performed. A 6-month shutdown would take place the first construction season followed by a brief shutdown in the second construction season.

Wildcat Diversion Dam, Wildcat Canal, and Wildcat Pipeline Area

Project Elements

Project elements for the Wildcat Diversion Dam site include:

- removal of Wildcat Diversion Dam;
- removal of appurtenant dam facilities, including Wildcat Canal; and
- sediment management.

Wildcat Diversion Dam Removal

Under this alternative, Wildcat Diversion Dam would be demolished and removed to improve fish passage to the North Fork Battle Creek. Removal of the existing masonry rock structure would involve demolishing the rock/mortar matrix into pieces no larger than 1 to 2 feet in size, similar to existing cobble material transported within the river system. The resulting 70 cubic yards of material would be spread over an area extending about 100 feet downstream from

the dam site. The material would be placed along and within the creek channel in a manner that would not hinder fish passage or flow. Natural stream floodflow would distribute the material throughout the downstream river system. The streambed would be restored to preproject conditions.

Appurtenant Facility Removal

Appurtenant facilities that would be removed under the Five Dam Removal Alternative include:

- masonry intake structure;
- all electrical and mechanical items, including the gates and associated controls;
- steel Alaska Steeppass fish ladder;
- original concrete ladder structure;
- hand rails, metal walkways, and other miscellaneous metalwork;
- Wildcat Pipeline and associated support structures and footings;
- Wildcat Canal;
- powerline and associated power poles.

The disposition of each of these appurtenant facilities under this alternative is described below.

The masonry intake structure would be broken up and spread within the streambed downstream of the dam (within 100 feet) and would be distributed by natural floodflows. There is about 40 cubic yards of material in the intake structure. A thin concrete cap on top of the intake structure contains less than 3 cubic yards of material. This concrete cap would also be broken up and distributed within the streambed.

Any metalwork associated with the intake structure and dam, including trash racks, 36-inch-diameter slide gate, hoist, 30-inch pipe, mechanical controls, and electrical controls, would be removed and either salvaged by PG&E or disposed of at the nearest approved commercial disposal site. In addition, the 24-inch-diameter sluice gate within the dam section would be removed and disposed of or salvaged.

The steel Alaska Steeppass fish ladder set into the original concrete fish ladder would be removed, cut up, and disposed of at the nearest approved commercial disposal site. The original concrete fish ladder would be broken up into pieces no larger than 1 to 2 feet in size. Concrete pieces, which contain steel reinforcement, would be removed and disposed of at the nearest approved commercial disposal site, and the remaining concrete rubble would be spread within the streambed downstream of the dam (within 100 feet). The amount of material to be left instream versus the amount to be hauled out can vary greatly depending on the construction method. There is an estimated 10 cubic yards of material. Under some methods, an estimated maximum of 8 cubic yards of this

material would be left instream and spread in the area below the dam. The remaining estimated 2 cubic yards that contain steel reinforcement would be removed from the site. Other methods can result in the opposite proportions.

The foot trail leading from the top of the canyon to the dam site would remain. The metal walkway at the end of the access trail and other miscellaneous metalwork, the stream gage below the dam, and the power line to the site would also be left in place.

Approximately 5,390 feet of the 24-inch Wildcat Pipeline (total of 5,530 feet) and steel support framework would be removed from the stream channel. Approximately 140 feet of the pipeline and support structure would be left in place to provide the local landowner access across Juniper Gulch. Within this section all concrete piers, steel supports, and miscellaneous metalwork would remain. All other concrete piers along the pipeline alignment will be left in place; however, all timber and steel supports are to be removed. The protruding portions of any steel bolts embedded in the concrete piers (these bolts currently attach the steel support structure to the piers) would be cut off flush with the surface and removed. In addition, in a few places along the length of the pipe, the structure is anchored into the canyon wall. All of these anchor bolts would be cut off at the rock surface and the ends removed.

Wildcat Canal would be filled in except for specific sections, which would be left unfilled either at the request of the landowners or as a means to control natural drainage that enters the canal from upslope. Captured drainage water would be conveyed to selected discharge points. This would help control flooding or erosion of downslope lands. Wildcat Pipeline ends at a concrete header box at which the pipeline transitions into a canal section. The concrete header box would be left in place. From the header box, the first 1,465 feet of the canal would be filled in. This section of canal is earth-lined. The depth of filling the canal would depend on several considerations. To minimize construction costs, the goal would be to fill the canal with the adjacent canal bank material that came from the original canal excavation. The existing canal bank would be excavated to a depth that fills in the canal to the same height. This would result in a wide, slightly sloped surface that would prevent ponding, allow cross-slope drainage to continue downslope, allow vehicle access, and prevent animals from becoming trapped. The width of the bank excavation would be adjusted locally to avoid root zones of adjacent trees. Import of fill materials would be minimized. Any imported materials that might be needed would be obtained from the stream channel or from excess excavated materials (materials that would otherwise be disposed onsite) from other work sites, such as at the Coleman Diversion Dam/Inskip Powerhouse site (connector pipeline and bypass pipeline excavation).

About 1,465 feet downstream of the header box, double culverts drain into the left side of the canal. Upslope natural runoff enters the canal at this point. Just upstream of these double culverts, the canal filling would be terminated. Runoff from the double culverts would still be allowed into the canal section at this point. The canal section would be left open for about 620 feet downstream

where the canal would be breached to allow this drainage water to flow into another natural drainage gulch running downslope of the canal. The canal immediately downstream of this point would be plugged to force the runoff water through the canal breach and into the natural drainage. Beyond this point, the canal would be filled to Wildcat Road by excavating the canal bank and filling-in the canal as described above. In this section the right side of the canal (looking downstream) is concrete-lined. This concrete lining would be broken up and buried in the canal section as it is filled. At Wildcat Road, the canal transitions into a pipe culvert to convey water underneath the road. This culvert would be plugged. Wildcat Canal continues for about another 1,500 feet to Coleman Canal. Below Wildcat Road the canal section would be filled in for about the first 440 feet. Downstream of this point, the canal begins collecting a large amount of natural drainage. This remaining section of earthen canal would be left open. East of Wildcat Road the reconfigured canal road, which is used by the landowner, would be graded and graveled upon completion of the removal and reconstruction activities.

Sediment Management

The existing sediment behind Wildcat Dam would not be removed. No significant quantities of fines in the sediments behind the dam exist, and turbidity is not expected to be a problem. No hazardous materials contamination problems are expected in the sediments. These sediments would be left in place for floodflows to distribute the primarily cobble material throughout the river system downstream. It is expected that this material would serve as suitable habitat for aquatic resources.

Construction Considerations

Construction activities potentially would affect the following areas near Wildcat Diversion Dam, Wildcat Canal, and pipeline:

- **The intersection of the access road with Battle Creek Bottom Road.** This intersection would be widened, graded, and graveled. Fences and gates would be modified to facilitate the movement of construction equipment and personnel. The total area affected would be approximately 5,000 square feet (50 feet by 100 feet).
- **Access road from Battle Creek Bottom Road that proceeds south to the dam.** This 4,400-foot-long, 15-foot-wide road would be bladed and graveled as necessary to facilitate access. This area may be used for helicopter staging. The total area affected would be approximately 66,000 square feet.
- **Parking area on the north abutment above the dam site.** This parking area would be graded and graveled as necessary to serve as a staging area. This area would be used for helicopter staging. The total area affected would be approximately 5,000 square feet.
- **Footpath from parking area to dam site.** This footpath would be improved as necessary to allow safe and efficient access for construction workers.

Improvements may include rebuilding or adding to existing steps and stairs, shoring up or adding new handrails, and trimming or removal of vegetation. The footpath is too narrow for bringing equipment to the worksite. The total area affected would be approximately 5,000 square feet.

- **Wildcat Diversion Dam.** Work required below the canyon rim for the removal of Wildcat Diversion Dam would be limited to an approximate 100-foot width across the canyon and extend 100 feet downstream from the dam and 250 feet upstream of the dam. The total area affected would be approximately 35,000 square feet.
- **Overhead powerlines.** The overhead powerlines and poles to be removed drop to the dam site from the top of the left canyon. An access road off of Manton Road follows the lines and would be used to accomplish the removal work. The total area affected would be approximately 6,000 square feet.
- **Wildcat Pipeline.** Work required for the removal of the Wildcat Pipeline would be limited to the 5,500-foot-long pipeline corridor that averages 20 feet wide. The total area affected would be approximately 110,000 square feet.
- **Wildcat Canal.** Work required for the abandonment of the Wildcat Canal would be limited to a 70-foot-wide corridor along the portion of the canal from the pipe outlet box to 70 feet west of Wildcat Road, for a total of 3,100 feet. The total area affected would be approximately 217,000 square feet.
- **Staging area that may be established on private property adjacent to Wildcat Road.** The area would require grading, graveling, and fence and gate modifications. This area would be used for helicopter staging. The total area affected would be approximately 44,000 square feet.
- **Use of helicopters.** Both the dam site and pipeline alignment are in remote areas with no nearby vehicular access. All construction equipment and materials heavier than can be carried by workers along the footpath would be transported to and from the site by helicopter. Materials to be permanently removed from the sites would be transported by helicopter. These materials would be picked up or dropped off at identified staging areas.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired or repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded, and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

The sequence of construction at the Wildcat Diversion Dam would roughly follow this order:

- cut Wildcat Pipeline about 100 feet downstream of dam to allow draining of reservoir area through outlet,
- remove sluiceway gate to lower reservoir level further,
- construct upstream cofferdam,
- remove old fish ladder and notch dam to streambed grade to further reduce reservoir level,
- remove remainder of dam,
- remove last section of walkway (metalwork),
- remove pipeline concurrent with dam removal activities,
- fill in Wildcat Canal and complete remaining reconfiguration of canal for drainage and access road concurrent with dam removal activities, and
- remove upstream cofferdam and complete site restoration activities.

Construction at this site would occur over a 9-month period, with a potential winter shutdown lasting approximately 4 months. Construction is anticipated to begin in summer 2005 and end by spring 2006.

South Diversion Dam and South Canal Areas

Project elements for the South Diversion Dam site include:

- removal of South Diversion Dam;
- removal of appurtenant dam facilities, including South Canal;
- improving site access; and
- sediment management.

Project Elements

South Diversion Dam Removal

Under this alternative, South Diversion Dam would be completely removed, including both the overflow section and the non-overflow sections with special consideration for some of the intake structure and appurtenant facilities as described below. The steel plate cap and steel bin-wall components of the dam would be removed. The gravel and cobble material filling the bins would be removed and spread downstream of the dam over about a 100-foot distance. Some of the streambed materials may be used to fill portions of South Canal. All

concrete would be removed from the stream channel. Concrete containing steel reinforcement would be disposed of off site in an approved commercial disposal site. Concrete not containing steel would be disposed of off site or broken up into 1- to 2-foot size fragments and buried in portions of South Canal.

Appurtenant Facility Removal

Portions of a reinforced concrete intake structure to South Canal would be retained on the right abutment of the dam to allow the gate to inlet portal (Tunnel No. 1) to be welded closed. The radial sluice gate on the right abutment would be removed and either salvaged or disposed of off site. The South Canal intake structure trashrack and slide gate operator would be removed. The steel denil-type fish ladder that is attached to the downstream face of the overflow crest structure would be removed and either salvaged or cut into sections and disposed of off site. Miscellaneous handrails, ladders, and metal walkways associated with the canal intake structure or along the trail leading to the structure would be removed and salvaged or disposed of off site.

South Canal

The metal canal flume sections along South Canal would be disassembled and bundled for removal by helicopter. Spillway sections, feeder pipes, access walkways, stairways, and other miscellaneous metalwork also would be removed. Because of the remoteness of the work sites and the general lack of vehicle access, helicopters would probably be used to airlift metal items between staging areas near the access roads and the work sites. These items would be removed from the work sites and salvaged or disposed of off site. The reinforced concrete flume footings generally would be left in place. However, at the request of the landowner, some footings would be entirely removed from the site and disposed of off site. With the approval of the landowner, a few potentially unstable tall footings would be knocked over, broken up, and left onsite.

All 10 tunnel sections along the South Canal would be closed with angle iron gates to prevent people from entering the tunnels but also allow bats to access the tunnels. A total of 19 portals require gates. The twentieth portal is the Tunnel No. 1 inlet portal, which would be sealed by welding the intake gate shut. The gates would be designed in accordance with current guidelines for promoting bat habitat and may include partial closure of the portal with concrete to optimize airflow and climate within the tunnel. The tunnel closures would incorporate drainage features at the base to prevent buildup of any groundwater within the closed tunnel. The open-channel sections of South Canal would be filled in. The depth of filling the canal would depend on several considerations. To minimize construction costs, the goal would be to fill the canal with the adjacent canal bank material that came from the original canal excavation. The existing canal bank would be excavated to a depth that fills in the canal to the same height. This would result in a wide, slightly sloped surface that would prevent ponding, allow cross-slope drainage to continue downslope, allow vehicle access, and prevent animals from becoming trapped. The width of the bank excavation would be adjusted locally to avoid root zones of adjacent trees. Importing of materials to accomplish filling would be minimized. Any imported materials that might be needed would be obtained from the stream channel, the South Dam

bin-wall fill, or from excess excavated materials (materials that would otherwise be disposed onsite) from other work sites, such as at the Inskip Diversion Dam/South Powerhouse site (tunnel and access road excavation). Some portions of the open-channel sections are formed by vertical concrete walls. Concrete walls not containing steel would be broken up and buried in the canal. Concrete walls containing steel would be removed and disposed of off site. Where natural drainages occur in the existing canal system, the runoff would be conveyed across the old canal alignment to the natural downstream drainage draws. Canal wasteways with downslope concrete aprons would be left in place.

Some clearing of vegetation adjacent to the canal may be required to facilitate access for the removal of flume sections and canal backfilling. A 20-foot clearing zone at various canal locations may be required, and trimming of trees or bushes outside of the 20-foot zone also may be required on a case-by-case basis. Also, minor areas of clearing or trimming of brush at locations not adjacent to the flumes, canal, or tunnel sections may be required to accommodate remote winch setup, helicopter access, and equipment access to canal sites.

The canal corridor is generally not fenced.

Access Road Improvements

Some creek channel and access road improvements would be necessary to accommodate the construction equipment required for dam and canal removal. The archaeological site identified along the access road to South Dam would be protected and left undisturbed. For all reaches of the access road, improvements would include smoothing and graveling road surfaces as necessary to support standard construction vehicular traffic. There are two locations along the access road at drainage crossings that would be excavated and graded to widen them enough to allow large construction equipment (i.e., dump trucks) to turn around. The switchback and parking areas near the end of the access road would be excavated, graded, and graveled to widen them enough to allow large construction equipment to easily access the work site. Access for construction equipment from the end of the existing road to the dam site would be developed over two possible routes. The first route would involve reestablishing an old access ramp near the parking area, which leads to a low-water crossing located approximately 740 feet downstream of the dam, and rehabilitating the existing construction haul road along the south creek bank to the dam abutment. The second route would involve widening the existing canal bank between the parking area and the outlet of Tunnel No. 1. A ramp would then be excavated through the canal bank down to a terrace above the creek channel. Any fill material required to complete the ramp would be obtained from terraces above the creek channel. Some tree limbs or trees, as required, would be removed to facilitate equipment access.

Several existing access roads would be used to reach various points along or near South Canal. These existing roads would be graded and graveled as necessary to allow transporting personnel and small equipment to various locations along the canal to facilitate removal activities. Much of the 5.7-mile length of the canal cannot be reached practically by vehicles. In these areas existing foot trails off of

the access roads would be used by personnel, and equipment and materials would be brought to and from the site by helicopter. At several locations where it is practical, existing trails would be widened and graveled as necessary to allow construction equipment to reach the worksite.

Sediment Management

The reservoir behind the dam is largely filled with sand, gravel, cobbles, boulders, and debris so that the depth of water averages between 2 and 3 feet below the dam crest. Most of the material is cobble size. These sediments would be left in place and allowed to be distributed downstream by natural floodflows. It is anticipated that only one normal flood season will be required to distribute these materials downstream. A pilot channel would be excavated in the sediments 200 feet upstream from the dam site to facilitate sediment flushing and to ensure that fish passage is adequate. The pilot channel would have a bottom width of approximately 2 feet and side slopes of approximately 3:1. The bottom slope of the channel would range from 8:1 to 10:1. Material excavated for the pilot channel would be spread in the river channel upstream of the dam.

Construction Considerations

Construction activities potentially would affect these areas near South Diversion Dam and the South Canal:

- **Area within creek channel high-water surface, extending about 500 feet upstream from South Diversion Dam.** Construction of a pilot channel for the excavated sediments, redistribution of the reservoir sediments within the areas upstream and downstream of the dam, and excavation of sediments to allow dam removal would affect this area. The total area affected would be approximately 72,000 square feet.
- **Area within the creek channel downstream of South Diversion Dam, including part of the access ramp on the downstream right creek bank.** This area would be disturbed by equipment crossing the creek to reach the dam removal area and by the redistribution of the upstream sediments. The total area affected would be approximately 96,000 square feet.
- **Area along the left creek bank.** This area would be disturbed by regrading and by equipment crossing the creek to reach the dam removal area. The total area affected would be approximately 18,000 square feet.
- **Water conveyances.** The project width along the South Canal would be 70 feet for all three types of water conveyances used (open channels, flumes, and tunnels). The entire project width would not need to be disturbed during abandonment or removals. The entire 70-foot width may be needed for open channel sections, up to 40 feet for the flumes, and only 20 feet for tunnels, resulting in affected areas of 1,412,250 square feet for the 20,175 feet of open channel, 95,360 square feet for the 2,384 feet of flumes (total of nine flumes), and 152,260 square feet for the 7,613 feet of tunnels (total of 10

tunnels). The total area affected would be approximately 1,660,000 square feet.

- **Access roads to South Diversion Dam and South Canal.** Approximately 3 miles of unimproved public road (Ponderosa Way) would be affected by construction activities. The road would be bladed and graveled as needed to support construction equipment and maintain public access. The total area affected would be approximately 324,000 square feet. Improvements to the 2.3-mile private access road, which continues to South Diversion Dam and the eastern access points along South Canal, are described above. The total area affected would be approximately 234,000 square feet. The network of private unimproved access roads that branch off of the Bluff Springs gate to the middle and western portions of the South Canal would be bladed and graveled as needed to support construction equipment. The total length of this road network that is affected is approximately 3.6 miles and the total area affected would be approximately 451,000 square feet. The portions of access roads that are along the canal banks are not included in these figures. These affected areas are included in the water conveyances estimate. The private South Powerhouse Access Road and Old Ranch Road also provide access to the western portions of South Canal but are addressed in the description for Inskip Diversion Dam/South Powerhouse site.
- **Use of helicopters.** The dam and canal sites are in remote areas with limited vehicular access. Certain construction equipment and materials, and materials to be permanently removed from the site may be brought to or removed from the sites by helicopter. These materials would be picked up or dropped off at identified staging areas.

Overall, the type of equipment used for construction of this element would include bulldozers, excavators, cranes, loaders, backhoes, and other transportation vehicles.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired, or repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded, and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

Removal activities at the South Diversion Dam site would be accomplished roughly in the following order:

- close off diversion at South Diversion Dam by sealing inlet portal,
- remove any mechanical features to be salvaged or disposed of from the dam,
- remove South Diversion Dam,
- remove South Canal features concurrently with the dam removal, and
- complete site cleanup and restoration.

Construction at this site would occur over a 2.5-month period. Construction is anticipated to occur during fall 2005.

Soap Creek Feeder

Project Elements

Proposed elements for the Soap Creek Feeder site include:

- removal of appurtenant dam facilities, pipeline, and junction box where flow enters South Canal; and
- improving site access.

Soap Creek Feeder Diversion Dam

Under this alternative, Soap Creek Feeder Diversion Dam would be removed. All mechanical equipment would either be salvaged or disposed of off site. Dam materials not containing steel would be broken up into pieces no larger than 1 to 2 feet in size, hauled to the nearest South Canal open-channel site and buried. These materials could be temporarily stockpiled until South Canal flows cease. Materials containing steel would be removed and disposed of off site. The dam would be removed to the existing streambed grade. The dam retains a minor volume of sediments. A pilot channel would not be excavated. Natural creek flows would be sufficient to distribute the materials downstream. Cold spring water entering Soap Creek above the dam would be allowed to continue downstream of the dam site.

Soap Creek Appurtenant Facilities

The pipeline, which extends 291 feet downstream to a junction box (including a stilling well, a venturi flume, and a 27-foot-long No. 72 metal flume) would be removed from site. The concrete piers that support the pipeline would be removed and disposed of off site.

Access Road Improvements

Road improvements would involve blading and graveling as described above for South Canal access.

Construction Considerations

Construction activities potentially would affect the following areas near Soap Creek Feeder Diversion Dam:

- **Existing access road off of Ponderosa Way.** This road would be bladed and graveled as described above for South Canal.
- **Staging area.** A staging area would be established to accommodate helicopter work. The proposed location would be established in the field but would be adjacent to the main access road at a flat spot at the top of the plateau after the turnoff from Ponderosa Way.
- **Staging area for the removal of Soap Creek Feeder Diversion Dam.** Work for the dam removal would be staged from a small area above the right abutment of the dam. This area and the access footpath leading down to the dam would be graded and shaped to establish safe access. The access path corridor would be minimized to about 20 feet wide. The total area affected would be approximately 5,000 square feet.
- **Area within the creek channel upstream and downstream of Soap Creek Feeder Diversion Dam.** This area would be disturbed during dam removal. The affected area would extend about 60 feet upstream and about 40 feet downstream from the dam and would be 40 feet bank to bank. The total area affected would be approximately 30,000 square feet.
- **Area of pipeline and associated structures.** Removal would be contained within a 15-foot-wide corridor between Soap Creek Feeder Diversion Dam and South Canal, a distance of about 300 feet. The total area affected would be approximately 4,000 square feet.

Equipment used for this element includes bulldozers, loaders, excavators, cranes, helicopters, and dump trucks.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired or repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

Once the diversion gate is closed on Soap Creek Feeder Diversion Dam, removal of both the dam and appurtenant facilities could proceed concurrently. The

sluice gate section within the dam would be left in place until the end to facilitate diversion of the creek water. Once the largest portion of the dam is removed, this final section would be taken out. Construction at this site would occur over a 1-month period. Construction is anticipated to occur during summer 2005.

Inskip Diversion Dam/South Powerhouse

Project Elements

Proposed features at the Inskip Diversion Dam/South Powerhouse site include:

- Inskip Diversion Dam fish screen and ladder,
- Inskip Canal wasteway,
- South Powerhouse tailrace connector,
- South Powerhouse tailrace channel,
- access road improvements,
- power line relocations, and
- waste areas.

The features proposed for the Inskip Diversion Dam/South Powerhouse site for the Five Dam Removal Alternative are shown on Figure 3-2c.

Project elements would be designed to improve fish passage at Inskip Dam, reduce diversion of fish into Inskip Canal, eliminate powerhouse tailrace discharges to South Battle Creek, and allow Union Canal flows to bypass South Powerhouse and enter Inskip Canal.

Inskip Diversion Dam Fish Ladder and Screen

Fish ladder. The proposed fish screen and ladder would improve fish passage at Inskip Diversion Dam and flow diversion to the Inskip Canal. The proposed Half Ice Harbor fish ladder would be located on the north (right) bank of South Fork Battle Creek below Inskip Diversion Dam. Beginning at the entrance pool, the ladder climbs the northern stream bank in the downstream direction, roughly paralleling the streamflow, for a distance of about 200 feet, where it turns perpendicular to the creek and climbs the remaining elevation up the stream bank slope to tie into the Inskip Canal.

The exit pool of the fish ladder will be located immediately downstream of the fish screen and adjacent to the gate structure on Inskip Canal. Video monitoring equipment would be installed at the outlet pool for biological monitoring. A bypass channel will be provided to divert water around the fish screen, if needed. Auxiliary water will be collected from behind the fish screen, piped to the ladder entrance, and diffused up through the grating in the floor of the entrance pool.

The design flow of the ladder is 39 cfs and will be supplemented by up to 131 cfs of auxiliary water.

The ladder would have pools 9 feet wide by 10 feet long and have both weir and orifice flow between consecutive pools. The weirs would be 5 feet wide and the orifices would be 24 inches high by 24 inches wide. There is sufficient inflow to the site for the ladder to operate without adjustment in all but the very driest of years. If creek flows drop to the 20- to 25-cfs range, the orifices may need to be partly closed to maintain proper ladder hydraulics. Sensors would be included in the ladder to allow automatic operation of the control gates during high flows. Other sensors would be incorporated in the ladder and fish screen to ensure minimum instream flow requirements are met.

The creek bed would be excavated to a depth of approximately 5 feet to develop a pool at the ladder entrance. Some bedrock on the creek bank opposite the ladder may also need to be excavated to maintain desirable creek hydraulics. The top of the entrance pool would be covered with grating to prevent debris from being deposited within the ladder during large flow events.

An access road would be constructed on the north (right) creek bank to provide access for operation and maintenance of the fish ladder and screen. The new 16-foot-wide road would originate at a new parking area adjacent to the fish screen, continue upstream along the right bank of the creek and terminate at South Powerhouse, where it would connect to the existing access road. A prefabricated railroad car bridge would be constructed across Inskip Canal, just downstream of the new fish screen structure, for access to the fish ladder and entrance pool via a lower service road. Originating at the railroad bridge, the service road would run along the fish ladder and terminate at stream level near the entrance pool. Fill for the service road will extend approximately 50 feet towards the creek, measured from the south ladder wall. An upper service road, approximately 160 feet long, will tee off the lower service road, cross over the fish ladder, and terminate at the sluiceway. The road will provide access to the top of the fish ladder entrance chamber so staff can operate and maintain the entrance gates and install and remove stoplogs.

The entire northern streambank slope, from the entrance pool roughly 50 feet below the dam downstream to about 1,100 feet below the dam, would be affected by construction activities.

The metalwork will be removed from the existing Alaska Steeppass fish ladder. The concrete portion of the original pool and weir ladder would remain in place, but the upper end would be blocked so upstream migrants are no longer attracted to the ladder.

Fish screen. The proposed 121.5-foot-long flat plate fish screen would be constructed in Inskip Canal extending downstream from a point beginning about 190 feet below the diversion headworks. The fish ladder exit would be just downstream of the screen bypass. The proposed fish screen would have a capacity of 220 cfs under normal operating conditions. The water depth on the

screen would be maintained at 6 feet to 7 feet depending on the creek stage. The base of the screen would be set 6 inches above the canal bottom to allow for some sediment collection without affecting the screen operation. Louvers would be installed behind the screen to provide uniform velocity control along the face of the screen. Sweeping velocities are expected to be 3 feet per second resulting in an estimated time of 41 seconds for the fish to move past the screen. The framing system would support a removable, stainless-steel, wedge-wire or equivalent screen meeting DFG and NOAA Fisheries fish screen criteria. A motorized sweeping-type brush assembly would clean the entire screen face. Multiple independent cleaning brush systems would be required to cover the full length of the screen within durations satisfying the criteria specified by DFG and NOAA Fisheries. Failsafe fish screen elements are incorporated into the design and operation of the diversion system. The water diversion will be automatically shut off whenever the fish screen fails to meet design or performance criteria until the fish screen is functioning again. The screen would be equipped with stage sensors on both sides of the screen to measure head differential. If a problem is detected, the sensors would trigger an activation of the screen-cleaning mechanism (motorized sweeping brushes), and/or send an alarm. If the problem continues the diversion will be shut down. If this shutdown occurs, the auxiliary water supply would also be shut down to prevent dewatering of the downstream face of the screen.

Coordinated hydraulic control of the fish screen and ladder would be accomplished with the use of a series of vertical sliding gates located in the canal. Through the range of design flows, the head differential between the creek and the canal can vary approximately 2 feet. Because only a 1-foot head differential is desired between any two pools in a fishway, two control structures are proposed. The first control structure is the headworks located at the dam. This structure is a set of two 6-by-6-foot automated vertical sliding gates in parallel. These gates serve as the flow control structure for the ladder and screen and dissipate up to 1 foot of head between the creek and canal water surfaces. The second control structure is a gate at the top of the fish ladder. This gate would be adjusted to keep the screen and ladder within design standards until the creek discharge reaches the design flow. To account for the possibility that the head differential may vary by more than 2 feet over the range of design flows, a foundation would be laid immediately upstream of the existing sediment trap to accommodate an additional control structure if it is determined to be needed at a later date.

Construction of the fish screen would require the placement of a cofferdam within Inskip Canal just below the construction zone for the screen. The location of this cofferdam is along the alignment of the proposed permanent prefabricated bridge canal crossing. A construction access road would be maintained across this cofferdam during construction. Construction of this cofferdam allows operation of the completed bypass tunnel and continued power generation at downstream powerhouses while construction of the fish screen and ladder proceeds.

To meet velocity requirements across the fish screen, the Inskip Canal cross section would require widening, and the capacity of the existing Tunnel No. 1 would need to be increased. This existing tunnel has very little overburden cover over it, leading to concerns that any attempt to increase the diameter of the tunnel to provide additional capacity would lead to its collapse. Consequently, Tunnel No. 1 would be converted to an open-channel section to provide the additional capacity. The canal cross section would be realigned approximately 40 feet to accommodate the new section. This widened section would be tied into the existing canal cross section immediately downstream of the proposed ladder and screen.

Headworks

The existing headworks structure, located near the right bank, just upstream of the tunnel entrance, would be removed and replaced with a new structure. The new concrete structure would be cast against the rock embankment on one side and anchored to the existing dam on the other side. The structure would be just over 31 feet long and 20 feet wide, with a rectangular flow area 16 feet wide. The headworks entrance would be protected by a trashrack and would house two electric gates mounted side by side. Headworks equipment would include electrical controls and monitoring systems to allow automatic operation of the gates, in coordination with other flow regulation equipment at the site.

Sluiceway

The existing sediment basin is located just upstream of the future fish screen and includes a radial gate structure. The radial gate would be repaired and a new sluiceway would be added downstream of the radial gate to convey water over the new fish ladder and into the creek. The sluiceway, a concrete channel 8 feet wide, 5 feet high, and about 60 feet long, would be constructed on fill and also supported by piers. Radial gate improvements at the sediment basin would consist of cleaning and coating radial gate steel surfaces and installing a new beam assembly above and just in front of the radial gate, to prevent fish from jumping over the gate. The sluiceway and radial gate would be used periodically to remove accumulated sediment. The improvements to the radial gate at Inskip Diversion Dam would be similar and will also include replacing damaged steel members.

Inskip Canal Wasteway

An overflow wasteway in the Inskip Canal would be provided in the area between the South Powerhouse tailrace connector tunnel outlet and the fish screen. The wasteway would consist of a 100-foot-long concrete overflow box and pipe set in the southwestern Inskip Canal embankment. Excess water in the canal would overflow a lowered weir section into a concrete box collector. This concrete collector box would feed the excess water into a pipeline that discharges into the South Fork. The wasteway structure would have a capacity of 105 cfs. This wasteway would protect Inskip Canal from an uncontrolled overtopping that could occur when an excessive amount of water is discharged into the canal from the combined flows of the South Powerhouse tailrace and the penstock bypass while supplemental diversions were being made at Inskip Diversion Dam through the fish screen. The Inskip Canal wasteway would ensure that any flows that

exceed the capacity of Inskip Canal could be removed from the canal in a controlled manner. The discharged water would be a mixture of North and South Fork water but would be of a short duration.

South Powerhouse Tailrace Connector Tunnel

The proposed tailrace connector tunnel would allow diversion of South Powerhouse tailrace flows to Inskip Canal. The connector tunnel consists of a new 1,200-foot-long excavated tunnel in the northern slope paralleling the South Fork. The tunnel inlet portal branches off of the existing tailrace channel about 300 feet downstream of the powerhouse and consists of a 50- to 100-foot-long open-channel section transitioning into the tunnel bore section. The tunnel portal cut would be about 34 feet high and 50 feet wide. The concrete headworks structure constructed at the inlet portal would incorporate an 8-foot-by-7-foot radial gate for operation and maintenance purposes. The inlet portal headworks would also incorporate stoplog slots to act as a backup to the radial gate.

The tailrace channel immediately upstream of the inlet portal to the tunnel would include a sediment trap basin. This basin consists of an excavated basin approximately 20 feet by 100 feet. This basin would be excavated into the channel with a gabion wall at the upstream end. This basin would be used to trap any rock and sediment entering the tailrace from the wasteway before it enters the proposed tunnel.

The tunnel outlet portal discharges flows into the Inskip Canal at a point about 150 feet upstream of the inlet portal of Tunnel No. 2 on Inskip Canal. The outlet portal consists of a transition into an open-channel concrete-lined stilling basin section that would be about 120 feet long extending from the tunnel section to the connection with Inskip Canal. The open channel cut would be approximately 50 feet wide, and the total footprint of this open canal would be approximately 70 feet wide. The connector tunnel design discharge is 165 cfs. The proposed tunnel cross section is horseshoe-shaped with a height/diameter of 10 feet. The tunnel would be predominantly unlined, with the exception of some short sections that may require shotcrete lining.

South Powerhouse Tailrace Channel Modification

The South Powerhouse tailrace channel would be modified to prevent mixing of North Fork Battle Creek water with South Fork water. The proposed modification would continue to use the natural drainage channel wasteway to bypass waste flows past the powerhouse to the tailrace when the powerhouse or penstock is shut down. However, instead of being allowed to enter the South Fork Battle Creek, the tailrace would be closed off and the water would be conveyed into the new connector tunnel (described above). The proposed South Powerhouse tailrace modification incorporates the modifications to the peninsula and existing tailrace channel that are necessary to divert flows into the proposed new bypass tunnel.

Proposed elements that are included in this feature include:

- construction of a roller compacted concrete (RCC) dike,

- construction of a temporary tailrace construction cofferdam,
- construction of a permanent tailrace box culvert, and
- construction of a tailrace access ramp.

RCC dike. An RCC dike would be constructed along the left bank of the tailrace channel from the South Powerhouse discharge outlet to the tunnel inlet portal. The dike would be constructed to Elevation 1460, which would prevent South Fork Battle Creek from overtopping the dike for flows up to the 100-year flood. A 50-foot-long portion of the dike would be constructed at Elevation 1458. This portion of the dike would function as a spillway, which would allow the controlled discharge of overtopping tailrace flows into South Fork Battle Creek. The dike would be protected with riprap on the creek side to prevent erosive forces from undercutting the dike foundation. The top of the RCC dike would be utilized as the access road to the Inskip Diversion Dam fish screen and ladder facilities.

Temporary tailrace construction cofferdam. A temporary cofferdam would be constructed upstream of the proposed bypass tunnel inlet portal in the tailrace to prevent tailrace water from entering the tunnel while the tunnel is being constructed. The 13-foot-high cofferdam would be approximately 70 feet long at its top elevation, 60 feet wide (at its base) and be constructed from approximately 2,000 cubic yards of suitable on-site materials and a geomembrane. The upstream face of this temporary cofferdam would be treated with riprap for slope protection.

Permanent tailrace pipe culvert. A permanent 170-foot-long, gated box culvert would be constructed through the northern section of the tailrace peninsula. This box culvert is to extend from upstream of the location of the temporary construction cofferdam to a point downstream of the RCC dike. Both the upstream and downstream ends of this culvert would incorporate an entrance and exit concrete structure with riprap slope protection. This culvert would be equipped with slide gate/stoplog system to provide on/off flow control. If future powerhouse releases must be diverted from the connector tunnel or Inskip Canal for repair and/or inspection purposes, the box culvert gate could be opened and the connector tunnel inlet portal gate could be closed. This would allow continued operation of South Powerhouse by temporarily routing tailrace flows to the South Fork of Battle Creek through the culvert. Such operation would result in temporary mixing of North and South Fork water.

Operation and maintenance tailrace access ramp. A permanent 10-foot-wide earth ramp into the tailrace channel would be provided to allow equipment access to the sediment basin that would be located upstream of the approach to the bypass tunnel inlet portal. This permanent access ramp would extend off of the permanent dike to be constructed at the downstream end of the tailrace channel.

Access Road Improvements

Two types of access improvements would be required to implement the project elements. An access point on top of the plateau (near South Powerhouse) that

avoids the residential area would be required for construction. Access improvements also would be required in the vicinity of the South Powerhouse and Inskip Diversion Dam. The road that provides access down the slope to the powerhouse from the top of the plateau is considered sufficient for construction and long-term operation and maintenance purposes.

To avoid the residential area on top of the plateau, a new road is proposed that restores and improves an old ranch road that is located approximately 1,500 feet east of the residential area. This road would provide construction access from Hazen Road where improvements to the intersection would be required to meet all county standards for temporary construction road intersections. This road would be 20 feet wide and would follow along the old road alignment, which is in a degraded condition. This road would be smoothed and paved with 3 inches of suitable road gravel. A construction zone 50 feet wide would be required to build this road. Brush along this road would be cleared to reduce fire hazard. This improved access road on top of the plateau would intersect with the existing South Powerhouse Access Road at the point beyond the residence.

Permanent vehicular access would be required to construct, operate and maintain the proposed Inskip Diversion Dam fish screen and ladder and new tunnel outlet portal facilities. The new road would begin at the South Powerhouse and utilize the RCC dike to cross the tailrace area. The road would then travel overland from a point near the tunnel inlet portal toward Inskip Diversion Dam fish screen and ladder facilities on the north side of South Battle Creek. The proposed road alignment is shown in Figure 3-2c.

After crossing the tailrace channel via the RCC dike, the 1,850-foot-long road would rise above the riparian vegetation zone and existing foot trail and then roughly parallel the slope to the vicinity of Inskip Diversion Dam. Construction of this section of the access road would require a 20-foot-wide cut with the upslope side of the road cut at a slope of 1½:1. The maximum cut occurring in the slope is 31 feet high. As the road approaches Inskip Diversion Dam, the road begins dropping to the level of the fish screen and ladder where a large, flat staging/parking area would be developed. This staging/parking area would be roughly 60 feet by 70 feet in size. This sloped area would be cleared and flattened to provide both construction access and long-term operation and maintenance staging. An additional spur road would be developed off the staging/parking area that parallels Inskip Canal along its upslope side to the outlet portal and its associated stilling basin.

The proposed road would be 16 feet wide, with an additional 4 feet of width to provide for hillside drainage and guardrails as required. The road would be designed to provide all-weather access to the various sites for operation and maintenance purposes. The entire length of the road would be provided with 6-inch gravel surfacing, and those portions of the road with slopes greater than 6% would be topped with a 4-inch-thick asphalt layer. A maximum grade of 12% was assumed in accordance with safety standards. A minimum radius curvature of 50 feet at centerline was assumed sufficient for concrete mixer truck travel during construction.

Construction of the proposed access road would also require relocating one power pole and associated power line. This pole would be relocated upslope of the proposed road near where it is; the new site would be chosen to avoid impacts on trees and facilitate any needed rewiring.

Waste and Borrow Areas

Waste disposal areas to contain approximately 25,000 cubic yards of material would be required to accommodate material from the proposed tunnel excavation and access road construction. This material would be used to improve the road on top of the plateau that leads to the South Powerhouse header box. A 2,400-foot length of this road could be improved by placing and compacting the materials on top of the road. This road could be raised about 2 feet using this method of disposal. The remainder of waste material would be spread over an area up to 300 feet wide by 400 feet long. The waste material would be piled as high as is practical, in accordance with the landowner's requirements, and to minimize the amount of area permanently disturbed. The local landowner or PG&E could use this material for future road maintenance and improvements. Small quantities of waste material may also be used, as needed, for the fish ladder construction and for filling in nearby sections of South Canal.

To the extent possible, excavated materials would be reused to construct various project features. There are no borrow areas identified on the project lands. If special materials were needed that cannot be obtained from the excavations then those materials would be imported from off site.

Construction Considerations

Construction activities potentially would affect the following areas near the South Powerhouse:

- **Intersection modifications to the Old Ranch Road at Hazen Road and Manton School Road.** Selected clearing and grading would disturb approximately 5,500 square feet. An additional 2,500 square feet would be completely cleared, graded, and paved. Work would involve clearing vegetation, compacting the ground, placing and compacting aggregate road base material, placing asphalt pavement, realigning the fence, and adding a gate and cattle guard. Electrical power may be brought to the site to operate a new automatic gate and notification system. If an electric-powered system were installed, the overhead power lines located 650 feet north of Hazen Road (east side) would be extended to the new entrance.
- **Improvements to an existing deteriorated dirt road to accommodate construction traffic.** These improvements would include:
 - A 4,100-foot-long, 50-foot-wide corridor would be cleared of vegetation to reduce fire hazard. The total area cleared would be approximately 205,000 square feet.

- ❑ A 20-foot-wide traveled way would receive 3 inches of aggregate base material. The total area to be graveled would be approximately 80,000 square feet. Minor grading and compacting would be performed to the existing ground.
- ❑ A 12-inch-diameter, 25-foot-long, CMP culvert would be installed at a swale in the topography near the spring area located 2,000 feet south of Hazen Road.
- ❑ Two existing gates would be widened and possibly relocated within the 50-foot corridor.
- **South Powerhouse Access Road.** Maintenance during construction of the existing PG&E access road to the South Powerhouse, from its junction with the temporarily improved Old Ranch Road down to the powerhouse, would consist of grading and adding gravel surfacing and possibly chip seal or asphalt paving over certain portions. Vehicle travel would be restricted to this road, which would not be widened. The 3,800-foot section of the South Powerhouse access road from Hazen Road to the junction with Old Ranch Road would not be affected.
- **Area A.** The gently sloped portion of this area would be used by the contractor or government for staging, temporary stockpiling, or other temporary uses. The total area affected would be approximately 68,000 square feet.
- **Contractor use area.** This area would be located adjacent to the existing access road. The total area affected would be approximately 60 feet by 200 feet, or 12,000 square feet.
- **Peninsula area.** This area, adjacent to the powerhouse, would be heavily disturbed by construction activities for the following new features: an access road, a tailrace-side retaining structure, creek-side riprap armoring, temporary small cofferdams in the creek and tailrace, an access ramp into the tailrace, a permanent embankment to close off the tailrace, large-diameter culverts through the peninsula, and associated riprap downstream of the culverts and embankment. The area would extend to 20 feet south of the south bank of Battle Creek and to the uphill-side waterline (north side) of the tailrace. As much of the peninsula as possible would be protected from disturbance. The total area affected would be approximately 122,000 square feet.
- **Low-water crossing area.** This crossing area, which allows access to the left (south) side of Inskip Diversion Dam, may be widened and vegetation cleared to a 20-foot-wide corridor for a distance of approximately 250 feet. The existing crossing has a concrete apron within the flow channel and is suitable for the lower flows normally encountered. Because of the required cessation of flows in the South Canal, the flows in Battle Creek would be increased. Temporary culverts may be installed to improve safety and increase the duration of use of this crossing area. The crossing is necessary to establish access to the right side of Inskip Diversion Dam in order to

construct the fish ladder exit (headworks modifications). The total area affected would be approximately 5,000 square feet.

- **Area encompassing the terrain affected by construction of the new access road.** This area would extend from the tailrace to the parking area adjacent to the fish passage facilities. It also would include the tunnel inlet portal area, but would not include the parking area or downstream portal area. The total area affected would be approximately 99,000 square feet.
- **Area encompassing the new tunnel downstream portal area, construction access ramp, and other features associated with the new tunnel from the Tunnel No. 2 inlet to the existing footbridge and from the left edge of the canal bank (looking downstream) upslope to the limits of the access road.** The total area affected would be approximately 24,000 square feet.
- **Area extending from the preceding 24,000-square-foot area downhill to the middle of Battle Creek.** Features to be constructed in this area would include the wasteway inlet structure, its outfall pipe, and the levee bank reinforcement between the fish screen and the Tunnel No. 2 inlet. The total area affected would be approximately 37,000 square feet.
- **Area encompassing the fish facilities downstream of Inskip Diversion Dam to the two preceding areas (24,000 square feet and 37,000 square feet) and extending 20 feet south of the south bank of the creek.** This area would include the fish ladder, fish screen, associated access roads, ramps, bridges, and parking areas, and would extend to within 70 feet downstream of the dam. The existing fish ladder, which encompasses approximately 700 square feet of this area, would be partly demolished (metalwork removed and disposed of) and plugged. Much of the area not permanently occupied by the new features would be used by the contractor for staging, stockpiling, and other temporary uses. This area would be required to allow the construction workers and equipment access to the new and existing fish ladder work sites. The total area affected would be approximately 137,000 square feet.
- **Area encompassing the temporary access road on the south side of Battle Creek.** This area would encompass the diversion works that would be built to allow construction of the headworks modifications on the right abutment of Inskip Diversion Dam (for the fish ladder exit). A 20-foot-wide path would be cleared and graded from the low-water crossing described above, downstream to the vicinity of the dam. The diversion works would consist of an earthen cofferdam enclosing the headworks area, an access road embankment from the left side of the creek to the cofferdam, culverts under this access road to pass the creek flow through, riprap armoring to protect the temporary embankments from creek erosion effects, and excavation within the creek to channel the diverted creek flow toward Inskip Diversion Dam. The diversion works activities within the creek would extend about 200 feet upstream of the dam. All of these features would be removed at the completion of the headworks modifications and the areas restored to their preconstruction condition. The total area affected would be approximately 46,000 square feet.

- **2,400 feet of existing access road connecting the road along the top of the plateau to Lower Ripley Diversion Dam** (both discussed under the Lower Ripley Creek Area below). The road may be raised up to 2 feet with excess excavated material. The total area affected would be approximately 36,000 square feet.
- **Disposal area.** This area adjoins the access road described above. It would be used for excess excavated materials. The total area affected would be approximately 132,000 square feet.
- **Staging area for contractor and government use.** This area also adjoins the access road. The total area affected would be approximately 320,000 square feet.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired, or repaved if necessary. Staging and disposal areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded, and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

Construction activities at the Inskip Diversion Dam/South Powerhouse site would require extensive coordination. The sequence of construction at this site would roughly follow this order:

- prepare upper plateau access road;
- prepare initial section of lower site access road across peninsula, including concrete retaining wall and rip-rap sections across narrow section of the peninsula;
- construct peninsula culvert and RCC dike;
- construct lower site access road after crossing peninsula and RCC dike;
- install temporary tailrace cofferdam;
- construct bypass tunnel;
- construct cofferdam upstream of Inskip Canal headworks and install fish screen and ladder; and
- complete site restoration.

Construction at this site would occur over a 24-month period, with a winter shutdown lasting approximately 5 months. Construction is anticipated to begin in spring 2004 and end by fall 2006.

Water diversions into Cross Country and South Canals that supply water to South Powerhouse would be interrupted to allow construction to be performed. Water diversions into Inskip Canal would also be interrupted for periods. Also South Powerhouse would be shutdown to allow construction to be performed. A 3-month powerhouse outage would be taken during the first construction season followed by a brief powerhouse outage in the second construction season.

Lower Ripley Creek Feeder

Project Elements

Proposed actions at the Lower Ripley Creek Feeder site include:

- removal of Lower Ripley Creek Feeder Diversion Dam;
- removal of appurtenant facilities, including the feeder canal; and
- improving access roads.

Lower Ripley Creek Feeder Diversion Dam

Under this alternative, Lower Ripley Creek Diversion Dam would be removed. The dam consists of a 17-inch-thick concrete wall with a maximum structural height of about 5 feet and a crest length of 44 feet. An 8-foot-wide overflow section with wooden flashboards provides for releases to Ripley Creek. Diversion releases are made through a 22-by-35-inch wooden slide gate near the left abutment. The diversion dam is a very small structure and could be removed easily using an excavator with a hoe-ram or similar construction equipment. All waste concrete would be removed from the site. Cold spring water entering Ripley Creek above the dam would be allowed to continue downstream of the dam site.

Appurtenant Facilities

The diversion canal extends 384 feet downstream from the dam to the Inskip Canal. The canal would be filled in using the existing canal bank materials. The existing canal bank would be excavated to a depth that fills in the canal and re-establishes the original ground slope as near as possible. The area would be graded to prevent ponding and allow cross-slope drainage to continue downslope. The bank excavation would be adjusted locally to minimize affecting the root zones of adjacent trees. Where the feeder canal discharges into Inskip Canal the transition would be shaped and armored with riprap or concrete to ensure stability of the canal. The concrete measuring flume located in the canal just downstream of the dam would be removed and disposed of off site. All waste steel, mechanical, and miscellaneous items would be removed and disposed of off site.

Access Road Improvements

Lower Ripley Creek Diversion Dam is accessed from the east or west directions over primitive roads. Grading and graveling would be performed as needed to facilitate construction.

Construction Considerations

Construction activities potentially would affect the following areas near Lower Ripley Creek:

- **Road along the top of the plateau.** The road would be graded to reduce its roughness (ruts, potholes, etc.). Vehicle travel would be restricted to this road, which would not be widened. The distance from the South Powerhouse Access Road to Lower Ripley Diversion Dam is 16,300 feet. This 15-foot-wide road continues to the west of Lower Ripley Diversion Dam for 9,400 feet to the headworks for Inskip Powerhouse at the confluence of Eagle Canyon Canal and Inskip Canal.
- **Lower Ripley Creek.** Water from the Cross Country Canal would be diverted into Lower Ripley Creek to bypass water around the South Powerhouse construction zone. This reach of Lower Ripley Creek would convey uncharacteristic, but not unprecedented, high flows (50 cfs versus 3 cfs) for up to several months. The flows diverted from the Cross Country Canal would be diverted at Lower Ripley Diversion Dam to the Inskip Canal via the present Feeder Canal (modified as described below). The length of affected creek channel from the Cross Country Canal to Lower Ripley Diversion Dam would be approximately 16,100 feet. The distance from Lower Ripley Diversion Dam to South Fork Battle Creek is 4,500 feet. The total length of Lower Ripley Creek that would be affected is 20,600 feet.
- **Lower Ripley Creek Diversion Dam.** Removal of Lower Ripley Diversion Dam would affect a 6,000-square-foot area. Prior to the period of diverted flows described above, the Feeder Canal would be widened and deepened and its banks raised so that it could safely accommodate these higher, temporary flows. The final removal of the Feeder Canal would affect a total area of approximately 14,000 square feet.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired, or repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded, and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

Construction at Lower Ripley Creek Feeder Diversion Dam would involve diverting flow back into Ripley Creek followed by removing the dam and backfilling the diversion channel. Construction at this site would occur over a period of 2 weeks for the temporary raising and an additional 2 weeks for the final removals. Construction is anticipated to occur during summer 2005.

Coleman Diversion Dam/Inskip Powerhouse

Project Elements

Proposed actions at Coleman Diversion Dam/Inskip Powerhouse site include:

- constructing Inskip Powerhouse bypass facility,
- constructing Inskip Powerhouse tailrace connector, and
- removing Coleman Diversion Dam and appurtenant facilities.

The features proposed for Coleman Diversion Dam/Inskip Powerhouse for the Five Dam Removal Alternative are shown on Figure 3-2d.

Inskip Powerhouse Bypass Facility

A new overflow wasteway on Eagle Canyon Canal would be constructed about 40 feet upstream of the Inskip Canal confluence to the penstock forebay inlet. The proposed wasteway consists of a new side channel spillway constructed in the existing Eagle Canyon Canal berm that would allow water to spill out of the canal in a controlled manner when the penstock or Inskip Powerhouse facilities are shut down. The overflow spillway consists of a concrete box 115 feet long by 6 feet wide, which directs canal flows to an 84-inch concrete pipe. The overflow spillway would include a trash rack to collect any debris and a safety guardrail. The 84-inch collector pipe would be buried to grade and extend approximately 150 feet downslope where it transitions to a 66-inch-diameter reinforced concrete pipe. The existing Inskip Canal wasteway located on the Inskip Canal approximately 500 feet upstream of the penstock forebay inlet would be raised by a new flashboard structure, limiting any canal water from entering South Fork Battle Creek via the existing drainage channel.

The primary conveyance feature provided to bypass powerhouse flows would involve constructing a 5,662-foot-long, 340-cfs, bypass pipeline/chute that consists of sections of pre-cast reinforced concrete pipeline and open-channel rectangular chute. This bypass facility would have three sections: (1) the upland pipeline section; (2) the downslope chute section; and (3) the Coleman Canal connector section.

The upland section would extend from the end of the 84-inch overflow spillway concrete pipe about 3,600 feet along the top of the plateau to a point overlooking

Coleman Diversion Dam. This upper plateau pipeline section consists of 66-inch-diameter reinforced concrete pipe. This section terminates into an upper jump basin constructed at the top of the plateau at the point where the bypass facility is directed down the slope to the floodplain terrace at creek level. This pipe would be completely buried with a minimum of 2 feet of cover over the top of the pipe. This pipe section would transition into a 50-foot-long-by-14-foot-wide upper jump basin energy dissipater. The purpose of this energy dissipater is to reduce the energy generated by the water falling about 160 feet in elevation as it traverses the upper plateau. The upper jump basin stilling pool would exit into the second section of the bypass facility, the downslope chute section. The upper jump basin area would be enclosed by chain link fence to prevent people or animals from entering the area. From the top of the plateau at the upper jump basin, the water would be conveyed to a second jump basin, located at the base of a drop, approximately 210 feet, from the plateau. The 340 cfs of water would be conveyed to the second jump basin via a 550-foot-long open-channel rectangular-shaped concrete chute. This chute is about 6 feet high, 5 feet of which would be embedded into the ground (about 1 foot of the side walls of the rectangular chute would extend aboveground). The second jump basin at the bottom of the hill would be approximately 54 feet long, 15 feet wide, and 19 feet deep. The chute would cross an existing water supply line about 200 feet downstream of the upper jump basin. The water supply line would be rerouted through a new steel pipe section that would cross above the chute. Water deliveries would not be interrupted during the installation of the replacement section. The chute and lower jump basin area would be enclosed by chain link fence to prevent people or animals from entering the chute. Crossings would be built at locations along the chute to allow animals access to both sides of the structure. The feasibility of providing animal crossings for the portion of the existing penstock that descends the hillside will be investigated to enhance the benefits resulting from providing the chute animal crossings.

From the second jump basin, the bypass facility would convey water to Coleman Canal with a 263-foot-long, 66-inch reinforced concrete, buried pipe to a baffled outlet structure. The outlet structure would discharge into a new entrance channel, which directs the flow from both the bypass facility and the Inskip Powerhouse tailrace connector into the canal. This open entrance channel section is about 60 feet wide at its widest point and transitions down to about 10 feet wide at the existing Coleman Canal trash rack and gate control facility. The depth of the open channel would vary from about 10 to 16 feet deep. A 10-foot-wide access ramp would be provided into the channel to allow for maintenance of the entrance channel.

The existing bridge that crosses Eagle Canyon Canal to allow access to the forebay inlet and penstock header box area would be removed. The existing road would be relocated and the Eagle Canyon Canal crossing would be replaced with a steel arch culvert. A 12-foot-wide graveled access road would be constructed from the new overflow spillway along the bypass pipeline to the upper jump basin. Drainage flows from the header box sluicing operations would be conveyed over the bypass pipeline in armored channels and under the access road in culverts. A spoilbank would be placed along the pipeline corridor. The

spoilbank materials result from excess materials from the structure excavations. From the upper jump basin a temporary graveled access road would extend north to Manton Road. An intersection would be developed at this location about 0.2 mile east of the Coleman Dam access road and would serve as the primary point of entry to the plateau site for construction activities.

Inskip Powerhouse Tailrace Connector

The Inskip Powerhouse tailrace would be reconstructed to prevent powerhouse discharges from entering directly into the South Fork Battle Creek. The existing tailrace contains a 31-foot-long, 10-foot-wide, curved concrete outlet with vertical walls. The outlet floor slopes upward 4.5 feet from the turbine draft tube sump to the creek bottom. The proposed tailrace reconstruction includes:

- installing a bolted-on slide gate or bulkhead at the end of the existing tailrace walls to close off the tailrace from the creek;
- constructing a gate structure through the right tailrace wall that would convey the discharge from the powerhouse to an 84-inch pipeline leading to the Coleman Canal; and
- constructing an outlet transition to discharge water from the 84-inch pipeline into the Coleman Canal.

The channel and gate structure would facilitate continuation of power generation during construction of the tailrace connector pipeline. The 660-foot-long, 84-inch tailrace connector pipeline would be buried, terminating at an outlet transition structure equipped with a slide gate or bulkhead for operation and maintenance purposes. The outlet transition structure would discharge the tailrace flow into the new Coleman Canal entrance channel.

Coleman Diversion Dam and Appurtenant Facility Removal

Under this alternative, the masonry dam overflow section with a concrete overlay would be removed. The dam construction incorporates rock cobbles embedded in a mortar matrix that requires demolition of the rock/mortar matrix into pieces no larger than 1 to 2 feet in size. The rock/cobble pieces are similar to existing cobble material transported within the river system. The resulting 500 cubic yards of broken up material would be spread over an area that extends about 100 feet downstream from the dam. Concrete would be removed from the site and disposed of at a waste disposal area out of the streambed.

The following appurtenant structures would also be removed:

- radial sluice gate structure,
- Alaska Steeppass fish ladder and concrete,
- reinforcing steel and miscellaneous metalwork, and
- original concrete fish ladder structure.

The rock masonry wall that forms the left embankment of the Coleman Canal would be retained, including the weir wall that extends approximately 30 feet upstream from the dam parallel to the creek flow. The curved wing wall that extends from the metal grating footbridge out toward the creek also would be retained. The masonry wing wall that extends from the curved wall would be partially removed to allow construction of the newly configured entrance channel to the canal. The area that lies behind the weir wall that extends upstream from the dam and parallels the creek flow would be backfilled and riprapped.

Sediment Management

Sediment behind the existing dam would be left in place to be distributed by floodflows. A pilot channel would be excavated to approximately 500 feet upstream of the dam site to facilitate mobilization of sediments in the stream channel and fish passage. The pilot channel would have a bottom width of 8 feet and side slopes of 3:1. The bottom slope of the pilot channel would be approximately 0.024. Material excavated for the pilot channel would be spread in the river channel upstream of the dam. Under low flow conditions, the pilot channel geometry would provide a sufficient depth of water so as not to pose a barrier to fish passage. Under typical winter flow conditions, sediments would quickly begin to erode and distribute downstream.

Construction Considerations

Construction activities potentially would affect the following areas near the Inskip Powerhouse:

- **Existing paved access road off of Manton Road to Inskip Powerhouse.** This road would be used heavily during construction. The road would not be widened or otherwise modified for construction. The traveled surface may be repaved (2,200 feet by 15 feet) at the end of construction. The total area affected would be approximately 33,000 square feet.
- **Dirt access road off Manton Road that follows the Eagle Canyon Canal to the Inskip Powerhouse Penstock header box.** This 3,600-foot-long-by-20-foot-wide road may be bladed and graveled to allow all-weather access by light vehicles only. Heavy construction equipment would not use this access route. The traveled surface would be restored at the end of construction. The total area affected would be approximately 72,000 square feet.
- **Primitive dirt road off Manton Road located 1,000 feet northeast of the entrance of the paved access road off Manton Road to the Inskip Powerhouse.** This road would be improved to allow all-weather access for heavy construction equipment. The intersection area would be widened to create a paved turnoff lane and a paved apron setback off Manton Road (400 feet by 150 feet). The existing 10-foot-wide path would be widened to 20 feet and graveled for a 900-foot length to the point where it joins the planned 85-foot-wide corridor of the new penstock bypass. A staging area (about 1 acre) would be established near the upper jump basin. The total area affected would be approximately 144,000 square feet.

- **Vicinity of inlet structure for penstock bypass.** Construction would include rerouting the access road, an Eagle Canyon Canal temporary bypass, the inlet structure, and adjacent staging areas. The total area affected area would be approximately 138,000 square feet.
- **Shotcreted overflow structure on the Inskip Canal.** This structure, which serves as the penstock bypass, would be modified to incorporate a flashboard-type structure. Construction would include a 12-foot-wide access road crossing the existing penstock headworks structure. The total area affected would be approximately 33,000 square feet.
- **3,600 feet of the Inskip Powerhouse penstock bypass pipeline.** The portion of the pipeline crossing the plateau area between the inlet structure at the Eagle Canyon Canal and the upper jump basin would be replaced with a new pipeline and chute system. The work corridor is 85 feet wide; the total area affected would be approximately 309,000 square feet.
- **Area south of the penstock bypass pipeline.** Outflows from the header box would be rerouted and channelized to cross the new pipeline. Work would include constructing deflector berms with stone armoring, filling abandoned channels, and installing culverts. The total area affected would be approximately 88,000 square feet.
- **Chute portion of penstock bypass.** The chute portion corridor would be widened from 85 feet to 120 feet in order to conduct special work to cross the water supply line. The total area affected would be approximately 77,000 square feet.
- **Area between the powerhouse and new chute area.** This area would be used as staging areas and a disposal site for excess excavated materials. Total area affected would be approximately 78,000 square feet.
- **Closure wall.** The area that would be disturbed to construct the tailrace connector pipeline in the vicinity of the creek would be minimized to protect the riparian corridor and the upland area to protect trees. Some work within the creek in the vicinity of the powerhouse tailrace outlet area would be necessary to construct the closure wall and riprap slope protection. Total area affected would be approximately 141,000 square feet.
- **The area upstream of Coleman Diversion Dam below the high-water mark.** This area would be affected by the excavation and redistribution of the sediments that are presently impounded. A pilot channel would be excavated and portions of the materials placed in spoilbanks within the creek channel and left to be distributed by the natural flows. Total area affected would be approximately 69,000 square feet.
- **The area including Coleman Diversion Dam and the vicinity downstream.** This area would be affected by the disposal of portions of the masonry dam and sediments excavated from behind the dam. Total area affected would be approximately 28,000 square feet.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired, or

repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

The sequence of construction at Coleman Diversion Dam/Inskip Powerhouse would roughly follow this order:

- construct Eagle Canyon Canal plugs and temporary bypass channel;
- construct Eagle Canyon Canal wasteway overflow spillway;
- construct upper plateau reinforced concrete pipeline and upper jump basin energy dissipater;
- construct slope reinforced concrete rectangular chute with lower jump basin energy dissipater;
- construct entrance channel to the Coleman Canal and lower jump basin exit pipe, baffled outlet structure, and tailrace connector pipe and outlet structure;
- construct cofferdam in South Fork Battle Creek (if required);
- close existing diversion channel to the Coleman Canal;
- concurrently plug old Inskip Canal wasteway and remove remaining plug of new entrance channel; and
- remove Eagle Canyon Canal plugs and remove Eagle Canal temporary bypass channel.

Construction at this site would occur over a period of 26 months, with two winter shutdown periods lasting 2 months and 13 months. Construction is anticipated to begin spring 2004 and end fall 2006.

Water diversions into Eagle Canyon and Inskip Canals that supply water to Inskip Powerhouse would be interrupted to allow construction to be performed. Water diversions into Coleman Canal would also be interrupted for periods. Also Inskip Powerhouse would be shutdown to allow construction to be performed. Two brief powerhouse outages would be taken during the first construction season followed by a brief powerhouse outage in the second construction season.

Asbury Pump Diversion Dam

Asbury Diversion Dam is located on Baldwin Creek approximately 0.7 mile above its confluence with Battle Creek. Baldwin Creek has been identified as one of several tributaries to Battle Creek capable of providing suitable habitat for steelhead and other aquatic organisms. Releasing water at Asbury Diversion Dam would allow the cold water from Darrah Springs to enter the mainstem of Battle Creek and help improve the summer holding conditions in that reach of the stream for the target species.

Project Elements

Under this alternative, proposed restoration actions in Baldwin Creek include an instream flow release of up to 5 cfs from Asbury Pump Diversion Dam. Cold spring water entering Baldwin Creek from Darrah Springs above the dam would be allowed to continue downstream of the dam site. PG&E would be required to operate a remote-sensing device to continuously measure and record total flow and stage fluctuations immediately below the diversion dam during all operations to verify compliance with applicable provisions under the FERC license.

The spill gates would be operated to pass the instream flow without structural modifications. However, a new gaging station would be required just below the diversion dam to monitor instream flow. A low weir with a calibrated standard section (e.g., Cipoletti or V-notch weir) would be constructed between the pipe crossing foundations to meet these requirements.

Construction Considerations and Sequencing

Construction activities potentially would affect the following areas near Asbury Diversion Dam:

- **Baldwin Creek.** Construction of the new measuring weir downstream of Asbury Diversion Dam would require minor earthwork within the creek. The total area affected would be approximately 1,000 square feet. Existing access roads and walkways would be used and would not require modification.
- **Access trail.** The existing access trail would be improved to allow construction staff to reach the work area. The total area affected would be approximately 1,000 square feet.

Adaptive Management Plan

Adaptive management is an integral component of the Five Dam Removal Alternative. Adaptive management is a process that (1) uses monitoring and

research to identify and define problems; (2) examines various alternative strategies and actions for meeting measurable biological goals and objectives; and (3), if necessary, makes timely adjustments to strategies and actions based on best scientific and commercial information available.

The primary reason for using an adaptive management process is to allow changes to restoration strategies or actions that may be needed to achieve the long-term goals and/or biological objectives and to ensure the likelihood of the survival and recovery of naturally spawning chinook salmon and steelhead. Under adaptive management, restoration activities would be monitored and analyzed to determine whether they are producing the desired results (i.e., properly functioning habitats).

As implementation proceeds, results would be monitored and assessed. If the anticipated goals and objectives are not being achieved, adjustments in the restoration strategy or actions would be considered through the draft *Battle Creek Salmon and Steelhead Restoration Project Adaptive Management Plan* (Adaptive Management Plan) (Kier Associates 2001) (Appendix F), which has been developed consistent with relevant CALFED guidelines (Chapter 3 in CALFED 1999a) and the MOU (Appendix A). The Water Acquisition Fund and Adaptive Management Fund, which are elements of adaptive management, would provide funding for potential changes to Restoration Project actions that result from the application of the Adaptive Management Plan.

Facility Monitoring and Maintenance Plan

A detailed facility monitoring plan, prepared by PG&E in consultation with the other parties to the MOU, will be submitted to FERC as part of the license amendment application for the Five Dam Removal Alternative. The monitoring plan delineates a program related to the Proposed Action's components that expands on typical FERC license monitoring requirements. PG&E would perform and assume the costs for the following facility monitoring:

- Verifying compliance with the FERC license at the various outlet and spillway works for North Battle Creek Feeder, Eagle Canyon, Inskip, and Asbury (Baldwin Creek) Diversion Dams by operating properly calibrated remote-sensing devices that continuously measure and record total flow and the fluctuation of stage immediately below each dam during all operations.
- Identifying debris problems at the fish ladders at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams by operating properly calibrated remote sensing devices that continuously monitor water surface elevations at the tops and bottoms of the ladders. In addition, PG&E would continuously operate a calibrated automated fish counter or an underwater video camera to document fish movement through the ladder during the first 3 years of operation or as otherwise agreed upon by the parties to the MOU.
- Identifying instances of plugging at the fish screens at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams by operating properly

calibrated remote-sensing devices that continuously monitor water surface elevation differences on the inlet and outlet sides of the screens. If the monitoring reports a critical malfunction on the screen, the fail-safe feature would shut down the inlet to the canal until the situation has been remedied.

PG&E will perform all the necessary maintenance and replacement on the fish screens, fish ladders, and stream gages as indicated by the monitoring, once Reclamation has released these structures for operation.

Water Rights

PG&E's water diversion rights associated with all dams removed in this alternative would be transferred to the DFG. For example, when the rights for the Soap Creek diversion are transferred, all rights and obligations associated with that diversion would be transferred, including but not limited to, PG&E's Bluff Springs rights and obligations, which are subject to an agreement regarding senior water rights for Hazen Ditch (Bluff Springs-Hazen Ditch Water Users Agreement, dated May 31, 1988). PG&E would execute the necessary documents to transfer these water diversion rights when it receives the associated portions of the funding specified in the MOU. DFG agrees that the transferred water rights would not be used to increase prescribed instream flow releases above the amounts specified in the MOU (Appendix A) or developed pursuant to the Adaptive Management Plan (Appendix D). It further agrees that the rights would not be used adversely against remaining Hydroelectric Project upstream or downstream diversions until the FERC license is abandoned, at which time the limitation regarding transferred water rights would no longer apply.

In this alternative, PG&E agrees that it will not use its riparian rights tied to lands associated with components of this alternative to decrease prescribed instream flow releases below the amounts specified in this alternative or developed pursuant to the Adaptive Management Plan. PG&E agrees that any deed transferring such riparian land or rights will contain this restriction.

PG&E and DFG would jointly file a petition with the SWRCB pursuant to Section 1707 of the California Water Code to dedicate to instream uses the water diversion rights associated with all removed dams in this alternative.

Water Acquisition Fund

An important component of this alternative is the Water Acquisition Fund. Its purpose is to establish a ready source of money that may be needed for any future purchases of additional instream flow releases in Battle Creek. These releases may be recommended under the Adaptive Management Plan during the 10-year period following the initiation of prescribed instream flow releases. The fund shall be used solely to purchase additional environmentally beneficial instream flow releases.

The Water Acquisition Fund account would be funded with federal funds administered by the resource agencies, following consultation with appropriate interested parties. Reclamation would commit \$3 million to an account or subaccount for the Water Acquisition Fund.

Protocols would be developed by the adaptive management technical team to identify environmentally beneficial flow changes for anadromous fish under the Adaptive Management Plan. If the adaptive management technical team or the adaptive management policy team cannot reach a consensus regarding flow changes, the resource agencies (collectively) and PG&E would each choose a person, and together those two persons would choose a single third party to act as mediator. If consensus through mediation still were not achieved, the resource agencies and PG&E would reserve their rights to petition FERC to resolve the subject action. The resource agencies and PG&E would assume their respective costs for any FERC process.

Adaptive Management Fund

The Adaptive Management Fund would implement actions developed under the Adaptive Management Plan. The purpose of the Adaptive Management Fund is to provide a readily available source of money to be used for possible future changes in the Restoration Project. The fund shall be used only for Restoration Project purposes directly associated with the Hydroelectric Project including compensation for prescribed instream flow release increases after the Water Acquisition Fund has been exhausted or terminated. The Adaptive Management Fund shall not be used to fund monitoring or construction cost overruns.

The Adaptive Management Fund, in the amount of \$3 million, will be made available to PG&E and the resource agencies by a third-party donor to fund those actions developed pursuant to the Adaptive Management Plan. The third-party donor shall deposit that amount in an interest-bearing account pursuant to a separate agreement to be developed jointly by the resource agencies, PG&E, and the third-party donor. These three parties jointly will develop account disbursement instructions.

The three parties agree that (1) interest on the funds in the Adaptive Management Fund will accrue to the account and shall be applied to changes in the Restoration Project adopted pursuant to the Adaptive Management protocols, and (2) all uncommitted funds in the Adaptive Management Fund will revert to the third-party donor at the end of the current term of the license for the Hydroelectric Project. USFWS shall request disbursements from the Adaptive Management Fund in writing, based on identified protocols.

Protocols to designate environmentally beneficial adaptive management actions to be funded from the Adaptive Management Fund pursuant to the Adaptive Management Plan are detailed in the plan.

The protocols for funding prescribed instream flow increases will be the same as for the Water Acquisition Fund described in Section 9.2 A 3 of the MOU. The protocols for funding facility modifications will also be the same as that described in Section 9.2 A 3, with two exceptions: (1) no interim action will be implemented prior to any required FERC approval of a license amendment or other necessary action by FERC, and (2) for all actions resolved by FERC in which PG&E is in the minority opinion (opposing a proposed action expenditure), the Adaptive Management Fund will contribute 60% of any resulting facility modification cost; if PG&E is in the majority opinion (in support of a proposed action expenditure), the Adaptive Management Fund will contribute 100% of any resulting facility modifications.

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. This alternative was derived from the AFRP (U.S. Fish and Wildlife Service 2001d). Table 3-2 summarizes the components of the No Dam Removal Alternative. Figure 3-3 displays the facilities and flows that would occur under this alternative. The inset table in Figure 3-3 indicates the continuous minimum instream flow releases that would increase below North Battle Creek Feeder, Eagle, Wildcat, South, Inskip, and Coleman Diversion Dams after completion of facility modifications.

Table 3-2. No Dam Removal Alternative Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen Fish ladder
Eagle Canyon Diversion Dam	70-cfs fish screen Fish ladder
Wildcat Diversion Dam	20-cfs fish screen Fish ladder
South Diversion Dam	90-cfs fish screen Fish ladder
Inskip Diversion Dam	220-cfs fish screen Fish ladder
Coleman Diversion Dam	340-cfs fish screen Fish ladder
Instream Flows	Minimum instream flows below selected dams would be increased

Under the No Dam Removal Alternative, fish screen capacities would be able to handle full-flow water rights, and the fish ladders would be designed in general to discharge about 10% of the design stream flow at the fish ladder entrance. Fish screens would meet NOAA Fisheries and DFG criteria (NOAA Fisheries 1997a; DFG 2000a). The instream flows for this alternative were derived from the AFRP (USFWS 2001d). The estimated production targets for the actions on Battle Creek discussed in Appendix B of the AFRP did not include any populations of spring- or winter-run chinook salmon (USFWS 2001d). Generally, the highest minimum instream flows for salmon spawning occur in the fall-run spawning period. Figure 3-3 displays the proposed facility changes and flows that would be in place under this alternative. The inset table in Figure 3-3 indicates proposed continuous minimum instream flow releases that would increase below the six diversion dams upon implementation. The No Dam Removal Alternative would continue to collect and convey spring water to existing canals. These spring complexes include those diverted near Eagle Canyon Diversion Dam, the Bluff and Soap Creek basins, and the Darrah/Baldwin Creek basin. The facilities that result in the transfer of water originating from North Fork Battle Creek into the natural channel of South Fork Battle Creek are the same in both the No Dam Removal Alternative and the No Action Alternative.

Several additional activities would occur between dam sites or at off-site locations where disturbance is needed to facilitate construction. These activities would include constructing water conveyance upgrades (e.g., chutes and weirs), staging areas, and road improvements and other ground-disturbing activities to support the construction of fish screens, fish ladders, and stream flow gages.

The following sections describe the proposed activities under the No Dam Removal Alternative for North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dam sites.

Under this alternative, facility improvements would occur at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip and Coleman Diversion Dams. No modifications would be made to Lower Ripley Creek Feeder, Soap Creek Feeder, or Asbury Pump Diversion Dam facilities, and no diversion dams would be removed. No powerhouse tailrace connectors or penstock bypass facilities would be constructed that prevent mixing of North and South Fork Battle Creek flows.

North Battle Creek Feeder Diversion Dam

Project Elements

Proposed project elements at the North Battle Creek Feeder Diversion Dam site under this alternative would be the same as described for the Five Dam Removal Alternative. Project elements include a pool and chute fish ladder, fish screen, footbridge, and access road improvements.

Construction Considerations

Construction considerations at the North Battle Creek Feeder Diversion Dam site under this alternative would be the same as described for the Five Dam Removal Alternative.

Construction Sequencing and Schedule

Construction sequencing and schedule at the North Battle Creek Feeder Diversion Dam site under this alternative would be the same as described for the Five Dam Removal Alternative.

Eagle Canyon Diversion Dam

Project Elements

Proposed project elements at the Eagle Canyon Diversion Dam site under this alternative would be the same as described for the Five Dam Removal Alternative, except that the improvements to the spring collection facilities would not be implemented. Project elements include a vertical-slot fish ladder, fish screen, powerline relocation, and access trail improvements.

Construction Considerations

Construction considerations at the Eagle Canyon Diversion Dam site under this alternative would be the same as described for the Five Dam Removal Alternative.

Construction Sequencing and Schedule

Construction sequencing and schedule at the Eagle Canyon Diversion Dam site under this alternative would be the same as described for the Five Dam Removal Alternative.

Wildcat Diversion Dam

Project Elements

Under the No Dam Removal Alternative, Wildcat Diversion Dam site project elements include:

- fish ladder,

- fish screen, and
- improved access.

Wildcat Diversion Dam and appurtenant facilities would be modified to allow the addition of the new fish ladder and fish screen. No modifications to the Wildcat Pipeline or Canal would occur under this alternative.

Fish Ladder

The new fish ladder at Wildcat Diversion Dam would be similar to the fish ladder proposed for the North Battle Creek Feeder site. Both dams are approximately 8 feet high. However, the creek design flow for the Wildcat site is 70% higher (1100 cfs vs. 1900 cfs). The pool and chute type ladder design proposed for the North Battle Creek Feeder site would be adjusted to handle the higher ladder design flow at the Wildcat site (Ladder design flow is 10% of the creek flow, i.e., 190 cfs vs. 110 cfs). The Wildcat ladder would be approximately 15 feet longer and 3 feet wider to satisfy the hydraulic requirements related to fish ladder design standards. The new ladder would be located near the middle of the dam to the left of the existing sluice gate and diversion intake structure. A new walkway would be extended out to the ladder to provide access for maintenance. The new ladder would extend downstream, roughly covering a rectangular footprint about 20 feet wide by 90 feet long. The new ladder would incorporate the other elements described at the North Battle Creek Feeder site, which provide for reliability and ease of operation and maintenance, monitoring of flows, and fish monitoring. The old ladder structure would be removed and the fish exit at the upstream face of the dam would be plugged.

Fish Screen

Wildcat Diversion Dam provides for a diversion of up to about 20 cfs into the Wildcat Pipeline and Canal. The proposed fish screen would be a 5-foot-diameter cylindrical type screen attached to the inlet pipe at the intake structure. It would be periodically cleaned by the air burst method. The cylinder is approximately 20 feet long and would be installed on the upstream end of the present intake structure. The existing headworks and trashrack structure would be removed and disposed. A new headworks structure would be built to accommodate the new cylindrical screen. The new screen would be placed behind the new trash rack system to afford it protection from debris. The screen would be designed to meet screen criteria set forth by NOAA Fisheries and DFG for both salmon and steelhead.

Access Improvements

The existing footpath to the dam is inadequate to allow proper operation and maintenance of the new facility, and precludes construction equipment access. Constructing an access road from the plateau down to the creek channel would be prohibitively expensive and would permanently disturb a large area of the canyon wall. During construction, helicopters would be used to transport equipment and materials. The footpath would be widened and improved by addition or reconstruction of stairs, handrails, and lighting. The existing walkway between the footpath and headworks area would be widened and strengthened. These

improvements to the footpath would provide safe and efficient access for construction and operation and maintenance personnel. However, any major maintenance activities that would require large equipment or materials would need to be transported by helicopter.

Construction Considerations

Construction activities potentially would affect the following areas near Wildcat Diversion Dam, Wildcat Canal, and pipeline:

- **The intersection of the access road with Battle Creek Bottom Road.** This intersection would be widened, graded, and graveled. Fences and gates would be modified to facilitate the movement of construction equipment and personnel. The total area affected would be approximately 5,000 square feet (50 feet by 100 feet).
- **Access road from Battle Creek Bottom Road that proceeds south to the dam.** This 4,400-foot-long, 15-foot-wide road would be bladed and graveled as necessary to facilitate access. This area may be used for helicopter staging. The total area affected would be approximately 66,000 square feet.
- **Parking area on the north abutment above the dam site.** This parking area would be graded and graveled as necessary to serve as a staging area. This area would be used for helicopter staging. The total area affected would be approximately 5,000 square feet.
- **Footpath from parking area to dam site.** This footpath would be improved as described above to allow safe and efficient access for construction and maintenance workers. The total area affected would be approximately 5,000 square feet.
- **Area within the creek channel extending about 200 feet upstream of the dam.** Diversion banks and other water control systems would be required for construction of the fish ladder and fish screen structures in the dry. The total area affected would be approximately 20,000 square feet.
- **Area within the creek channel downstream of dam.** This area would be disturbed by the construction of the fish facilities, which would extend about 200 feet downstream of the dam, and access improvements, which extend 300 feet downstream of the dam. Total area affected would be approximately 23,000 square feet.
- **Disposal of materials.** Rock, masonry, and concrete materials not containing metal would be broken into 1- to 2-foot-size fragments and distributed within the creek channel downstream of the dam. Materials containing metal would be removed and disposed of off site. Common excavation composed of sediments would be temporarily stockpiled in the work zone and then reused as backfill.
- **Use of helicopters.** The dam site is in a remote area with no nearby vehicular access. All construction equipment and materials heavier than can

be carried by workers along the footpath would be transported to and from the site by helicopter. Materials to be permanently removed from the sites would be transported by helicopter. These materials would be picked up or dropped off at identified staging areas.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired, or repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded, and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

The sequence of construction at the Wildcat Diversion Dam would roughly follow this order:

- build cofferdams and temporary water bypass structures;
- prepare site by demolition of existing facilities, including headworks and pertinent sections of the dam, and by excavation for structures, including removing boulders;
- perform concrete work for new intake headworks, screen, and ladder;
- install metalwork for headworks, screen, and ladder;
- install and test mechanical and electrical systems; and
- remove cofferdams and complete site restoration.

Construction at this site would occur over a period of 15 months with a 7-month winter shutdown. During this time diversions would not be made to Wildcat Pipeline.

South Diversion Dam

Project Elements

Under the No Dam Removal Alternative, South Diversion Dam site project elements include:

- fish ladder,

- fish screen, and
- access improvements.

South Diversion Dam and appurtenant facilities would be modified to allow the addition of the new fish ladder and fish screen. Under this alternative, no modifications would be made to the South Canal downstream of the fish screen.

Fish Ladder

A Half Ice Harbor fish ladder would be constructed at the South Diversion Dam site, similar to the ladder proposed for Inskip Diversion Dam. The South Dam ladder would climb 16 feet as opposed to 28 feet at Inskip Dam. The creek design flow for the South Dam site is 12% lower (1500 cfs vs. 1700 cfs). The Half Ice Harbor ladder design proposed for the Inskip Dam site would be adjusted to handle the lower ladder design flow at the South Dam site (Ladder design flow is 10% of the creek flow, i.e. 150 cfs vs. 170 cfs) and to satisfy the hydraulic requirements related to fish ladder design standards. The South Dam ladder would have approximately the same pool and weir configuration as the Inskip ladder but would only be 60% as long (approximately 180 feet versus 300 feet). The new ladder would be located near the middle of the dam to the left of the existing sluice gate and diversion intake structure. The new ladder would extend downstream approximately 100 feet to a turning pool then would extend back in the upstream direction to an entrance pool. The ladder footprint would be roughly rectangular about 40 feet wide by 120 feet long. An auxiliary water supply system would deliver up to 110 cfs to a diffuser at the entrance pool. The new ladder would incorporate the other elements described at the Inskip Dam site, which provide for reliability and ease of operation and maintenance, monitoring of flows, and fish monitoring. The portion of existing ladder structure through the dam would be plugged and the portion attached to the downstream face of the dam would be removed. A new walkway would be extended from the sluice gate structure out to the ladder to provide access for maintenance.

Fish Screen

South Diversion Dam provides for a diversion of up to about 100 cfs into the South Canal. Under this alternative, the proposed screen would be a 90-cfs flat plate screen, placed in the South Canal downstream of the diversion dam, the headworks structure, and Tunnel No. 1. The 70-foot-long vertical fixed-plate type screen would be set in-line in an enlarged canal section approximately 200 feet long. The canal bank would be realigned and widened, resulting in new canal bank that would extend down to the creek channel. This slope would be armored with riprap. The canal and tunnel sections upstream of the fish screen would be designed for 110 cfs. The screen would pass 90 cfs and the new section would be configured to include a 20-cfs bypass system to return juvenile fish to the creek about 450 feet downstream of the dam. The wetted depth of the proposed screen would be about 5 feet. The new screen facility configuration would include elements similar to those described for the other fish screen sites, such as trashracks, flow control louvers, automated screen-cleaning mechanisms, and stage sensors to monitor water surface difference across the screens, and would be designed to meet screen criteria set forth by NOAA Fisheries and DFG

for both salmon and steelhead. A new gaging station would be established to monitor creek flows at a point downstream of the fish screen bypass discharge point.

Access Improvements

Access road improvements to South Diversion Dam under this alternative would be the same as described for the Five Dam Removal Alternative. An access road would be developed along the existing canal bank between the parking/turnaround area above South Canal to the downstream end of the screen facility.

A new walkway would be constructed from the screen facility to the right dam abutment area adjacent to the radial sluice gate to replace the existing footpath and ladder that is used. The walkway would be anchored to the near vertical, right canyon wall.

Construction Considerations

Construction activities potentially would affect the following areas near South Diversion Dam and Canal:

- **Area within the creek channel upstream of South Diversion Dam.** This area would be disturbed by equipment operating in the creek to construct the ladder, including constructing cofferdams. The total area affected would be approximately 20,000 square feet.
- **Area within the creek channel downstream of South Diversion Dam, including part of the access ramp on the downstream right creek bank.** This area would be disturbed by equipment operating in the creek to construct the fish ladder and the walkway between the fish screen and the dam. The total area affected would be approximately 96,000 square feet.
- **Area along the left creek bank.** This area would be disturbed by regrading and by equipment crossing the creek to reach the dam area. The total area affected would be approximately 18,000 square feet.
- **Area along South Canal.** The 750-foot-long section of canal between the parking/turnaround area and the outlet of Tunnel No. 1 would be excavated, widened, and realigned to accommodate the new fish screen. An approximately 70-foot-wide zone extending a short distance upslope and all the way down to the creek channel would be affected to allow construction of the widened canal embankment.
- **Access roads to South Diversion Dam and South Canal.** Approximately 3 miles of unimproved public road (Ponderosa Way) would be affected by construction activities. The road would be bladed and graveled as needed to support construction equipment and maintain public access. The total area affected would be approximately 324,000 square feet. Improvements to the 2.3-mile-long private access road that continues to South Diversion Dam are

described above in the Five Dam Removal for the South Dam removal work. The total area affected would be approximately 234,000 square feet.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired, or repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded, and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

The sequence of construction at the South Diversion Dam would roughly follow this order.

- improve access road to site;
- stop diversions to South Canal by closing gate at headworks to Tunnel No. 1;
- build cofferdams and temporary water bypass structures;
- prepare site by demolition of existing facilities, including pertinent sections of the dam, and excavation of structures, including removing boulders;
- perform concrete work for new screen and ladder;
- install metalwork for screen and ladder;
- install and test mechanical and electrical systems;
- remove cofferdams and complete site restoration; and
- construct walkway.

Construction at this site would occur over a period of 15 months with a 7-month winter shutdown. During this time diversions would not be made to South Canal.

Inskip Diversion Dam/South Powerhouse

Under the No Dam Removal Alternative, several of the project elements at Inskip Diversion Dam/South Powerhouse would be the same as under the Five Dam Removal Alternative. The fish ladder, fish screen, and new access road to the fish facilities would be the same. This alternative would not involve separating North Fork and South Fork Battle Creek water. The Union Canal forebay overflow spillway would continue to operate as currently designed using a natural drainage to convey overland water flow to the South Powerhouse tailrace

channel before mixing with South Fork Battle Creek. The tailrace channel modifications, tailrace connector tunnel, associated mechanical and electrical elements, associated temporary and permanent cofferdams and bypass culverts, and the Inskip Canal wasteway structure would not be constructed under this alternative. Inskip Diversion Dam and appurtenant facilities would be modified to allow the addition of the new fish ladder and fish screen. Under this alternative no modifications would be made to the Inskip Canal downstream of the fish screen, or to the South Powerhouse.

Project Elements

Under the No Dam Removal Alternative, the Inskip Diversion Dam/South Powerhouse site project elements would include:

- fish ladder,
- fish screen,
- access road improvements,
- powerline relocations, and
- waste and borrow areas.

Fish Ladder and Screen

Proposed fish ladder and screen facilities at Inskip Diversion Dam under this alternative would be the same as described for the Five Dam Removal Alternative.

The overflow wasteway required on Inskip Canal downstream of the fish screen would not be required because under this flow configuration the potential for overcharging the canal is minimal.

The existing Alaska Steeppass fish ladder would be removed. The concrete portion of the original pool and weir ladder would remain in place, but the upper end would be blocked, so upstream migrants would be no longer attracted to the ladder.

Access Road Improvements

Proposed access road improvements under this alternative would be similar to those identified for the Five Dam Removal Alternative. The new residential bypass access road would be the same. The new permanent vehicular access road to the new fish screen and ladder would follow the same alignment from South Powerhouse across the peninsula, along the north hillside to the fish facility. The portion of the access road between the tailrace channel and the fish facility would be the same. The portion of the access road between South Powerhouse and the tailrace channel would consist of an RCC dike with the same crest elevation, height, width, and dimensions as described for the Five Dam Removal Alternative, but would not incorporate the wasteway, bypass culvert, and access ramp features. The portion of the access road that crosses the tailrace

channel would consist of a railcar bridge with an 80-foot span and 16-foot width. The bridge ends would be supported on one side by a reinforced concrete abutment anchored to the RCC dike and by a reinforced concrete abutment anchored into bedrock on the other side, and would have sufficient load carrying capacity for construction equipment.

Waste and Borrow Areas

Proposed waste and borrow areas under this alternative would be the same as identified for the Five Dam Removal Alternative except that less area would be needed for approximately 10,000 cubic yards of waste material. Less waste material would need to be disposed of under this alternative compared to the Five Dam Removal Alternative because a new bypass tunnel to Inskip Canal would not be constructed.

To the extent possible, excavated materials would be reused to construct various project features. There are no borrow areas identified on the project lands. If special materials were needed that cannot be obtained from the excavations then those materials would be imported from off site.

Construction Considerations

Construction considerations at the Inskip Diversion Dam/South Powerhouse site under this alternative would be similar to those described for the Five Dam Removal Alternative, except where noted below.

- **The area identified in the vicinity of the inlet portal of the tailrace connector tunnel.** The area affected would decrease by approximately 16,000 square feet.
- **The area identified in the vicinity of the outlet portal of the tailrace connector tunnel and the Inskip Canal wasteway.** The area affected would decrease by approximately 61,000 square feet.
- **The area in the vicinity of the peninsula.** During construction, the area that would be disturbed would be the same. However, the area that would be permanently disturbed would decrease by 10,000 square feet.

Construction Sequencing and Schedule

Construction activities at the Inskip Diversion Dam/South Powerhouse site would require extensive coordination. The sequence of construction at this site would roughly follow this order:

- prepare upper plateau access road;
- construct cofferdam in downstream tailrace channel to isolate tailrace from South Fork flows;

- prepare initial section of lower site access road across peninsula, including riprap sections across narrow section of the peninsula;
- construct RCC dike;
- construct lower site access road, including bridge, after crossing peninsula and RCC dike;
- construct cofferdam upstream of Inskip Canal headworks;
- perform concrete work for new screen and ladder;
- install metalwork for screen and ladder;
- install and test mechanical and electrical systems; and
- remove cofferdams and complete site restoration.

Construction at this site would occur over a 24-month period, with a winter shutdown lasting approximately 5 months. Construction is anticipated to begin in spring 2004 and end by fall 2006.

Water diversions into Cross Country and South Canals that supply water to South Powerhouse would be interrupted to allow construction to be performed. Water diversions into Inskip Canal would also be interrupted for periods. Also, South Powerhouse would be shut down to allow construction to be performed. A 3-month powerhouse outage would be taken during the first construction season followed by a brief powerhouse outage in the second construction season.

Coleman Diversion Dam

Project Elements

Under the No Dam Removal Alternative, Coleman Diversion Dam/Inskip Powerhouse project elements include:

- fish ladder, and
- fish screen.

Coleman Diversion Dam and appurtenant facilities would be modified to allow the addition of the new fish ladder and fish screen. Under this alternative, no modifications would be made to the Coleman Canal downstream of the fish screen or to the Inskip Powerhouse.

Fish Ladder

A Half Ice Harbor fish ladder would be constructed at the Coleman Diversion Dam site, similar to the ladder proposed for Inskip Diversion Dam. The Coleman Dam ladder would climb 12 feet as opposed to 28 feet at Inskip Dam. The creek design flow for the Coleman Dam site is 12% higher (1,900 cfs vs. 1,700 cfs). The Half Ice Harbor ladder design proposed for the Inskip Dam site

would be adjusted to handle the higher ladder design flow at the Coleman Dam site (Ladder design flow is 10% of the creek flow, i.e., 190 cfs vs. 170 cfs) and to satisfy the hydraulic requirements related to fish ladder design standards. The Coleman Dam ladder would have approximately the same pool and weir configuration as the Inskip ladder but would only be 45% as long (approximately 135 feet vs. 300 feet). The new ladder would be located near the middle of the dam to the left of the existing sluice gate and canal intake weir. The new ladder would extend straight downstream to an entrance pool. The ladder footprint would be roughly rectangular, about 20 feet wide by 150 feet long. An auxiliary water supply system would deliver up to 150 cfs to a diffuser at the entrance pool. The new ladder would incorporate the other elements described at the Inskip Dam site, which would provide for reliability and ease of operation and maintenance, monitoring of flows, and fish monitoring. A new walkway would be extended from the sluice gate structure out to the ladder to provide access for maintenance. The existing Alaska Steeppass fish ladder would be removed. The concrete portion of the original pool and weir ladder would remain in place, but the upper end would be blocked so upstream migrants are no longer attracted to the ladder.

Fish Screen

Coleman Diversion Dam provides for a diversion of up to about 340 cfs into the Coleman Canal. Under this alternative, the proposed screen would be a 340-cfs flat-plate screen, placed in the Coleman Canal downstream of the diversion dam and the canal intake weir. The vertical fixed -late type screen would be set in-line in an enlarged canal section approximately 300 feet long. The total length of fish screen would be 180 feet. An intermediate bypass would divide the screen into two sections to comply with design criteria limiting travel time for juvenile fish along the screen. The bypass system would return juvenile fish to the creek approximately 300 feet downstream of the dam. The wetted depth of the proposed screen would be 6 feet. The new screen facility configuration would include elements similar to those described for the other fish screen sites such as trashracks, flow control louvers, automated screen-cleaning mechanisms, and stage sensors to monitor water surface difference across the screens and would be designed to meet screen criteria set forth by NOAA Fisheries and DFG for both salmon and steelhead.

Construction Considerations

Construction activities potentially would affect the following areas near the Coleman Diversion Dam/Inskip Powerhouse site:

- **Existing paved access road off of Manton Road to Coleman Dam and Inskip Powerhouse.** This road would be used heavily during construction. The road would not be widened or otherwise modified for construction. The traveled surface may be repaved (2,200 feet by 15 feet) at the end of construction. The total area affected would be approximately 33,000 square feet.

- **Area containing abandoned PG&E residences between the powerhouse and the dam on the uphill side of the access road.** This area would be used as staging areas and a disposal site for excess excavated materials. Total area affected would be approximately 78,000 square feet.
- **Area between the dam/creek channel and the access road.** This area, which includes Coleman Canal and the adjacent upland, would be used for staging and construction operations. The riparian corridor and the trees in the area above the corridor would be protected from disturbance. Total area affected would be approximately 96,000 square feet.
- **The area within the creek channel upstream of Coleman Diversion Dam and the canal intake weir.** This area would be affected by the construction of the fish ladder including cofferdams. Total area affected would be approximately 13,000 square feet.
- **The area within the creek channel, including Coleman Diversion Dam and the vicinity downstream.** This area would be affected by the disposal of portions of the masonry dam and sediments excavated for constructing the fish ladder. Total area affected would be approximately 43,000 square feet.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired or repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded, and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

The sequence of construction at Coleman Diversion Dam/Inksip Powerhouse would follow this order:

- construct cofferdams upstream and downstream of dam to isolate ladder construction area;
- perform concrete work, install metalwork, install and test mechanical and electrical systems for new ladder, then remove cofferdams;
- close off Coleman Canal for construction of fish screen;
- perform concrete work, install metalwork, install and test mechanical and electrical systems for new screen; and
- remove cofferdams and complete site restoration.

Construction at this site would occur over a period of 12 months, with a 2-month winter shutdown period. Construction is anticipated to begin in spring 2004 and end in spring 2005.

Water diversions into Eagle Canyon and Inskip Canals that supply water to Inskip Powerhouse would not be interrupted to allow construction to be performed. Water diversions into Coleman Canal would be interrupted to allow construction of the fish screen. Inskip Powerhouse would not be shut down to allow construction to be performed.

Adaptive Management

This alternative will also include elements of adaptive management consistent with the overarching principles of adaptive management set forth by the CALFED Science Program. This alternative does not include an adaptive management fund, dedicated water rights, or a water acquisition fund as established in the Five Dam Removal Alternative.

Six Dam Removal Alternative

The Six Dam Removal Alternative would include the facility changes shown in Table 3-3. This alternative was developed in response to suggestions that Eagle Canyon Diversion Dam should be included in the Hydroelectric Project features for removal. Figure 3-4 displays the proposed facilities and flows that would be in place under this alternative. The inset table in Figure 3-4 indicates the proposed continuous minimum instream flow releases that would increase below North Battle Creek Feeder, Inskip, and Asbury Diversion Dams after completion of facility modifications.

Table 3-3. Six Dam Removal Alternative Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen Fish ladder
Eagle Canyon Diversion Dam	Dam and appurtenant facilities removed
Wildcat Diversion Dam	Dam and appurtenant facilities removed
South Diversion Dam	Dam and appurtenant facilities removed
Inskip Diversion Dam and South Powerhouse	220-cfs fish screen Fish ladder Construction of South Powerhouse and Inskip Canal connector (tunnel)

Site Name	Component
Coleman Diversion Dam and Inskip Powerhouse	Dam removed Construction of Inskip Powerhouse and Coleman Canal connector Inskip Powerhouse bypass replaced
Lower Ripley Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
Soap Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
Asbury Diversion Dam	Reoperate Stream-gaging station installed Minimum instream flow set for Baldwin Creek

The major physical difference between this alternative and the Five Dam Removal Alternative is that this alternative includes the removal of Eagle Canyon Diversion Dam and its appurtenant facilities. This alternative also does not include an adaptive management fund, dedicated water rights, or a water acquisition fund as described for the Five Dam Removal Alternative.

Tailrace connectors would be installed to convey water directly from the Inskip and South Powerhouses to downstream canals to meet several fishery restoration goals. The tailrace connectors would maintain stable stream habitat, which would improve the ability of spawning fish to return to the streams where they were hatched. Water leaving the South Powerhouse would be conveyed through a new connector (a free-flow tunnel) and outlet works to the Inskip Canal. Water leaving the Inskip Powerhouse would be conveyed through a new connector (a full-flow buried pipe) and outlet works to the Coleman Canal.

Penstock bypass systems would be installed. The current bypass systems for both the South and Inskip Powerhouses do not prevent the mixing of North Fork and South Fork Battle Creek waters. The South Powerhouse bypass would be integrated with the new tailrace connector to prevent the mixing of these waters. The Inskip Powerhouse bypass would be replaced with a new pipeline and chute system that would prevent the mixing of these waters and ensure full-flow delivery of water to the Coleman Canal.

Under the Six Dam Removal Alternative, Eagle Canyon, Wildcat, South and Coleman Diversion Dams would be removed to accomplish fish passage. Inskip Diversion Dam and North Battle Creek Feeder Diversion Dam would remain, and fish passage would be accomplished by construction of new fish screens and ladders.

The following sections describe the proposed activities under the Six Dam Removal Alternative for Eagle Canyon and Coleman Diversion Dam sites that differ from previously described alternatives. Refer to the Five Dam Removal Alternative for a description of the facility improvements for North Battle Creek

Feeder, Wildcat, South, Inskip, Lower Ripley Creek Feeder, Soap Creek Feeder, and Asbury Pump Diversion Dam sites.

Eagle Canyon Diversion Dam

Project Elements

Under the Six Dam Removal Alternative, Eagle Canyon Diversion Dam project elements would include:

- diversion dam removal;
- appurtenant dam facility removal;
- Eagle Canyon flume, tunnel, and canal modifications;
- modification of spring collection facilities; and
- sediment management.

Diversion Dam Removal

Under this alternative, Eagle Canyon Diversion Dam would be removed. The dam is a masonry rock-filled gravity structure. Removal of this structure would involve demolishing the rock/mortar matrix into pieces no larger than 1 to 2 feet in size, similar to existing cobble material transported within the river system. The resulting material would be spread over an area extending about 100 feet downstream from the dam location along and within the creek channel in a manner that would not hinder fish passage or flow. Natural stream floodflow would distribute the material throughout the downstream river system.

Appurtenant Facility Removal

Appurtenant facilities include:

- concrete weir wall and diversion headworks structure;
- all electrical and mechanical items, including the gates and associated controls;
- steel Alaska Steeppass fish ladder;
- original concrete ladder structure;
- hand rails, metal walkways, and other miscellaneous metalwork;
- powerline and associated power poles; and
- access trail from the top of the plateau to the dam site.

The concrete weir wall and diversion headworks intake structure would be broken up in a manner similar to the dam removal, and the resulting debris would be spread within the streambed for a distance of up to 100 feet downstream from the dam. Metalwork associated with the intake structure and dam, including

trashracks, slide gates, hoist, mechanical controls, and electrical controls, would be removed and either salvaged or disposed of at the nearest approved commercial disposal site.

The steel Alaska Steeppass fish ladder that is set into the original concrete fish ladder would be removed, and the original concrete fish ladder would be broken up into 1- to 2-foot-size pieces and left in the stream channel. Concrete material that contains steel reinforcement would be removed, and the remaining concrete rubble would be spread within the streambed downstream from the dam.

The metal stairs and walkway located at the end of the access trail leading to the dam and all other metalwork would be removed. The foot trail leading from the top of the canyon down to the dam site would essentially be left in place. However, any metalwork such as handrails and foot traffic grating found along the trail would be removed. The powerline and one power pole serving the site would be removed and salvaged.

Eagle Canyon Flume, Tunnel, and Canal Modifications

The Eagle Canyon Canal goes through a series of tunnel and flume sections before leaving the canyon and continuing across land on top of the plateau to the South Fork powerhouses. Approximately 3,385 feet of metal flume section would be removed with the associated metalwork support structure and concrete footings. Two concrete bench flumes extending total of 181 feet also would be removed.

A total of ten tunnel portals along Eagle Canyon Canal would be closed with angle iron gates to prevent people from entering the tunnels but also allow bats to access the tunnels. The gates would be designed in accordance with current guidelines for promoting bat habitat and may include partial closure of the portal with concrete to optimize airflow and climate within the tunnel. The tunnel closures would incorporate drainage features at the base to prevent buildup of any groundwater within the closed tunnel.

The open-channel section of the canal, which begins at the end of the flume sections, would be plugged at the upstream reach, but the remainder of the canal would be left open. Material for plugging would be obtained from the adjacent canal bank.

Modification of Spring Collection Facilities

Work under this alternative would be the same as described for the Five Dam Removal Alternative.

Sediment Management

The reservoir behind Eagle Canyon Dam retains a relatively small amount of sand, gravel, cobbles and boulders. The existing impoundment covers about ¼ acre. A pilot channel would be excavated through the sediments to about 100 feet upstream of the dam. The channel would be about 2 feet wide and would be shaped so it does not pose a blockage to fish. Natural flows would distribute these materials downstream.

Construction Considerations

Construction activities would affect the same areas near Eagle Canyon Diversion Dam as described for the Five Dam Removal Alternative. The areas affected described for the spring collection facilities would be the same and would apply to portion of the flume and tunnel modifications. There is an additional unimproved access road off the main access road to the Eagle Canyon Dam south rim staging area that leads to the end of the flume sections and start of the open channel section. This road would be improved by grading and graveling and used for completing the removal of the downstream portions of the flume and tunnel work, and the plugging of the canal. The additional area affected by this element of work would be approximately 10,000 square feet.

There is no vehicular access to the dam site and the flume and tunnel areas. All construction equipment and materials heavier than can be carried by workers along the footpaths or flume walkways would be transported to and from the site by helicopter. Materials to be permanently removed from the sites would be transported by helicopter and dropped off at identified staging areas.

All areas temporarily disturbed by construction would be restored to their preproject conditions. Existing roads would be regraded, graveled, repaired, or repaved if necessary. Staging areas would be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures if necessary to prevent turbid runoff from escaping the site. Areas within the creek channel would be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes would be shaped, graded, and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff from escaping the area.

Construction Sequencing and Schedule

The sequence of construction at Eagle Canyon Diversion Dam would roughly follow this order:

- use existing sluiceway to draw down reservoir area as much as possible;
- remove right side of dam;
- remove old fish ladder;
- remove remainder of dam;
- remove last section of walkway (metalwork);
- remove access trail metalwork and spring collection facilities;
- remove flume, close tunnels, and plug canal open-channel section; and
- complete site restoration work.

Construction at this site would occur over a 4-month period. Construction is anticipated to begin in summer 2005.

Coleman Diversion Dam/Inskip Powerhouse

Under the Six Dam Removal Alternative, Coleman Diversion Dam/Inskip Powerhouse project elements would be the same as described for the Five Dam Removal Alternative except that the Eagle Canyon Canal wasteway would be modified and the bypass and tailrace connector pipelines would be resized. The flow capacity requirement of these elements would be lower due to flow contributions from Eagle Canyon Canal ceasing. Those elements that are different from the Five Dam Removal alternative are discussed below.

Project Elements

Under the Six Dam Removal Alternative, Coleman Diversion Dam/Inskip Powerhouse elements include:

- Inskip Powerhouse bypass facility, and
- Inskip Powerhouse tailrace connector.

Inskip Powerhouse Bypass Facility

New Overflow Wasteway on Eagle Canyon Canal. Under this alternative, the location of the overflow wasteway on Eagle Canyon Canal would be the same as identified for the Five Dam Removal, but the wasteway would be approximately 90 feet long (instead of 115 feet long). The concrete box collector would collect the overflow water into an approximately 80-inch pipeline.

Bypass Pipeline. Under this alternative, the bypass pipeline/chute conveyance system would convey approximately 260 cfs in a 5,662-foot-long pre-cast reinforced concrete pipeline and open-channel rectangular chute. This downsizing of the bypass pipeline reflects the need for less bypass capacity because of the termination of Eagle Canyon Canal diversions to the powerhouse. The bypass pipeline/chute would be located generally in the same areas as identified for the Five Dam Removal Alternative, but pipeline diameters and chute and dissipater widths would be downsized to accommodate 260 cfs of flow versus 340 cfs of flow.

Inskip Powerhouse Tailrace Connector

Under the Six Dam Removal Alternative, the proposed powerhouse tailrace connector pipeline would be approximately 72 inches in diameter. The alignment of this pipeline would be the same as described for the Five Dam Removal Alternative.

Construction Considerations

Construction considerations would be the same as described for the Five Dam Removal Alternative.

Construction Sequencing and Schedule

Construction sequencing and schedule for the Six Dam Removal Alternative would be the same as described for the Five Dam Removal Alternative.

Adaptive Management

This alternative would include elements of adaptive management consistent with the description for the No Dam Removal Alternative.

Three Dam Removal Alternative

The Three Dam Removal Alternative would include the facility changes shown in Table 3-4. Figure 3-5 displays the facilities and flows that would be in place under this alternative. The alternative developed based on the “Battle Creek: A Time for Action” proposal between late 1997 and early 1998 by stakeholders under the auspices of the BCWG. The inset table in Figure 3-5 indicates the continuous minimum instream flow releases that would increase below the North Battle Creek Feeder, South, Inskip, and Asbury Diversion Dams after completion of facility modifications.

Table 3-4. Three Dam Removal Alternative Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen Fish ladder
Eagle Canyon Diversion Dam	Dam and appurtenant facilities removed
Wildcat Diversion Dam	Dam and appurtenant facilities removed
South Diversion Dam	90-cfs fish screen Fish ladder
Inskip Diversion Dam and South Powerhouse	220-cfs fish screen Fish ladder Construction of South Powerhouse and Inskip Canal connector (flow separator channel)
Coleman Diversion Dam and Inskip Powerhouse	Dam removed Construction of Inskip Powerhouse and Coleman Canal connector

Site Name	Component
Asbury Diversion Dam	Reoperate Stream gaging station installed Minimum instream flow set for Baldwin Creek

The major physical differences between this alternative and the Five Dam Removal Alternative is the removal of Eagle Canyon Diversion Dam and its appurtenant facilities, the retention of South, Lower Ripley Creek Feeder, and Soap Creek Feeder Diversion Dams and their appurtenant facilities, the addition of a fish screen and ladder facility at South Diversion Dam, and elimination of the penstock bypass facility at Inskip Powerhouse. This alternative will also include elements of adaptive management consistent with the overarching principles of adaptive management set forth by the CALFED Science Program. This alternative does not include an adaptive management fund, facilities monitoring and maintenance plan, dedicated water rights, or a water acquisition fund as described for the Five Dam Removal Alternative.

Tailrace connectors would be installed to convey water directly from the Inskip and South Powerhouses to downstream canals to meet several fishery restoration goals. The tailrace connectors would maintain stable stream habitat, which would improve the ability of spawning fish to return to the streams where they were hatched. Water leaving the South Powerhouse would be conveyed through an open-channel flow separator designed to function under normal creek flow conditions rather than the full-flow tunnel proposed as part of the Five Dam Removal Alternative. Water leaving the Inskip Powerhouse would be conveyed through a new connector (a full-flow buried pipe) and outlet works to the Coleman Canal.

A new penstock bypass system would be installed only at the South Powerhouse site. The current bypass systems for both the South and Inskip Powerhouses do not prevent the mixing of North Fork and South Fork Battle Creek waters. The South Powerhouse bypass would be integrated with the new open-channel flow separator tailrace connector to prevent the mixing of these waters. The Inskip Powerhouse bypass would continue to discharge its water into the South Fork upstream of Coleman Diversion Dam. This would result in mixing of North and South Fork water for brief periods of time usually associated with unscheduled powerhouse outages. Bypassed water would not be returned to Coleman Canal because under this alternative Coleman Diversion Dam would be removed.

Under the Three Dam Removal Alternative, Eagle Canyon, Wildcat, and Coleman Diversion Dams would be removed to accomplish fish passage. South Diversion Dam, Inskip Diversion Dam and North Battle Creek Feeder Diversion Dam would remain, and fish passage would be accomplished by construction of new fish screens and ladders. Springs at Eagle Canyon and Darrah Springs area would release to adjacent stream sections.

The following sections describe the proposed activities under the Three Dam Removal Alternative for the Inskip and Coleman Diversion Dam sites that differ from previously described alternatives. Refer to the Five Dam Removal Alternative for a description of the facility improvements for North Battle Creek Feeder, Wildcat, and Asbury Pump Diversion Dam sites. Also refer to the Five Dam Removal Alternative for detailed descriptions of the facility improvements that are not specifically covered below for the Inskip and Coleman Diversion Dam sites. Refer to the Six Dam Removal Alternative for a description of the facility improvements for the Eagle Canyon Diversion Dam site. Refer to the No Dam Removal Alternative for a description of the facility improvements for the South Diversion Dam site.

The instream flows for this alternative were derived from the AFRP (CVPIA §3406(b)(1)) and specifically developed for the restoration of Battle Creek fall- and late-fall–run chinook salmon and steelhead, but not specifically for Battle Creek spring- and winter-run chinook salmon.

Inskip Diversion Dam/South Powerhouse

Project Elements

Features proposed at the Inskip Diversion Dam site under the Three Dam Removal Alternative are the same as the Five Dam Removal Alternative except for the new open-channel tailrace flow separator. Refer to the Five Dam Removal Alternative for detailed descriptions of the facility improvements that are not specifically covered below.

South Powerhouse Tailrace Flow Separator

This alternative differs from the Five Dam Removal Alternative in that the tailrace connection from the South Powerhouse to Inskip Canal would be accomplished using an open channel designed to function under normal creek flow conditions. Under the original formulation of this alternative, a separator structure located in the stream conveying the South Powerhouse tailrace discharge to the Inskip Canal was contemplated. Under the original formulation, however, no conceptual design was developed specifically for placement of this separator structure out in the stream channel. An alternative open-channel conveyance option placed along the north bank of the creek was subsequently developed that closely approximates the intent of the original proposal.

Under the Three Dam Removal Alternative, the existing tailrace channel would be reconfigured similarly as described in the No Dam Alternative with an RCC dike crossing the peninsula and a bridge over the portion of the tailrace channel that returns the water to the South Fork creek channel. Instead of diverting water into a tunnel, as in the Five Dam Removal Alternative, the water would be diverted into an open channel. The proposed channel would run along the northern bank of South Fork Battle Creek, in a bench cut protected by a rock-filled armored revetment. The proposed channel would be cut into the right embankment of South Fork Battle Creek and would have a bottom width of

8 feet, a depth of 6 feet, and a capacity of 220 cfs. Side slopes of this channel would be constructed predominantly with slopes of ½:1 (suitable for hard rock), with localized areas constructed with side slopes of 1½:1 (suitable for colluvium materials).

In the vicinity of Inskip Diversion Dam, Tunnel No. 1 would be opened and converted into an open-channel section, and a wide bench would be notched into the hillside to allow the construction of the channel paralleling the Inskip Canal. The proposed channel connector would tie into the Inskip Canal downstream of the proposed screen and ladder. The armored rockfill revetment embankment protecting the proposed channel would have a top width of 16 feet. The proposed revetment would be constructed to elevation 1,450 from locally available rock material excavated from the proposed connector/bypass channel. The river side of the revetment would be covered with geomembrane fabric and armored with riprap on the river side and keyed into the streambed to potential scour depth. Scour depths range from 0 to 7 feet, depending on the bedrock conditions. Floods above about a 50-year frequency event would be expected to overtop the revetment and enter the bypass/connector channel. Because of high-flow events and sediment load, this separator would need annual maintenance to ensure proper operation.

Similar to the Five Dam Removal Alternative, the existing drainage bypass channel would flow when South Powerhouse outages occur or are required. This water would be conveyed to the new separator channel. Because sediments would continue to be washed down the bypass channel and would enter the tailrace channel, an access ramp would be constructed through the peninsula area downstream of the bridge to allow excavating equipment to periodically remove these sediments. As described in the Five Dam Removal Alternative, the permanent RCC dike and creekside riprap, the bridge and new access road to the fish facilities, and the Inskip Canal Wasteway would be included in the Three Dam Removal Alternative.

Construction Considerations

Construction considerations at the Inskip Diversion Dam/South Powerhouse site under this alternative would be similar to those described for the Five Dam Removal Alternative, except where noted below.

Streamflow Diversion and Construction Methods

Construction of the tailrace connector and bypass channel would be accomplished through traditional excavation methods. The most likely method would be a drill-and-shoot blasting process combined with the use of excavators. Under this method, rock material would be blasted into pieces 6 inches to 2 feet in size, excavated out, loaded into dump trucks, and hauled to identified waste sites. Haul trucks would travel across the peninsula over the new access road, then up the hill to the primary disposal site at the top of the plateau. The material resulting from the channel excavation would be used to the extent possible for the rockfill-armored revetment. Approximately 3,600 cubic yards of material

would be required for this structure. Remaining unused material from the excavation would be hauled to the waste disposal sites.

Concrete required for the constructing the channel headworks and riprap for armoring the creek-side slope would be brought in by trucks.

Extensive instream work would be required to construct the proposed channel. A cofferdam consisting of localized materials with geomembrane fabric material, or some equivalent method, would be constructed instream, running parallel to the proposed channel. Approximately one half of the stream channel would be dewatered for this operation. The additional area affected by this element of work would be approximately 130,000 square feet more than identified under the Five Dam Removal Alternative and would involve extensive disturbance of both the creek channel and the riparian corridor on the north bank of the creek.

Construction Sequencing and Schedule

The sequence of construction at the Inskip Diversion Dam/South Powerhouse site would be the same as described under the No Dam Alternative except for the construction of the new open-channel tailrace flow separator. This channel would be constructed concurrent with construction of the fish screen and ladder.

Construction at this site would occur over a 24-month period, with a winter shutdown lasting approximately 5 months. Construction is anticipated to begin in spring 2004 and end by fall 2006.

Interruption of canal flows and outages of South Powerhouse would be the same as for the No Dam Removal Alternative.

Coleman Diversion Dam/Inskip Powerhouse

Project Elements

Proposed construction activities at the Coleman Diversion Dam site are the same as under the Six Dam Removal Alternative, except for the Inskip Powerhouse bypass pipeline, which is not an element under the Three Dam Removal Alternative. The Inskip Powerhouse tailrace connector design flow under the Three Dam Removal Alternative would be 320 cfs, compared to 300 cfs under the Five Dam Removal Alternative. This small increase in the design flow would not appreciably enlarge the required construction zone. Project elements under this alternative also include removal of Coleman Diversion Dam and appurtenant facilities.

Construction Considerations

Construction considerations at the Coleman Diversion Dam/Inskip Powerhouse site for the tailrace connector and dam removal elements under this alternative would be the same as described for the Six Dam Removal Alternative. The considerations for the absence of the bypass pipeline would be the same as described for the No Dam Removal Alternative

Construction Sequencing and Schedule

Construction sequencing and schedule at the Coleman Diversion Dam/Inskip Powerhouse site under this alternative would be the same as described for the Six Dam Removal Alternative, except for the discussion related to the bypass pipeline which is not part of the Three Dam Removal Alternative.

Adaptive Management

This alternative also includes elements of adaptive management consistent with the description provided for the No Dam Removal Alternative.

Summary of Facility Modifications Proposed for the Water Management Alternatives

Table 3-5 summarizes the proposed elements for the five alternatives analyzed in this EIS/EIR. Table 3-6 summarizes the prescribed minimum continuous monthly instream flow releases by alternative at each diversion dam at which facility modifications are proposed.

Table 3-5. Summary of Facility and Instream Flow Modifications Proposed for Five Salmon and Steelhead Restoration Alternatives

Component	Alternative				
	NA	5D*	ND	6D	3D
Remove Eagle Canyon Diversion Dam and appurtenant facilities				✓	✓
Remove Wildcat Diversion Dam and appurtenant facilities		✓		✓	✓
Remove South Diversion Dam and appurtenant facilities		✓		✓	
Remove Coleman Diversion Dam and appurtenant facilities		✓		✓	✓
Remove Soap Creek Feeder Diversion Dam and appurtenant facilities		✓		✓	
Remove Lower Ripley Creek Diversion Dam and facilities		✓		✓	
Reoperate and gage Asbury Dam		✓		✓	✓

Component	Alternative				
	NA	5D*	ND	6D	3D
Construct Inskip Powerhouse bypass facility		✓		✓	
Construct tailrace connector between South Powerhouse and Inskip Canal		✓		✓	✓
Construct tailrace connector between Inskip Powerhouse and Coleman Canal		✓		✓	✓
Construct North Battle Creek Feeder Diversion Dam fish screen and fish ladder		✓	✓	✓	✓
Construct Eagle Canyon Diversion Dam fish screen and fish ladder		✓	✓		
Construct Wildcat Diversion Dam fish screen and fish ladder			✓		
Construct South Diversion Dam fish screen and fish ladder			✓		✓
Construct Inskip Diversion Dam fish screen and fish ladder		✓	✓	✓	✓
Construct Coleman Diversion Dam fish screen and fish ladder			✓		
Increase releases at all Battle Creek dams not removed to levels per MOU		✓		✓	
Increase releases at all Battle Creek dams not removed to levels per AFRP			✓		✓
Provide water below dam sites on Soap and Lower Ripley Creeks		✓		✓	
Provide water below Asbury Diversion Dam		✓		✓	✓
Screen and ladder designs meet failsafe definition in MOU		✓	✓	✓	✓
Maintain and replace all fish ladders at Battle Creek diversion dams as necessary	✓	✓	✓	✓	✓

*The Five Dam Removal Alternative is the Proposed Action as developed in the MOU (Appendix A).

NA = No Action Alternative

5D = Five Dam Removal Alternative

ND = No Dam Removal Alternative

6D = Six Dam Removal Alternative

3D = Three Dam Removal Alternative.

Alternative Eliminated from Further Consideration

From 1999 to 2000, the parties to the MOU considered a sixth alternative. This alternative proposed the removal of all hydroelectric dams and appurtenant facilities (except the two Volta Powerhouses) below the natural fish passage barriers on Battle Creek. This alternative was referred to as Alternative 6 and was considered during the NEPA scoping period and as one of the Restoration Project alternatives in the CEQA NOP of an EIR. However, during public scoping and the course of the interagency alternatives development discussions, it was decided that Alternative 6 would be eliminated from further consideration because it did not meet the Restoration Project purpose of minimizing the loss of clean and renewable energy produced by the Hydroelectric Project.

The facilities proposed to be removed under Alternative 6 included:

- North Battle Creek Feeder and flume;
- Digger Creek Feeder;
- Cross Country Canal;
- Eagle Canyon Diversion Dam and Canal;
- Wildcat Diversion Dam, Pipeline, and Canal;
- South Diversion Dam and Canal;
- South Powerhouse;
- Inskip Diversion Dam and Canal;
- Inskip Powerhouse;
- Coleman Diversion Dam, Canal, and Forebay;
- Coleman Powerhouse;
- Upper Ripley Creek Diversion and Pipeline;
- Lower Ripley Creek Diversion and Canal;
- Soap Creek Feeder and Pipeline;
- Asbury Diversion Dam, Pumping Facility, and Pipeline; and
- Pacific Power Diversion and Canal.

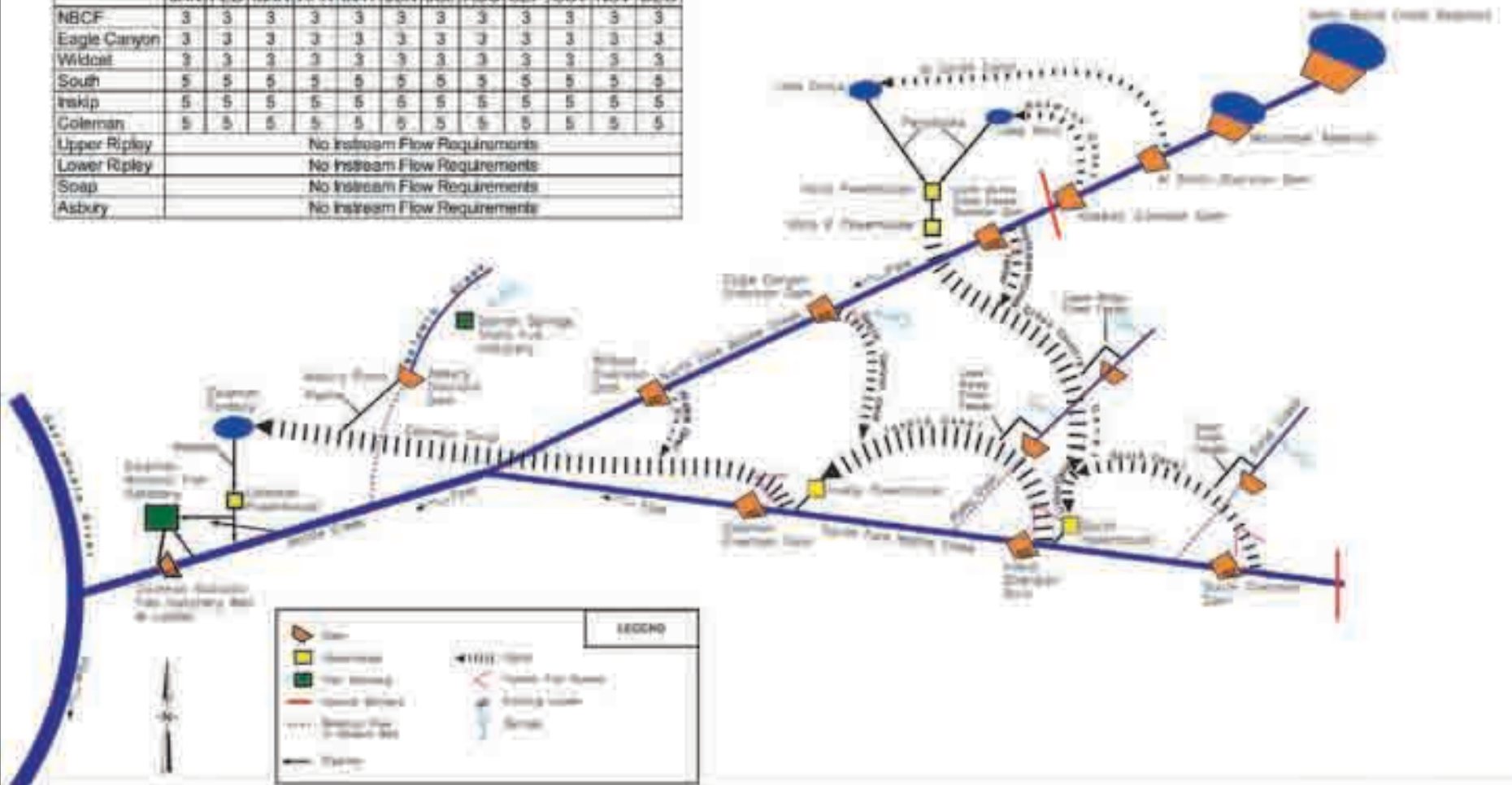
In addition to these Federal energy policy obstacles, Alternative 6 created unintended economic consequences. Removal of all structures below the two Volta powerhouses would likely have rendered the remaining portion of the Hydroelectric Project uneconomic for PG&E to operate, thereby requiring the entire Hydroelectric Project (including those portions above the natural barriers) to be decommissioned. The total capacity of the Battle Creek Hydroelectric Project, which consists of five powerhouses, is 36,056 kW. If, as described in Alternative 6, three of these powerhouses were decommissioned, approximately 75%, or 26,550 kW, would be eliminated. The lost generating capacity would shut down the entire hydroelectric project because the cost to maintain the remaining facilities could not be recovered by the revenue received for the reduce power generation. Consequently, partial decommissioning as formulated in the alternative would likely lead to a full decommissioning of the complete project, including those facilities above the natural barriers.

This alternative would unnecessarily result not only in the loss of all energy produced by the Hydroelectric Project, but would also have significant adverse economic impacts on the local community due to the loss of jobs at PG&E, which is a major employer in the community. A ripple effect would have occurred because the money earned and spent locally by PG&E employees turns over many times within that local community.

Therefore, because it does not meet the Restoration Project purpose, Alternative 6 has been eliminated from further consideration and will not be discussed further.

Diversion Dam	Monthly Minimum Flow Release (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
¹ On occasion, the release is unattainable because the quantity of inflow reaching North Battle Creek Feeder Diversion Dam. Additional inflows to the North Battle Creek Feeder reach are occasionally received from the junction box of the Volta II Powerhouse tailrace and Cross Country Canal a short distance downstream.												
² Eagle Canyon Diversion Dam releases reported in this table include 10 cfs releases from Eagle Canyon Springs (those springs located downstream of Eagle Canyon Dam that were included in the Interim Flow Agreement between the Licensee and Reclamation.												
³ The prescribed instream flow would be the total inflow in South Fork Battle Creek upstream of the South Powerhouse when the available inflow is less than the prescribed flow.												

DAM	MONTHLY MINIMUM FLOW RELEASE (cfs)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NBCF	3	3	3	3	3	3	3	3	3	3	3	3
Eagle Canyon	3	3	3	3	3	3	3	3	3	3	3	3
Wildcat	3	3	3	3	3	3	3	3	3	3	3	3
South	5	5	5	5	5	5	5	5	5	5	5	5
Inskip	5	5	5	5	5	5	5	5	5	5	5	5
Coleman	5	5	5	5	5	5	5	5	5	5	5	5
Upper Ripley	No Instream Flow Requirements											
Lower Ripley	No Instream Flow Requirements											
Soap	No Instream Flow Requirements											
Asbury	No Instream Flow Requirements											



BATTLE CREEK SALMON AND STEELHEAD RESTORATION PROJECT
Battle Creek near Merced, California

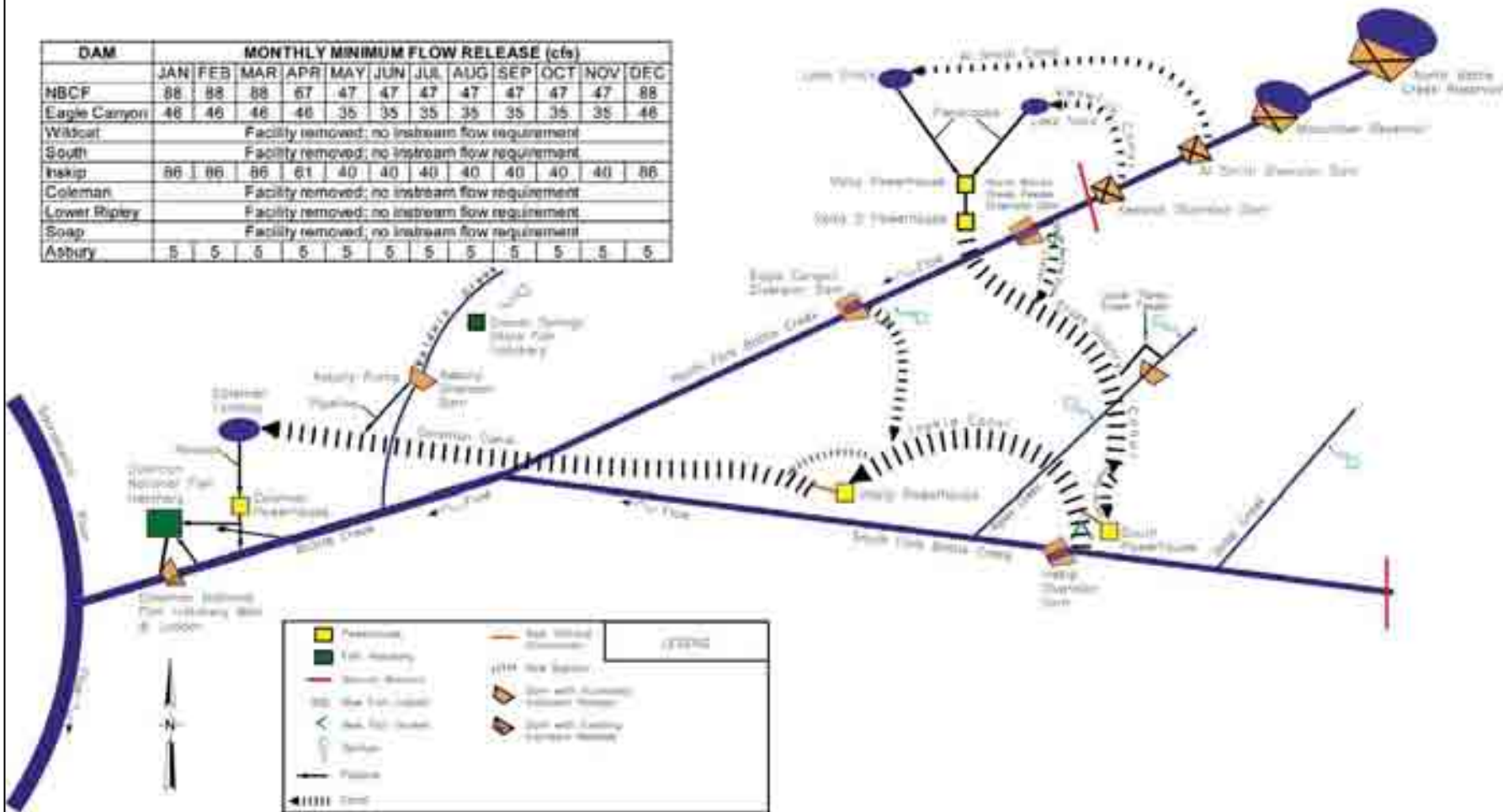
Battle Creek Schematic

Project Name	Battle Creek Salmon and Steelhead Restoration Project
Project Number	03035.03-001
Revision	1.0
Date	03/03/01

03035.03-001

Figure 3-1
No Action Alternative

DAM	MONTHLY MINIMUM FLOW RELEASE (cfs)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NBCF	88	88	88	67	47	47	47	47	47	47	47	88
Eagle Canyon	46	46	46	46	35	35	35	35	35	35	35	46
Wildcat	Facility removed; no instream flow requirement											
South	Facility removed; no instream flow requirement											
Inskip	86	86	86	61	40	40	40	40	40	40	40	86
Coleman	Facility removed; no instream flow requirement											
Lower Ripley	Facility removed; no instream flow requirement											
Soap	Facility removed; no instream flow requirement											
Asbury	5	5	5	5	5	5	5	5	5	5	5	5



BATTLE CREEK SALMON AND STEELHEAD RESTORATION PROJECT
Battle Creek near Marlin, California

Battle Creek Schematic

Prepared by: [Name] / Date: [Date]

Checked by: [Name] / Date: [Date]

Figure 3-2
Five Dam Removal Alternative

03035.03-001

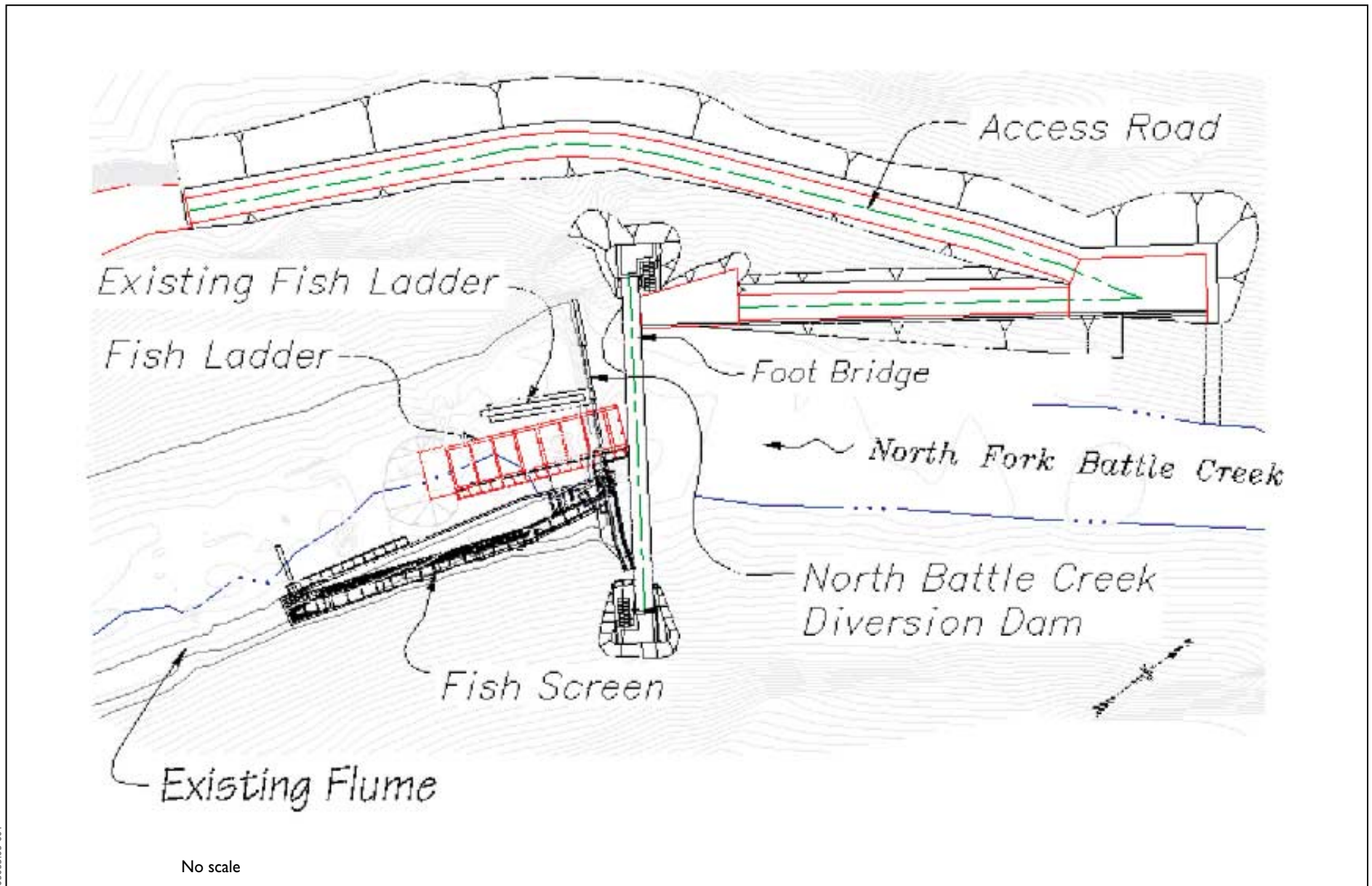
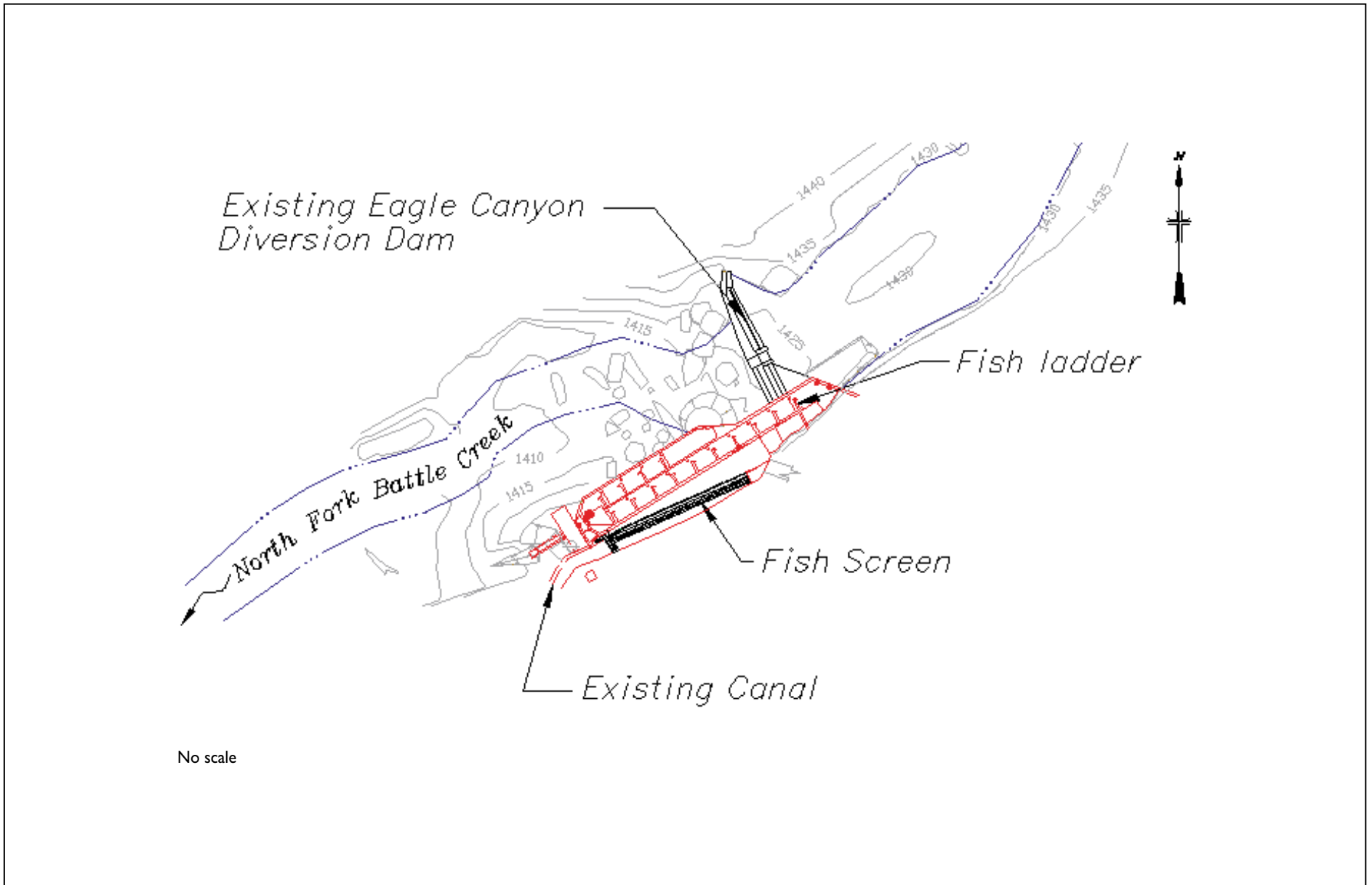


Figure 3-2a
Proposed Facilities for the North Battle Creek Feeder Diversion Dam
Five Dam Removal Alternative



03035.03.001

Figure 3-2b
Proposed Facilities for the Eagle Canyon Diversion Dam
Five Dam Removal Alternative

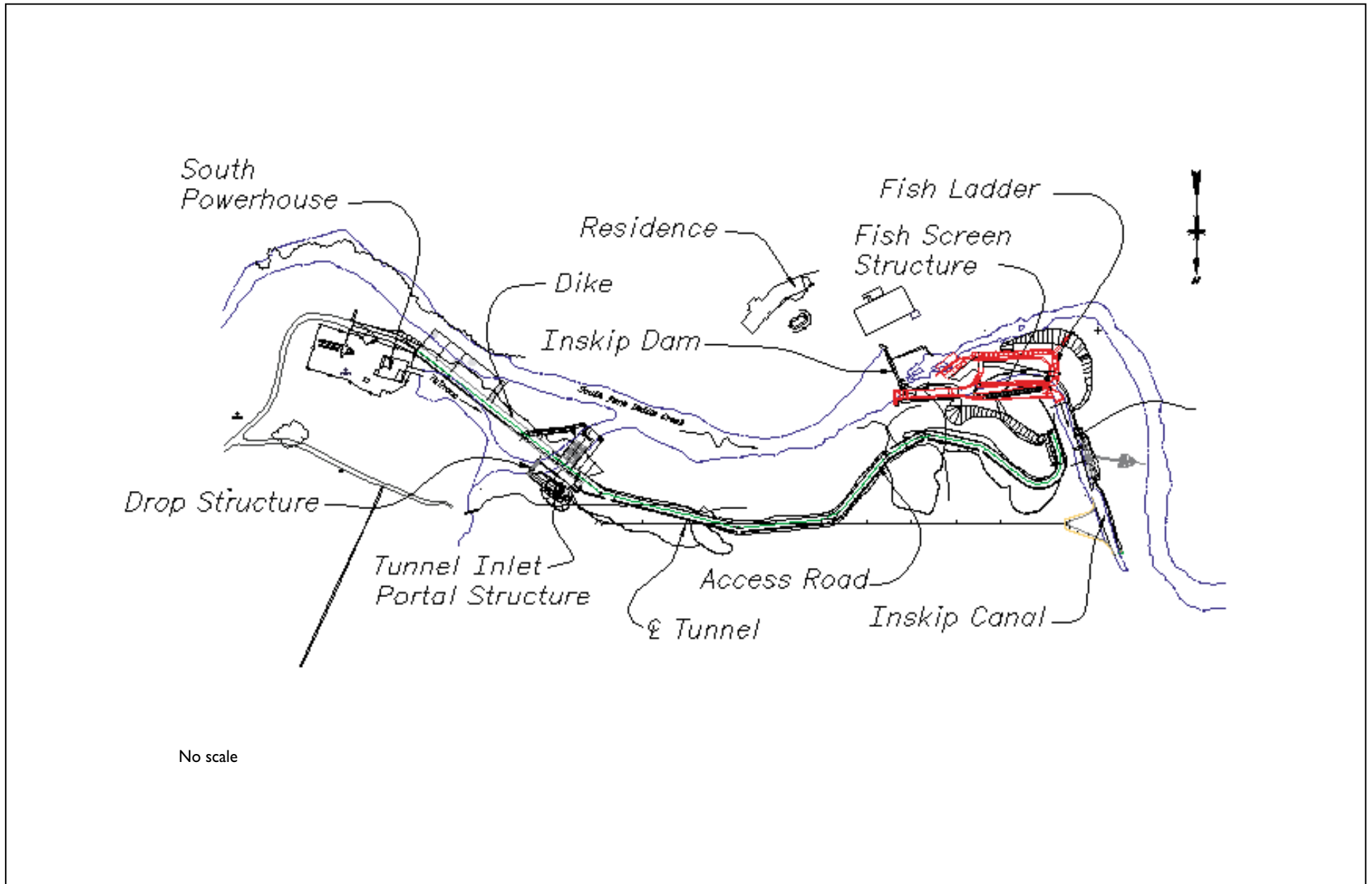
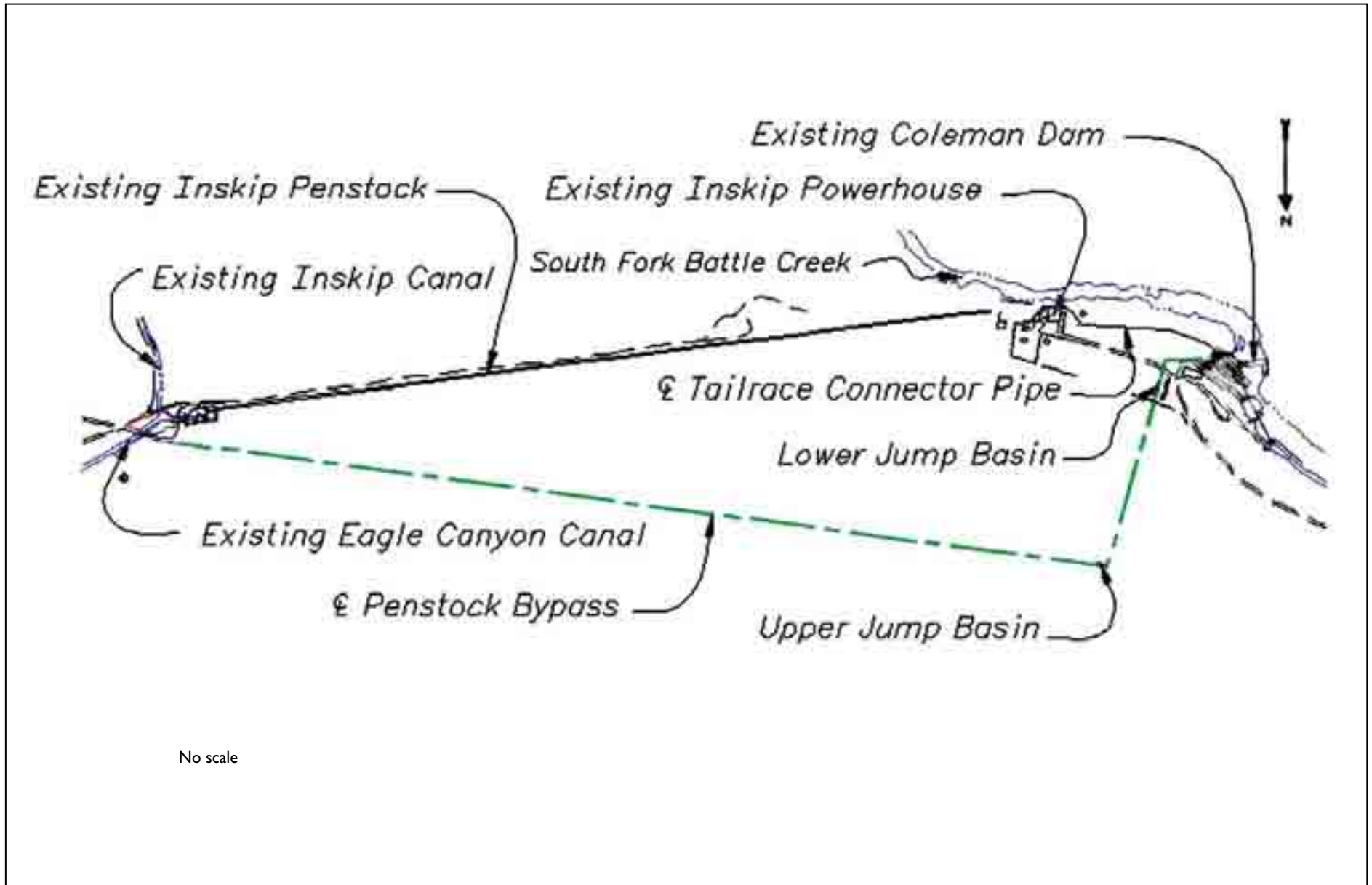


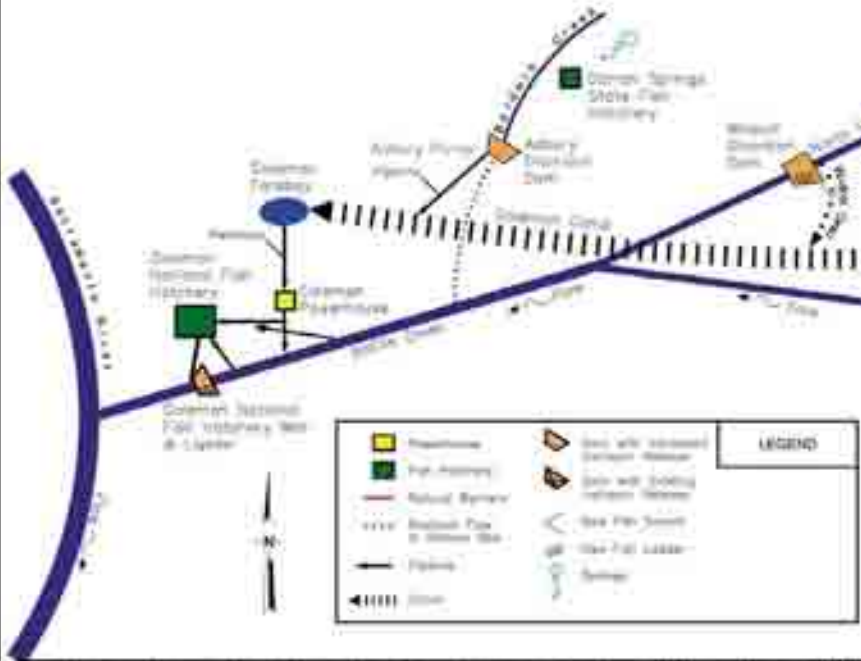
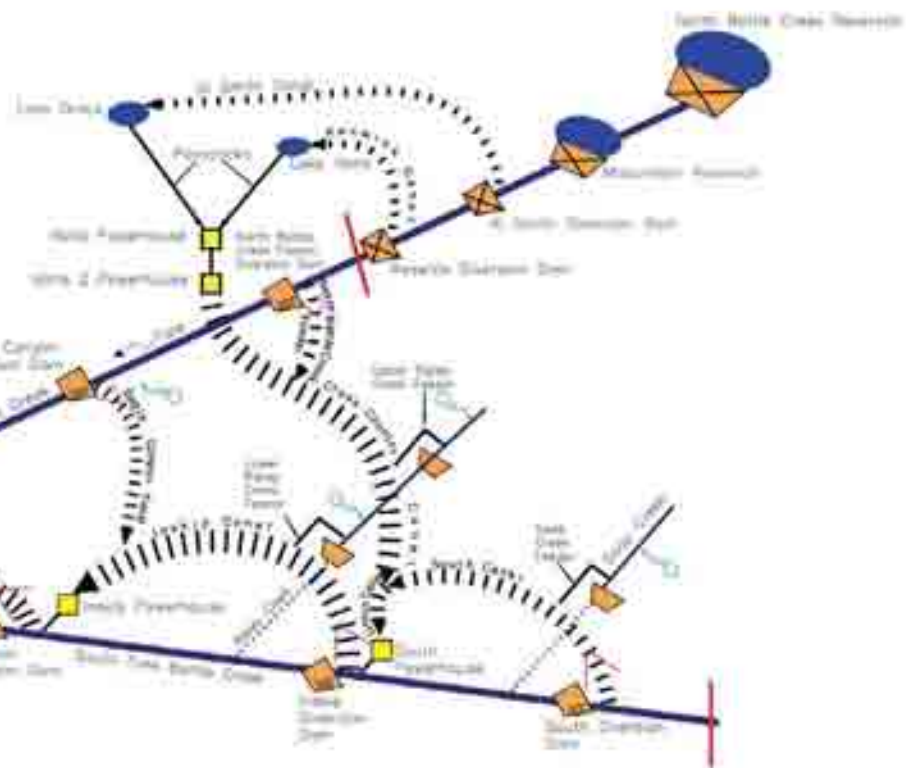
Figure 3-2c
Proposed Facilities for the Inskip Diversion Dam/South Powerhouse
Five Dam Removal Alternative



03035.03.001

Figure 3-2d
Proposed Facilities for the Coleman Diversion Dam/Inskip Powerhouse
Five Dam Removal Alternative

DAM	MONTHLY MINIMUM FLOW RELEASE (cfs)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NBCF	40	40	40	40	30	30	30	30	40	40	40	40
Eagle Canyon	50	50	50	50	30	30	30	30	30	30	30	50
Wildcat	50	50	50	50	30	30	30	30	30	30	30	50
South	30	30	30	30	20	20	20	20	20	20	20	30
Inskip	40	40	40	40	30	30	30	30	30	30	30	40
Coleman	50	50	50	50	30	30	30	30	50	50	50	50
Lower Ripley	No Instream Flow Requirements											
Soap	No Instream Flow Requirements											
Asbury	No Instream Flow Requirements											



BATTLE CREEK SALMON AND STEELHEAD RESTORATION PROJECT
Battle Creek near Manton, California

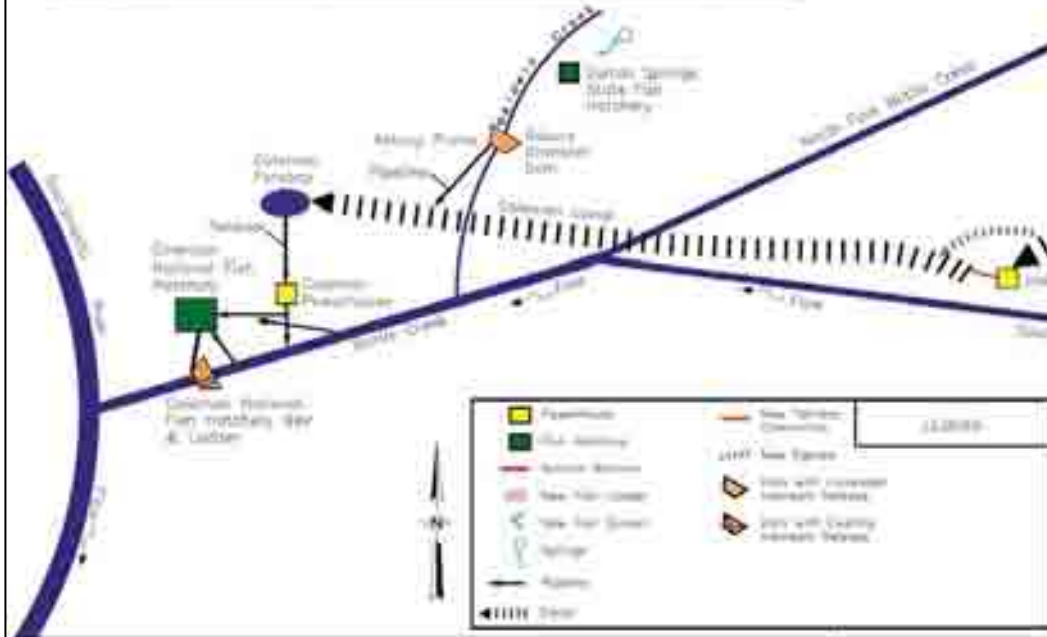
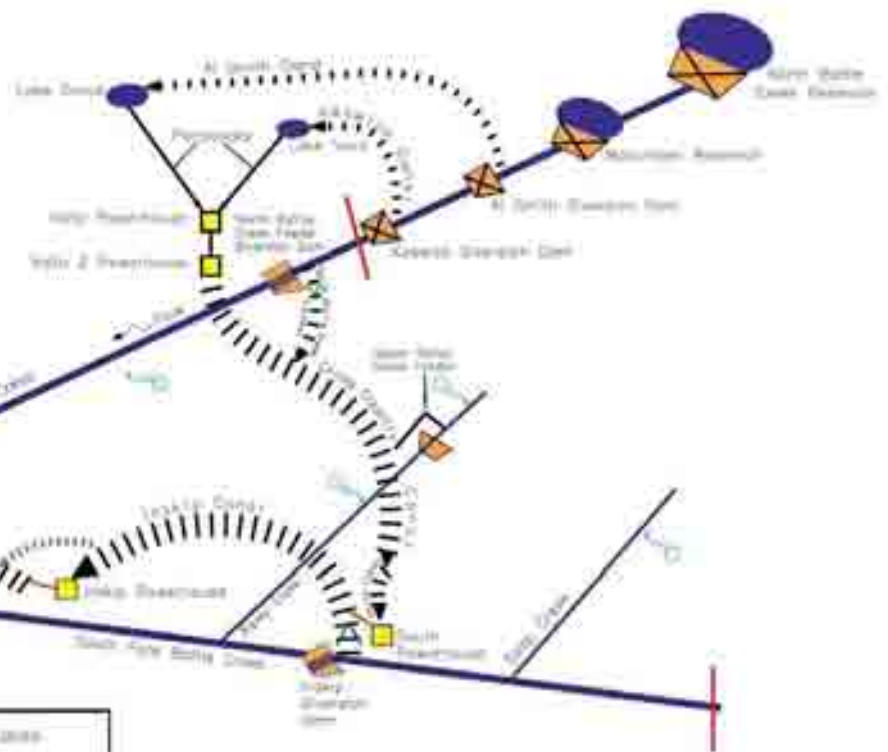
Battle Creek Schematic

<small> Prepared by U.S. Fish and Wildlife Service Western Division Manton, California </small>	<small> Checked by U.S. Fish and Wildlife Service Manton, California </small>
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03035.03-001

Figure 3-3
No Removal Alternative

DAM	MONTHLY MINIMUM FLOW RELEASE (cfs)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NBCF	88	88	88	67	47	47	47	47	47	47	47	88
Eagle Canyon	Facility removed: no instream flow requirement											
Wildcat	Facility removed: no instream flow requirement											
South	Facility removed: no instream flow requirement											
Inskip	88	88	88	61	40	40	40	40	40	40	40	88
Coleman	Facility removed: no instream flow requirement											
Lower Ripley	Facility removed: no instream flow requirement											
Soap	Facility removed: no instream flow requirement											
Asbury	5	5	5	5	5	5	5	5	5	5	5	5



BATTLE CREEK SALMON AND STEELHEAD RESTORATION PROJECT
Battle Creek near Madron, California

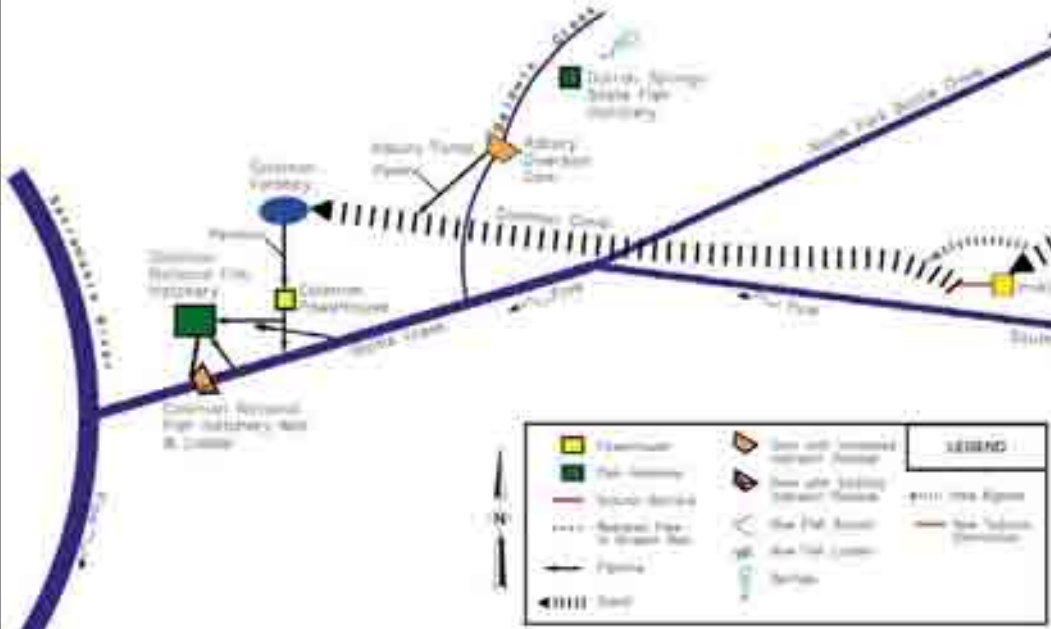
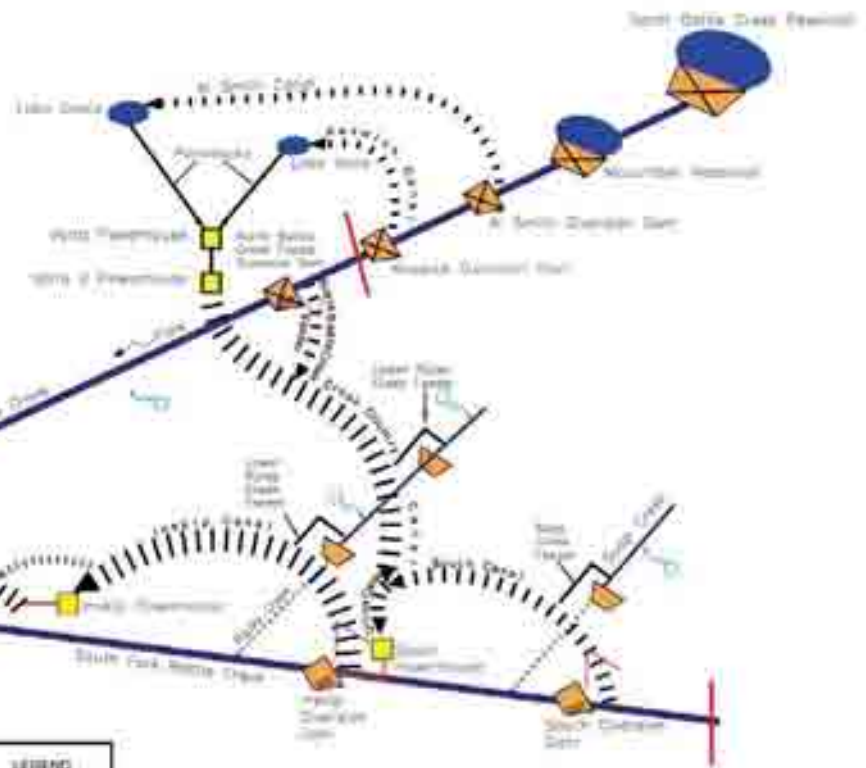
Battle Creek Schematic

PROJECT NUMBER	03035.03-001
DATE	03/03/01
SCALE	AS SHOWN

03035.03-001

Figure 3-4
Six Dam Removal Alternative

DAM	MONTHLY MINIMUM FLOW RELEASE (cfs)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NBCF	40	40	40	40	30	30	30	30	40	40	40	40
Eagle Canyon	Facility removed: no instream flow requirement											
Wildcat	Facility removed: no instream flow requirement											
South	30	30	30	30	20	20	20	20	20	20	20	30
Inskip	40	40	40	40	30	30	30	30	30	30	30	40
Coleman	Facility removed: no instream flow requirement											
Lower Ripley	No Instream Flow Requirements											
Soap	No Instream Flow Requirements											
Asbury	10	10	10	10	10	10	10	10	10	10	10	10



BATTLE CREEK SALMON AND STEELHEAD RESTORATION PROJECT
Battle Creek near Mattson, Oregon

Battle Creek Schematic

Prepared by: Bonneville Basin Council 2008-08-08	Checked by: Bonneville Basin Council 2008-08-08
Scale: 1" = 1/2 mile	Sheet: 10

03035.03-001

Figure 3-5
Three Dam Removal Alternative